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THE NEXT
YEARS
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BY MATTHEW GRIFFIN
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ABOUT THE AUTHOR

Matthew Griffin, an award winning futurist and author of the Codex of the Future series, is described as "The Adviser behind the Advisers" and a "Young Kurzweil." Matthew is the Founder of the 311 Institute, a global Futures and Deep Futures advisory, as well as the World Futures Forum and XPotential University, two philanthropic organisations whose mission it is to solve global inequality and the world's greatest challenges.

Regularly featured in the global media, including the Associated Press, BBC, CNBC, Discovery, Entrepreneur Magazine, Forbes, Netflix, RT, Sky, ViacomCBS, and WIRED, Matthew's ability to identify, track, and explain the impacts of hundreds of exponential emerging technologies and trends on global business, culture, and society, is unparalleled.

Recognised as one of the world's foremost futurists, innovation, and strategy experts Matthew is an international advisor and keynote speaker who helps many of the world's most respected brands, governments, investors, NGO's, and royal households, explore, envision, build, and shape the future of global business, culture, and society.

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A LETTER FROM OUR FOUNDER

MATTHEW GRIFFIN

WE LIVE in extraordinary times, in a world where individuals, organisations, and technology can impact the lives of billions of people and change the world at a speed and scale that would have been unimaginable just twenty years ago.

We also live in a world full of challenges, and a world where all too often negative news gets amplified at the expense of good news, and where tales of hope, inspiration, and positivity get drowned out and lost in the noise. It's no wonder therefore that today more people are more anxious about the future than ever before. And, arguably, a society which believes it's marching towards the darkness, rather than the light, has a poorer future than one that doesn't. Hope, however, is all around us and it's our purpose to light the way so all of us, people and planet, can prosper.

TESTIMONIALS

THANK YOU EVERYONE!

#FUTURENOW

EXTRAORDINARY!
Peter K., EMEA Managing Director
ACCENTURE

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WELCOME
FROM THE AUTHOR

PEOPLE . PLANET . PURPOSE . PROSPERITY

THE SKELETON COAST . NAMIBIA . 19.9873° S, 13.2605° E

I chose this striking image to represent this section because in many ways it's representative of many of today's realities: The Skeleton Coast is complex and unpredictable, but home to an amazingly adaptable ecosystem, yet it's also representative of the stark contrast between the have and have nots, those with water and other resources and those without, our increasingly polarised society, and even the contrast between our habitable blue planet and the desolation of space. The desert and the sea are also relentless, just like the human spirit, and given the right conditions they can overcome everything in their path, just as humanity can when we work together for the benefit of everyone to create a brighter future for all of us.

WHEN IT comes to exploring and learning about all of the latest emerging technologies this codex is your one stop shop with hundreds showcased in exquisite detail and in a deceptively simple format that lets you master them in minutes. While this codex covers all the obvious emerging technologies you'd expect though there are hundreds more that you've likely never heard of - all of which are impactful in their own rights. There are even a few that likely won't appear for a few millennia so be sure to explore Dyson Spheres and the awesome weirdness of Stellar Engines.

Furthermore, because innovators never sleep this codex is constantly updated with the latest information from yours truly so I hope you enjoy exploring it.

As anyone will tell you technology is a tool, a blank slate, but look around you and you'll see how it's transformed our world. While many people fixate on the benefits and trajectories of individual technologies though it's only when they're combined to create new products and services that we see their real potential to disrupt the status quo and change society.

Historically technology has been little more than a dumb prosthetic, a mechanical aid, but today it's increasingly our co-pilot and colleague. And, looking ahead to the Singularity, we can even see a point in time when we ourselves could become the latest thing in biological computing wetware.

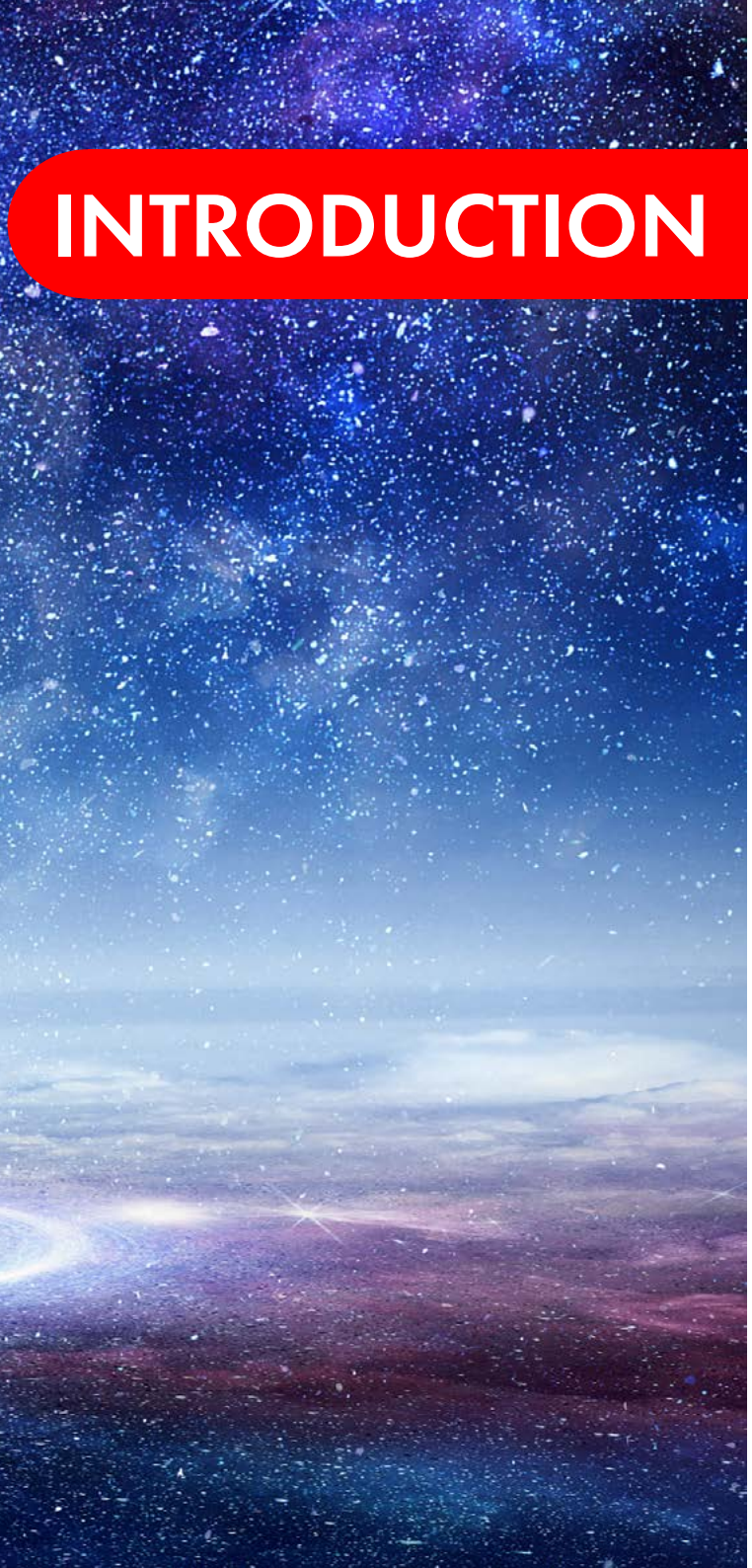
As the power and potential of the technologies we're developing and deploying increase exponentially the world is now changing at a faster rate than ever before. Not only does this put pressure on us as humans to adapt faster, but it also taxes us mentally as societal level changes that used to take generations now happen in mere months or weeks.

Globally this phenomenon is leading to what I call "Futures Anxiety," namely the fear that the future is something that's increasingly "done to us" rather than something we can understand, navigate, and shape for our own individual and collective benefits. Via my **Codex of the Future Series**, which this codex is a part of, my mission therefore is to help people explore the plausible, possible, preposterous and probable futures, encourage discussion, and help shape the development of an ethical, fair, and sustainable future that benefits everyone.

As they say forewarned is forearmed, and knowledge is power, so now what you do armed with this knowledge is down to you.

Explore More,

Matthew Griffin
Founder and Futurist in Chief



INTRODUCTION

THIS CODEX is your front row seat to the future. But not just any future - your future, your organisation's future, your country's future, and the world's future. Today, it's plain to see that humanity is on the cusp of a new technological era bought on by the development and adoption of increasingly powerful science-fiction like technologies. It's also clear that it won't be the last time we witness such a technological transformation in our lifetimes as the rate of progress continues to accelerate exponentially from here on in.

In the past twenty years humanity has made more technological progress than in the previous two thousand, and in the next fifty we will make more progress than we did in the previous twenty thousand - a staggering achievement by any measure. And all tomorrow's industries, products, and services will have their foundations in the technologies we are developing today - many of which, such as Artificial Intelligence and Synthetic Biology, will be as impactful as the discovery of electricity and fire, perhaps even more so.

As our rate of technological rate of change and disruption continues to accelerate our ability to track all the developments and their downstream implications will continue to become more complex and more **VUCA-MAX**.

It's this fact that drove me to create the **Codex of the Future Series** and this dedicated emerging technologies codex, a constantly updated living document that will collect and catalogue, and act as a repository, for every emerging technology I spot as it emerges, and that I hope will become your single point of reference for everything that the future of technology has to offer humanity.

Today is the slowest we'll ever move again, and while the future holds great promise it's vitally important that we remember we are all just caretakers in time, and that each of us is responsible for safeguarding and improving not just our own lives and the lives of everyone on our pale blue dot, but also the lives and livelihoods of future generations, and that we owe it to everyone to leave noone behind.

OUR NEW VUCA-MAX WORLD

No doubt you'll have heard of the term VUCA, an acronym devised by the US military in the 1970's to describe the world of the time which they felt was increasingly Volatile Uncertain Complex and Ambiguous.

VUCA - MAX

THE NEW WAY TO EXPLAIN HOW OUR WORLD IS CHANGING

VOLATILE
UNCERTAIN
COMPLEX
AMBIGUOUS

MASSIVE
ACCELERATING
E**X**PONENTIAL

Notes:

Fast forwards to today and we have a new acronym to describe our world, the **VUCA-MAX** world, where in addition to the above the changes that we're witnessing today are increasingly Massive, Accelerating, and Exponential, the impact of which means that it's harder than ever before for individuals and organisations everywhere to predict the effects of disruption on their lives and business, and to see and capitalise on new opportunities.

THE TWO SIDES OF VUCA-MAX

Look around you and you can see the impact of this new VUCA-MAX world everywhere, for better and worse, as we see leaders struggle and old incumbents fade, and as we see new leaders and incumbents emerge from the metaphorical flames.

For example, as we discuss in more detail in our **Future of Exponential Disruption Codex**, the rate of global disruption is accelerating, so much so that we can disrupt the status quo in just a single day. Furthermore, the scale of many of the changes we're seeing are global, or what we sometimes refer to as "System Level." And then, of course, the only thing being affected is everything - every aspect of global business, culture, and society.

Value Destruction

The first impact of this new world is that today we're seeing technology led disruption especially destroy over $50 Trillion of global GDP. After all, just look at how technology, let alone other trends, is disrupting every sector, and even the tech sector itself.

CEO Burn Out

Another impact is that CEOs are finding it increasingly difficult to see all of the changes that are taking place and understand how they might play out, and then develop profitable and successful strategies navigate them, with the consequence being that they're burning out faster with the average multi-national CEO tenure falling from a global average of 6 years down to 5 in the last five years.

CEOs No Longer In Control

Adding more fuel to the fire McKinsey's global leadership surveys are routinely highlighting the fact that today CEOs only directly influence 45% of what

Notes:

happens to their organisations - such as go to market, hiring and talent development and retention, investment and M&A, R&D, and strategy - with the remaining 55% being more directly influenced by external factors such as changing consumer behaviours, environmental and political trends, market forces, regulations, technological disruption, and so forth.

Take a minute to think about this - at a fundamental level this means that CEOs aren't in control of their companies, the external forces are. That's significant.

Dead In A Decade

And there's more still, with surveys such as the PWC 27th Annual Global CEO Survey which surveyed over 4,700 multi-national CEO's from every industry and more than 100 countries finding that a staggering 45% of CEOs interviewed believe their companies won't survive the next ten years without being re-invented.

Now take a minute to think about that as well. Without being re-invented almost half of the world's largest companies could be gone or a shadow of their former selves in a decade.

Everything Up For Grabs

So, if you wanted a wake up call there are four big ones for you. But let's not forget that there are two sides to every coin, and in this case the upsides are just as wild.

First off, while old value is being destroyed organisations like ARK Invest believe that disruptive technologies will help create over $200 Trillion of new value and economic opportunity, which is why today more than 65% of big cap organisations are running some form of Creative Destruction programs. And secondly, as old incumbents and industries are torn down new ones are being created with some examples including the rise of AI companies and the switch to Electric Vehicles and renewable energy - all of which have already created new industry behemoths with multi-trillion dollar valuations.

SUMMARY

With great change comes great opportunity, but understanding these changes, navigating and benefiting from them requires new tools and new thinking, and that's why we created the **Codex of the Future Series** - to help you land on the right side of history.

MERCEDES INVENTED THE AUTOMOBILE . BUT TESLA RE-INVENTED IT .

MARKET CAP MARCH 2024 : MERCEDES $79 BILLION . TESLA $635 BILLION

GREAT WISDOM COMES FROM GREAT QUESTIONS

" HOW CAN WE COMBINE TECHNOLOGIES TOGETHER TO BENEFIT EVERYONE & CHANGE THE WORLD ? "

USING THIS CODEX

THIS CODEX is constantly updated and is the result of years worth of work. As I've done my own exploration into what the future holds for us all there's no denying one thing - when it comes to future forecasting trying to see beyond the short term future is as complex as it is difficult.

That said though when it comes to forecasting the medium and deep future it is nevertheless possible to see trends through the fog and find tangible threads to tug on and follow - all of which we can then use to debate and envision what these futures might look like.

As a result of this it's this complexity and difficulty that I've tried my best to simplify and document for you so you have the best shot at deciphering and decoding the future from your own vantage point. Then, as part of this Codex and the others in the Codex of the Future series, I've also provided you with the critical tools and exponential thinking to help you build, shape, and lead those futures.

So, explore with impunity, envision the possibilities, and open your mind to the limitless potential that awaits you.

1

2

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

3

1 MRL /9

4

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5

7 /10

6

LIVING ROBOTS

7

LIVING ROBOTS, which are in the Prototype Stage, is the field of research concerned with developing new ways to create robots that are alive, but not necessarily sentient, or, as others describe it "Programmable Organisms." Recent breakthroughs in the field include the use of Artificial Intelligence, a supercomputer, and stem cells to create the world's first truly living robots that were adaptable and responded to external stimuli.

8

DEFINITION

Living Robots are neither traditional robot nor animal but are a form of re-programmable and controllable cell based living machine.

9

EXAMPLE USE CASES

Today we are using prototypes to prove the theory behind the technology and refine it. In the future the primary use case of this technology could be almost unlimited and they could be used in everything from monitoring pollution levels all the way through to being involved in in vivo healthcare treatments.

10

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by university grants. In time we will see the technology mature to the point where it is safe and viable, as well as commercially feasible, but given the nature of the technology it is highly likely that it will be subject to stringent regulatory scrutiny which will inevitably delay its adoption.

While Living Robots are in the Prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Bio-Sensors, Creative Machines, Evolutionary Robotics, Semi-Synthetic Cells, Simulation Engines, Stem Cells, Synthetic Biology, Synthetic Cells, Synthetic DNA, and Swarm Robotics, but at this point in time it is not clear what they will be replaced by.

11

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

12

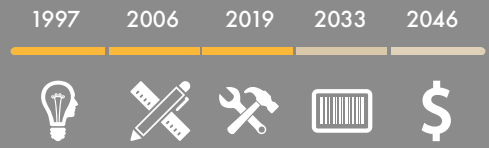
STARBURST APPEARANCES: '20, '21, '22, '23

13

IMPACT

14

STATUS



Accessibility	2
Affordability	2
Competition	2
Demonstration	6
Desirability	8
Investment	2
Regulation	1
Viability	8

15

PRIMARY GLOBAL DEVELOPMENT AREAS

USING THE TECH SHEETS

AS YOU can see I've gone to great lengths to detail as many emerging technologies as possible and simplify them for you. As a result each technology sheet contains tons of information to help you develop new product concepts and explore the art of the possible. This is the key:

1 / HERO IMAGE

An appropriate image for the technology.

2 / QR CODE WITH HYPER LINK

Scan or click the QR code to be taken to the latest news about the technology.

3 / MANUFACTURING READINESS LEVEL

The average MRL on a scale of 1 to 9 where 9 is the most mature.

4 / TECHNOLOGY READINESS LEVEL

The average TRL on a scale of 1 to 9 where 9 is the most mature.

5 / WEAPONISATION POTENTIAL

The technology's average weaponisation potential on a scale of 1 to 10 where 10 is the most dangerous and deadly.

6 / TECHNOLOGY NAME

The technology's official name or the one that best represents it.

7 / INTRODUCTION

A quick introductory summary.

8 / DEFINITION

The best definition for the technology.

9 / EXAMPLE USE CASES

Uses cases to spark the imagination.

10 / FUTURE TRAJECTORY AND REPLACABILITY

The estimated future development trajectory including anything that could supersede it.

11 / MATTHEW'S RECOMMENDATION

My next step recommendations.

12 / STARBURST APPEARANCES

The annual Griffin Emerging Technology Starbursts the technology's appeared on.

13 / IMPACT

It's overall estimated impact, disruptive nature, and primary deployment method.

HIGH
MODERATE
LOW

EVOLUTIONARY

DISRUPTIVE

CENTRALISED

DISTRIBUTED

DECENTRALISED

14 / STATUS

This panel summaries the technology's market readiness with estimated dates.

IDEA CONCEPT PROTOTYPE PRODUCTISATION MASS ADOPTION

LOW HIGH

15 / PRIMARY GLOBAL DEVELOPMENT AREAS

The primary development regions.

THE MUSEUM OF THE FUTURE

EVERY YEAR I publish a new Griffin Emerging Technology Starburst, and this year is no different. However, as the years change it would be all too easy just to consign all that hard work to the filing cabinet of history, never for them to be seen again. But that, in my opinion at least, would be a horrible waste so instead welcome to my Museum of the Future.

While the rest of this Codex looks to the future in this section we look to the present and the past, a kind of history of the future if you will, and put all those Starbursts proudly on display where you can scan and review them all at your leisure to see just how many powerful emerging technologies there are, and see first hand how difficult it is to keep up with them all and figure out the multitude of ways they can be combined together to create the products and paradigms that will shape our collective future.

Dive in to the wormhole ...

2024 GRIFFIN EMERGING TECHNOLOGY STARBURST

1 Estimated Wide Spread Use

1 General Purpose Technology

Image: Mangrove National Park, Abu Dhabi

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2024 STARBURST REVIEW

IN THE 2024 Griffin Annual Emerging Technology Starburst the timelines stretches to 2075 and tracks the development of 167 of the world's most promising emerging technologies, each with an addressable market value of over $500 Billion spread across 13 categories, I promoted 35 new emerging technologies and demoted 35 - almost matching 2017 and 2018's record breaking figures which suggests we are near pre-pandemic norms.

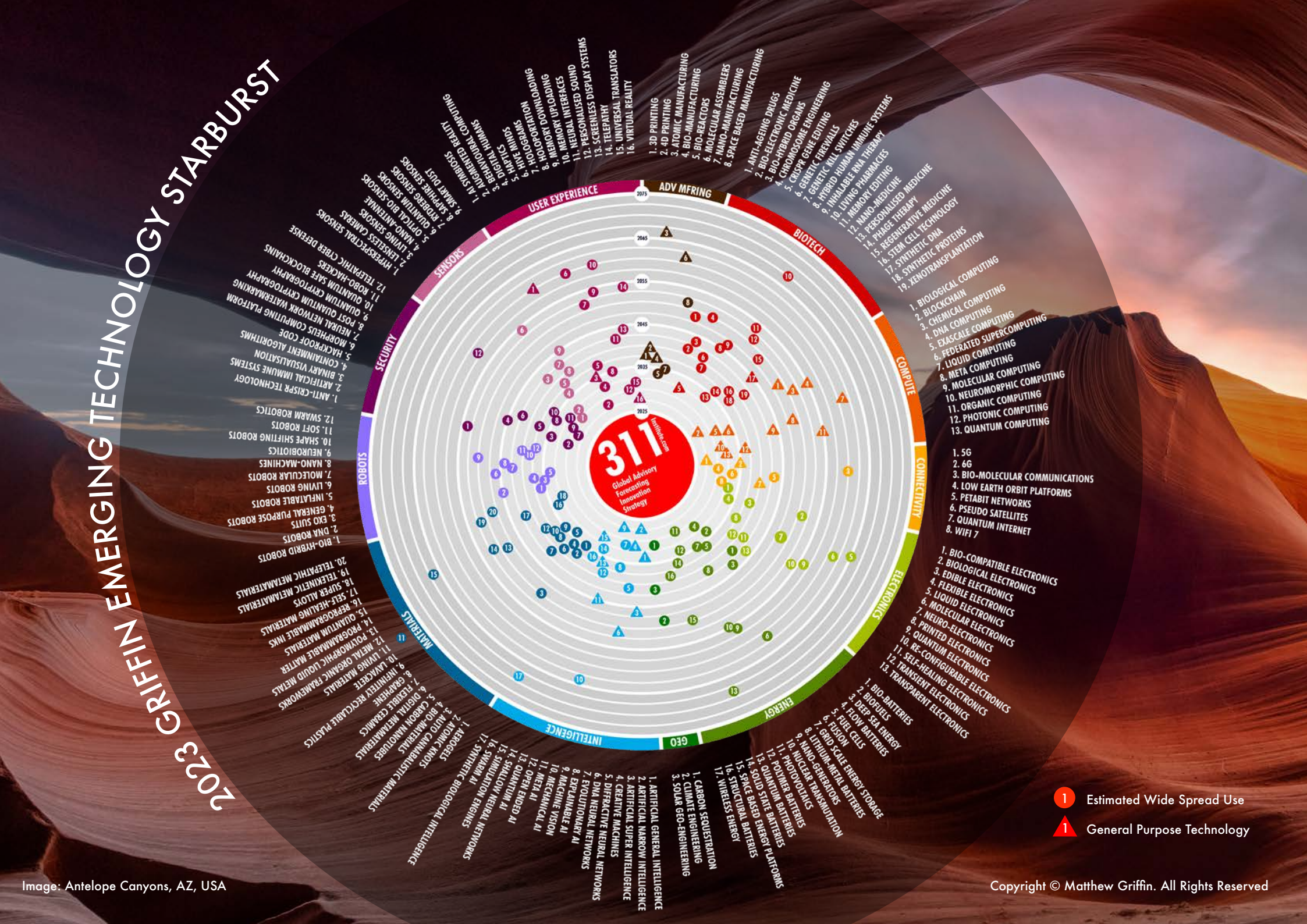
USING THE STARBURSTS

The Griffin Annual Emerging Tecgnology Starbursts have been specifically designed to let you quickly see the estimated maturity of different technologies across different technology categories. To get the most benefit from them I recommend you combine the information from this codex with that found in some of the other codexes in my Codex of the Future series, such as my 311 Institute Exponential Technologies Codex, the 311 Institute Annual Trends and Foresight Codex and the How to Build Exponential Enterprises Codex.

By doing this you will have all the frameworks and information you need to quickly model future scenarios, assess their impact on your organisation, as well as global business, culture, and society, and everything you need to develop new products, roadmaps, and strategies.

TIMELINE:

2025 to 2075


2023 GRIFFIN EMERGING TECHNOLOGY STARBURST
ADV MFRING
BIOTECH
COMPUTE
CONNECTIVITY
ELECTRONICS
ENERGY
GEO
INTELLIGENCE
MATERIALS
ROBOTS
SECURITY
SENSORS
USER EXPERIENCE
2075
2065
2055
2045
2035
2025
311
Institute.com
Global Advisory
Forecasting
Innovation
Strategy
1. 3D PRINTING
2. 4D PRINTING
3. ATOMIC MANUFACTURING
4. BIO-MANUFACTURING
5. BIO-REACTORS
6. MOLECULAR ASSEMBLERS
7. NANO-MANUFACTURING
8. SPACE BASED MANUFACTURING
1. ANTI-AGEING DRUGS
2. BIO-ELECTRONIC MEDICINE
3. BIO-HYBRID ORGANS
4. CHROMOSOME ENGINEERING
5. CRISPR GENE EDITING
6. GENETIC FIREWALLS
7. GENETIC KILL SWITCHES
8. HYBRID HUMAN IMMUNE SYSTEMS
9. INHALABLE RNA THERAPY
10. LIVING PHARMACIES
11. MEMORY EDITING
12. NANO-MEDICINE
13. PERSONALISED MEDICINE
14. PHAGE THERAPY
15. REGENERATIVE MEDICINE
16. STEM CELL TECHNOLOGY
17. SYNTHETIC DNA
18. SYNTHETIC PROTEINS
19. XENOTRANSPLANTATION
1. BIOLOGICAL COMPUTING
2. BLOCKCHAIN
3. CHEMICAL COMPUTING
4. DNA COMPUTING
5. EXASCALE COMPUTING
6. FEDERATED SUPERCOMPUTING
7. LIQUID COMPUTING
8. META COMPUTING
9. MOLECULAR COMPUTING
10. NEUROMORPHIC COMPUTING
11. ORGANIC COMPUTING
12. PHOTONIC COMPUTING
13. QUANTUM COMPUTING
1. 5G
2. 6G
3. BIO-MOLECULAR COMMUNICATIONS
4. LOW EARTH ORBIT PLATFORMS
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6. PSEUDO SATELLITES
7. QUANTUM INTERNET
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9. QUANTUM ELECTRONICS
10. RE-CONFIGURABLE ELECTRONICS
11. SELF-HEALING ELECTRONICS
12. TRANSIENT ELECTRONICS
13. TRANSPARENT ELECTRONICS
1. BIO-BATTERIES
2. BIOFUELS
3. DEEP SEA ENERGY
4. FLOW BATTERIES
5. FUEL CELLS
6. FUSION
7. GRID SCALE ENERGY STORAGE
8. LITHIUM-METAL BATTERIES
9. NANO-GENERATORS
10. NUCLEAR TRANSMUTATION
11. PHOTOVOLTAICS
12. POLYMER BATTERIES
13. QUANTUM BATTERIES
14. SOLID STATE BATTERIES
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3. SOLAR GEO-ENGINEERING
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2. ARTIFICIAL NARROW INTELLIGENCE
3. ARTIFICIAL SUPER INTELLIGENCE
4. CREATIVE MACHINES
5. DIFFRACTIVE NEURAL NETWORKS
6. DNA NEURAL NETWORKS
7. EVOLUTIONARY AI
8. EXPLAINABLE AI
9. MACHINE VISION
10. MECHANICAL AI
11. META AI
12. OPEN ENDED AI
13. QUANTUM AI
14. SHALLOW NEURAL NETWORKS
15. SIMULATION ENGINES
16. SWARM AI
17. SYNTHETIC BIOLOGICAL INTELLIGENCE
1. AEROGELS
2. ATOMIC KNOTS
3. AUXETIC CANNIBALISTIC MATERIALS
4. BIO-MATERIALS
5. CARBON NANOTUBES
6. DIGITAL METAMATERIALS
7. FLEXIBLE CERAMICS
8. GRAPHENE
9. INFINITELY RECYCLABLE PLASTICS
10. LAVACRETE
11. LIVING MATERIALS
12. METAL ORGANIC FRAMEWORKS
13. POLYMORPHIC LIQUID METALS
14. PROGRAMMABLE MATTER
15. QUANTUM MATERIALS
16. REPROGRAMMABLE INKS
17. SELF-HEALING MATERIALS
18. SUPER ALLOYS
19. TEKKINETIC METAMATERIALS
20. TELEPATHIC METAMATERIALS
1. BIO-HYBRID ROBOTS
2. DNA ROBOTS
3. EXO SUITS
4. GENERAL PURPOSE ROBOTS
5. INFLATABLE ROBOTS
6. LIVING ROBOTS
7. MOLECULAR ROBOTS
8. NANO-MACHINES
9. NEUROBIOTICS
10. SHAPE SHIFTING ROBOTS
11. SOFT ROBOTS
12. SWARM ROBOTICS
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2. ARTIFICIAL IMMUNE SYSTEMS
3. BINARY VISUALISATION
4. CONTAINMENT ALGORITHMS
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8. POST QUANTUM CRYPTOGRAPHY
9. QUANTUM CRYPTOGRAPHY
10. QUANTUM SAFE BLOCKCHAINS
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12. TELEPATHIC CYBER DEFENSE
1. HYPERSPECTRAL SENSORS
2. LENSELESS CAMERAS
3. LIVING SENSORS
4. NANO-ANTENNAE
5. OPTICAL BIO-SENSORS
6. QUANTUM BIO-SENSORS
7. RADARS SENSORS
8. SAPPHIRE SENSORS
9. SMART DUST
1. AI SWARMOSIS
2. AUGMENTED REALITY
3. BEHAVIOURAL COMPUTING
4. DIGITAL SMELL
5. HAPTICS
6. HIVE MINDS
7. HOLOGRAMS
8. HOLOPORTATION
9. MEMORY DOWNLOADING
10. MEMORY UPLOADING
11. NEURAL INTERFACES
12. PERSONALISED SOUND
13. PERSONALISED DISPLAY SYSTEMS
14. SCREENLESS DISPLAYS
15. TELEPATHY
16. UNIVERSAL TRANSLATORS
17. VIRTUAL REALITY
1 Estimated Wide Spread Use
1 General Purpose Technology
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2023 STARBURST REVIEW

IN THE 2023 Griffin Emerging Technology Starburst I extended the timeline to 2075, an increase from the 2022 Starburst which only extended to 2070, and tracked the development of 167 of the world's most promising emerging technologies, each with an addressable market value of over $500 Billion spread across 13 categories, I promoted 31 new emerging technologies and demoted 31.

In 2023 there were fewer technology world firsts than 2022 but triple the number of new emerging technologies spotted. Biotech, Energy, and Materials saw the biggest gains with Compute, Intelligence, Security, Sensors, and User Interfaces seeing more modest gains.

2023's breakthroughs and stand out world firsts included: 5 hour human gene sequencing • AI beat humans at drone racing • AI discovers 200 new CRISPR-like systems & 380,000 compounds • Analogue AI & computer chips • Brain navigating microbots • Cancer killing nanorobotic swarms • ChatGPT & GPT AI models • Constitutional AI • Creative AI • Criminal LLM AI • Electrogenetic interfaces • Exascale compute • Hardware bricking malware • Infinitely firing laser weapons • Injectable neuroprosthetics • In vivo robotic surgery • Large Behavioural AI models • Laser force fields • Living CAR-T drugs • Matter creation from light • Memory wiping with light • Mind reading earbuds • Near creator grade synthetic content • Near human-level multi-modal Gen AI • Organisms with 50% Synthetic DNA • Petabit photonic chips • Predictive vaccine development • Quantum energy teleportation • Robot CEO appointed • Semi-autonomous AI agents • Self-organising AI synthetic brains • Self-replicating DNA nanobots • Sound activated gene therapy • Spray on sensors & UI • Torpedo launching drones • Uncrewed fighter jets • Wolly mammoth meatballs • Zero Knowledge Proof cryptography … and MANY more.

TIMELINE:

2025 to 2075

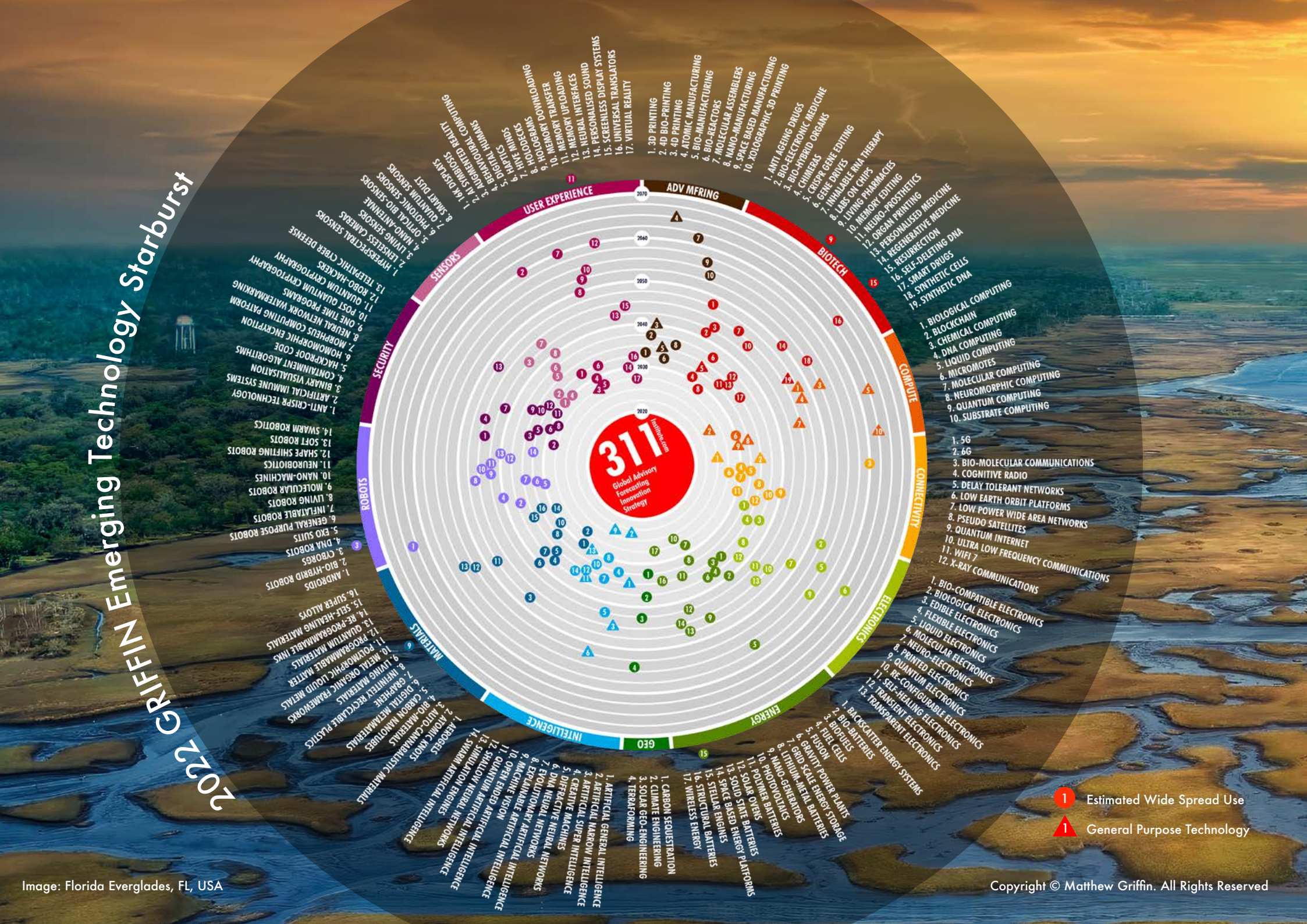

Image: Florida Everglades, FL, USA

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2022 STARBURST REVIEW

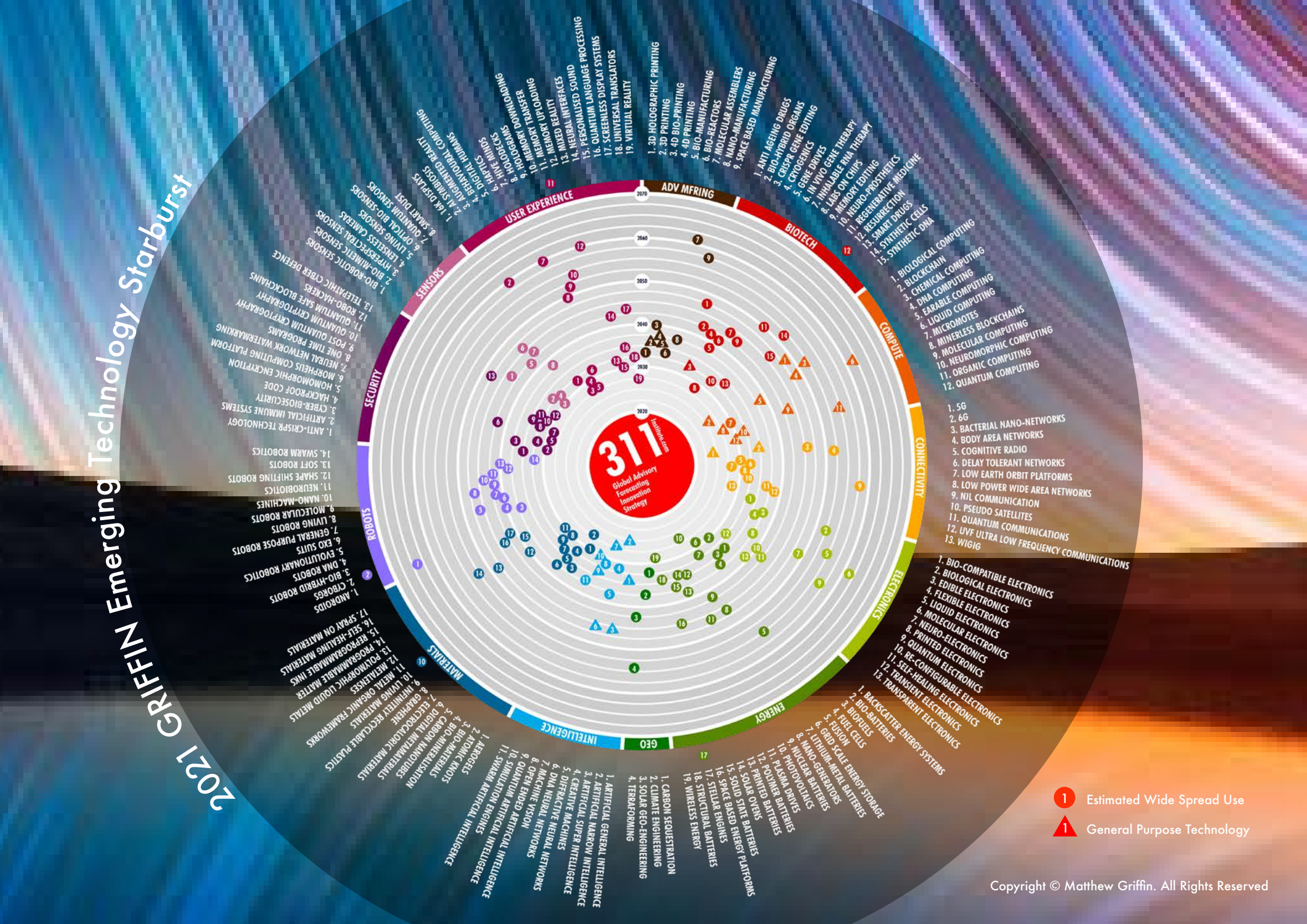
IN THE 2022 Griffin Emerging Technology Starburst, which displays 167 of the world's most significant emerging technologies, each with an addressable market value of over $500 Billion spread across 13 categories, up to a timeline of 2070, I promoted 28 new emerging technologies and demoted 28.

In 2022 there was an up tick in notable world firsts compared to 2021 which as the global pandemic faded wasn't unexpected as investment and R&D flows started returning to pre pandemic norms. Therefore, as expected, I saw an increase in the number of new emerging technologies which were double the number spotted in 2021. Biotech, Compute, Energy, Intelligence, and Materials saw the largest gains.

2022's breakthroughs and stand out world firsts included: 100% effective personalised cancer therapies • AI designs new chemical weapons and simulates all known proteins • AI redistributes wealth better than politicians • AI generated content and Digital Humans move mainstream • Chromosome Engineering accelerates biological evolution millions of years • First decentralised social network launches • First flexible ceramic • First lab grown blood cells • First Mechanical AI • First stress measuring wearable • First light based blood test • First tunnel dug by autonomous swarm robots • First telekinetic and telepathic materials • Google staffer claims AI is sentient • Lawyers drop NFTs to serve anonymous crims • Human mini-brains beat machine AI • Lab grown meat gains FDA approval • Military drone fleets emerge • Molecular computers break records • Russia first nation to use hypersonic weapons in wartime • Self-assembling space structures ace tests • Starlink achieves global network coverage. And many more.

TIMELINE:

2022 to 2070



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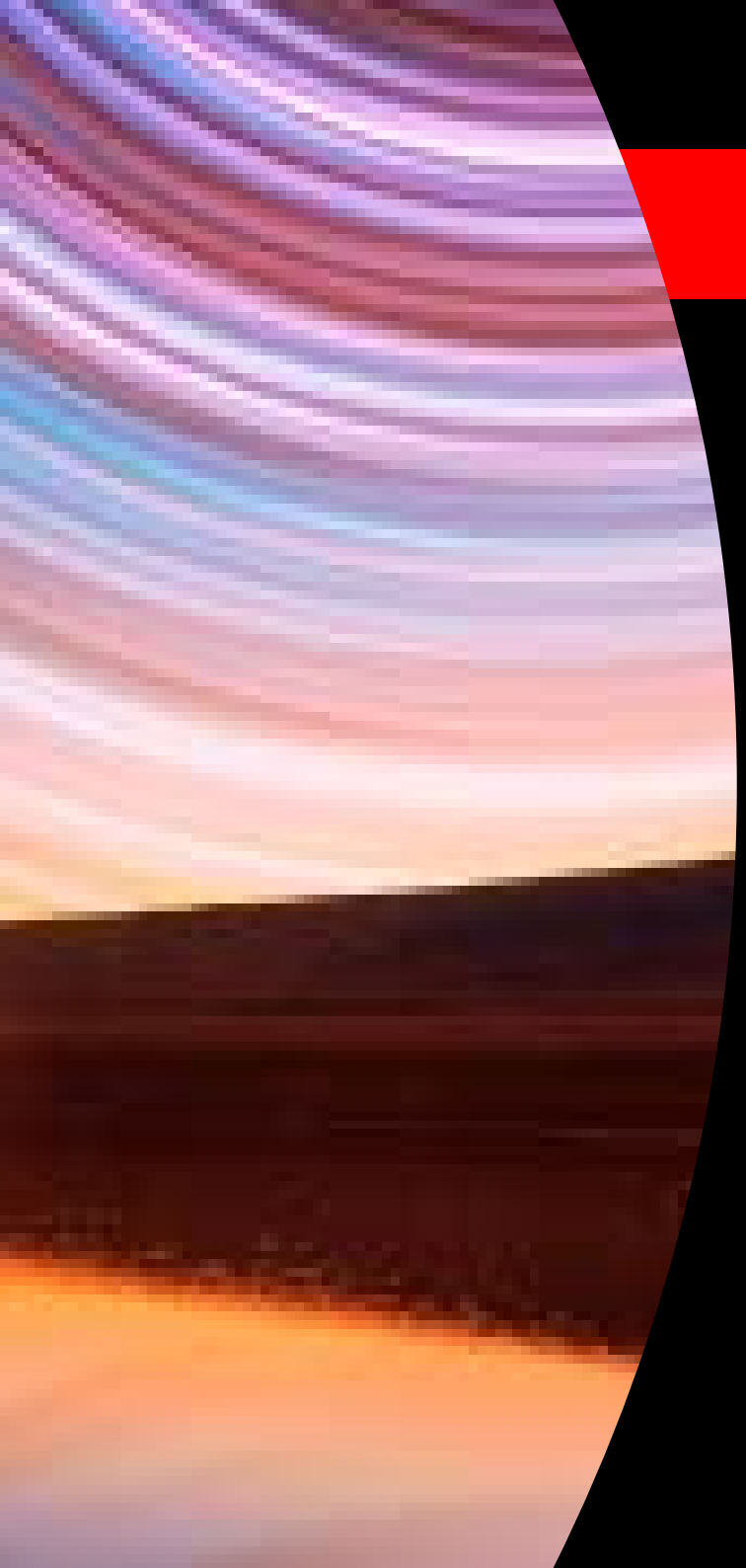

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2021 STARBURST REVIEW

IN THE 2021 Griffin Emerging Technology Starburst, which displays 167 of the world's most significant emerging technologies, each with an addressable market value of over $500 Billion spread across 13 categories, up to a timeline of 2070, I promoted 17 new emerging technologies and demoted 17 - the lowest of any year so far.

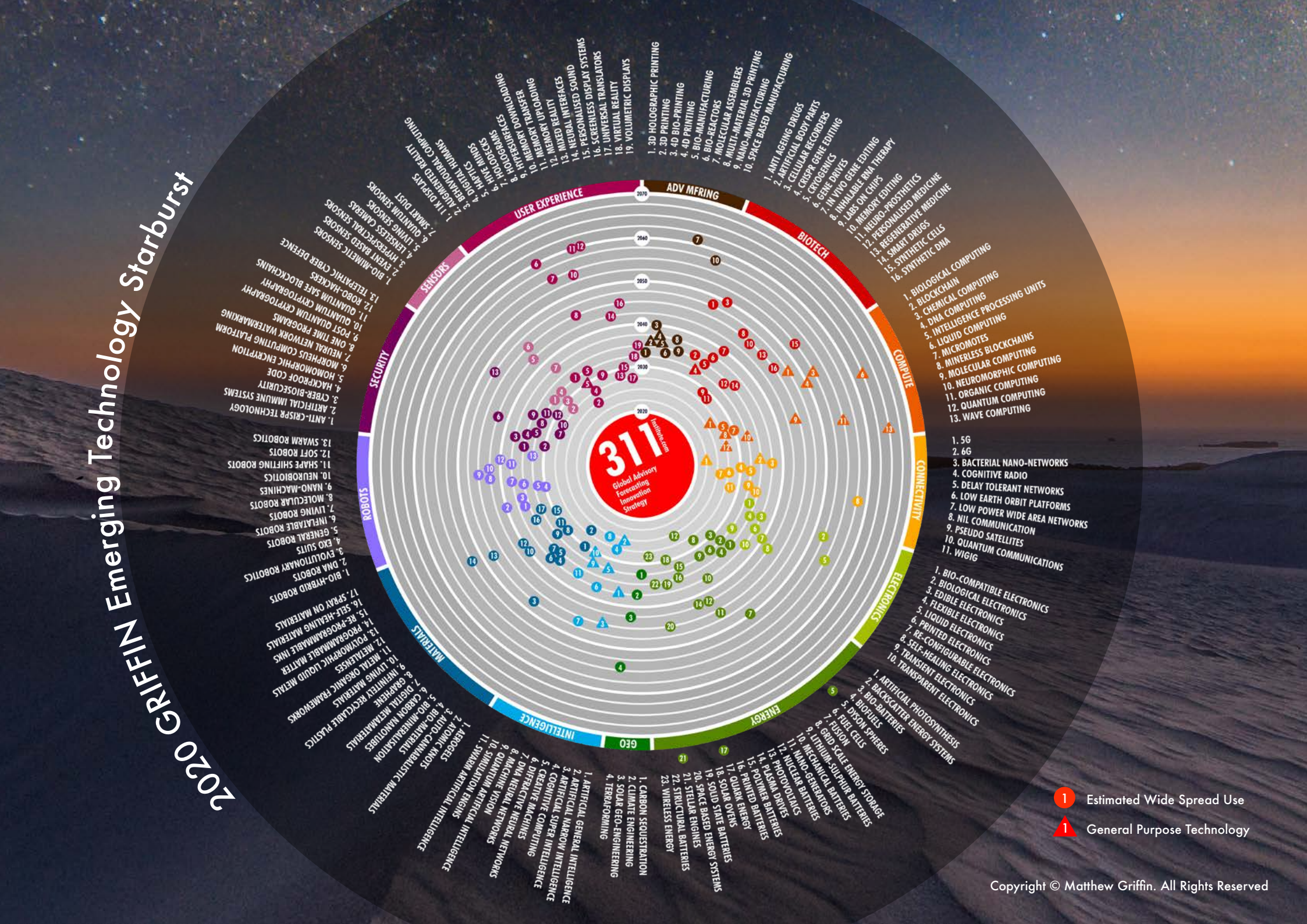
In 2021 there were fewer notable world firsts than in 2020 which, as in 2020, I again attribute to the fact that much of the worlds investment and R&D flows were re-aligned to fight the global pandemic, COVID-19. There was also a marked decrease, of approximately 23 percent year on year, in the number of new emerging technologies that appeared, and this marks the first consecutive year on year decline I've seen since I've been keeping records.

Unsurprisingly Biotech, Compute, and Energy saw the largest gains, and this was the year that many emerging technologies showed the world what they were capable of - whether it was using AI to develop vaccines or 3D printing to print out of stock parts for ventilators.

2021's stand out world firsts included: AI learning the art of "Diplomacy" • First 2nm computer chip • First 5G NR installation • First 5 minute EV charging system • First AI credited as an inventor • First autonomous Hunter-Killer drone kill • First Bio-Artificial Kidney • First empathetic first person VR surgery preview • First EV with 1,000km range • First green steel • First unethical Human burgers • First Internet of Electricity material • First mass biometric spoofing cyber attack • First Metaverse city • First re-programmable satellite • First spontaneously replicating living robot. And many more.

TIMELINE:

2021 to 2070


2020 GRIFFIN Emerging Technology Starburst
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2. 3D PRINTING
3. 4D BIO-PRINTING
4. 4D PRINTING
5. BIO-MANUFACTURING
6. BIO-REACTORS
7. MOLECULAR ASSEMBLERS
8. MULTI-MATERIAL 3D PRINTING
9. NANO-MANUFACTURING
10. SPACE BASED MANUFACTURING
BIOTECH
1. ANTI AGEING DRUGS
2. ARTIFICIAL BODY PARTS
3. CELLULAR RECORDERS
4. CRISPR GENE EDITING
5. CRYOGENICS
6. GENE DRIVES
7. IN VIVO GENE EDITING
8. INHALABLE RNA THERAPY
9. LABS ON CHIPS
10. MEMORY EDITING
11. NEURO-PROSTHETICS
12. PERSONALISED MEDICINE
13. REGENERATIVE MEDICINE
14. SMART DRUGS
15. SYNTHETIC CELLS
16. SYNTHETIC DNA
COMPUTE
1. BIOLOGICAL COMPUTING
2. BLOCKCHAIN
3. CHEMICAL COMPUTING
4. DNA COMPUTING
5. INTELLIGENCE PROCESSING UNITS
6. LIQUID COMPUTING
7. MICROMOTES
8. MINERLESS BLOCKCHAINS
9. MOLECULAR COMPUTING
10. NEUROMORPHIC COMPUTING
11. ORGANIC COMPUTING
12. QUANTUM COMPUTING
13. WAVE COMPUTING
CONNECTIVITY
1. 5G
2. 6G
3. BACTERIAL NANO-NETWORKS
4. COGNITIVE RADIO
5. DELAY TOLERANT NETWORKS
6. LOW EARTH ORBIT PLATFORMS
7. LOW POWER WIDE AREA NETWORKS
8. NIL COMMUNICATION
9. PSEUDO SATELLITES
10. QUANTUM COMMUNICATIONS
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9. TRANSIENT ELECTRONICS
10. TRANSPARENT ELECTRONICS
ENERGY
1. ARTIFICIAL PHOTOSYNTHESIS
2. BACKSCATTER ENERGY SYSTEMS
3. BIO-BATTERIES
4. BIOFUELS
5. DYSON SPHERES
6. FUEL CELLS
7. FUSION
8. GRID SCALE ENERGY STORAGE
9. LITHIUM-SULPHUR BATTERIES
10. MECHANICAL BATTERIES
11. NANO-GENERATORS
12. NUCLEAR BATTERIES
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15. POLYMER BATTERIES
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19. SOLID STATE BATTERIES
20. SPACE BASED ENERGY SYSTEMS
21. STELLAR ENGINES
22. STRUCTURAL BATTERIES
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GEO
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2. CLIMATE ENGINEERING
3. SOLAR GEO-ENGINEERING
4. TERRAFORMING
INTELLIGENCE
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2. ARTIFICIAL NARROW INTELLIGENCE
3. ARTIFICIAL SUPER INTELLIGENCE
4. COGNITIVE COMPUTING
5. CREATIVE MACHINES
6. DIFFRACTIVE NEURAL NETWORKS
7. DNA NEURAL NETWORKS
8. MACHINE VISION
9. QUANTUM ARTIFICIAL INTELLIGENCE
10. SIMULATION ENGINES
11. SWARM ARTIFICIAL INTELLIGENCE
MATERIALS
1. ABIOGELS
2. ATOMIC KNOTS
3. AUTO-CAMMALISTIC MATERIALS
4. BIO-MINERALISATION
5. BIO-MIMETIC MATERIALS
6. CARBON NANOTUBES
7. DIGITAL METAMATERIALS
8. GRAPHENE
9. INFINITELY RECYCLABLE PLASTICS
10. LIVING MATERIALS
11. METALENSES
12. POLYMORPHIC LIQUID METALS
13. PROGRAMMABLE MATTER
14. PROGRAMMABLE INKS
15. RE-PROGRAMMING MATERIALS
16. SELF-HEALING MATERIALS
17. SPRAY ON MATERIALS
ROBOTS
1. BIO-HYBRID ROBOTS
2. DNA ROBOTS
3. EVOLUTIONARY ROBOTICS
4. EXO SUITS
5. GENERAL ROBOTS
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8. MOLECULAR ROBOTS
9. NANO-MACHINES
10. NEUROBOTICS
11. SHAPE SHIFTING ROBOTS
12. SOFT ROBOTS
13. SWARM ROBOTICS
SECURITY
1. ANTI-CRISPR TECHNOLOGY
2. ARTIFICIAL IMMUNE SYSTEMS
3. CYBER-BIOSECURITY
4. HACKPROOF CODE
5. HOMOMORPHIC ENCRYPTION
6. MORPHEUS COMPUTING PLATFORM
7. NEURAL NETWORK WATERMARKING
8. ONE TIME PROGRAMS
9. POST QUANTUM CRYPTOGRAPHY
10. QUANTUM CRYPTOGRAPHY
11. QUANTUM SAFE BLOCKCHAINS
12. ROBO-HACKERS
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8. HYPERSURFACES
9. MEMORY TRANSFER
10. MEMORY UPLOADING
11. MIXED REALITY
12. NEURAL INTERFACES
13. NEURALISED SOUND
14. PERSONALISED DISPLAY SYSTEMS
15. SCREENLESS DISPLAY SYSTEMS
16. UNIVERSAL TRANSLATORS
17. VIRTUAL REALITY
18. VOLUMETRIC DISPLAYS
19. VOLUMETRIC DISPLAYS
1 Estimated Wide Spread Use
1 General Purpose Technology
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2020 STARBURST REVIEW

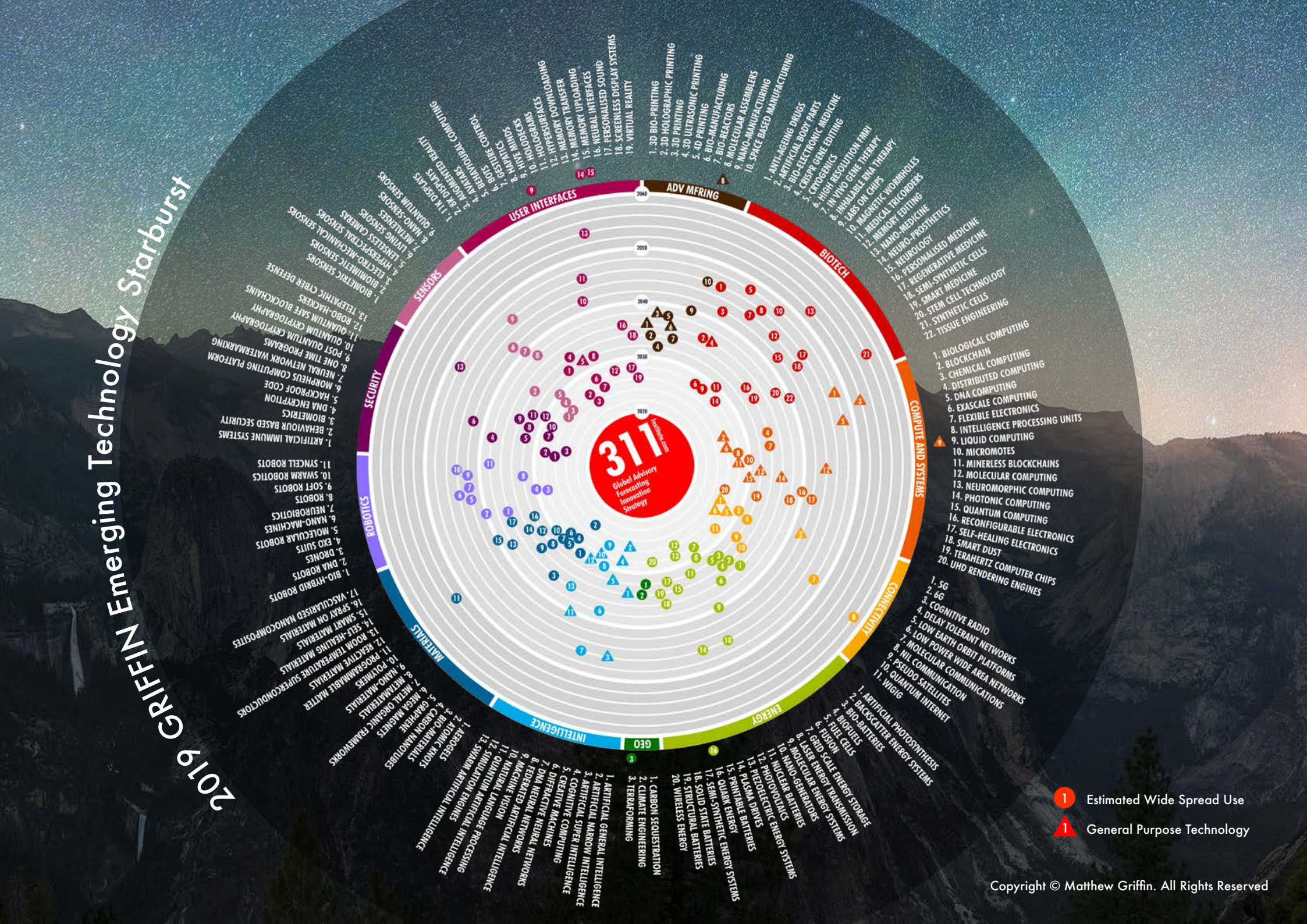
IN THE 2020 Starburst I extended the timeline to 2070, an increase from the 2019 Starburst which only extended to 2060, and tracked the development of 167 of the years most significant emerging exponential technologies, each with an addressable market value of over $500 Billion spread across 13 major categories, one of which "Electronics" was a new addition. I also promoted 44 new emerging technologies, and demoted 45.

In 2020 there were fewer notable world firsts than in 2019 which I attribute to the fact that much of the worlds investment and R&D flows were re-aligned to help the world conquer the debilitating global pandemic, COVID-19. There was also a marked decrease, of approximately 40 percent year on year, in the number of new emerging technologies that appeared this year and this is reflected in the 2021 Starburst that saw the lowest number of new entries since my records began. Unsurprisingly though the Biotech and Intelligence categories saw the largest gains.

2020's stand out world firsts included: Advanced DeepFakes • First 3D printed mini human heart • First 6G satellite test • First AI generated interactive procedural VR game • First AR smart contact lenses • First artificial living cells • First Bio-Synthetic network • First CRISPR in vivo gene editing • First hypersonic weapons deployment • First in vivo 3D Bio-Printing robot • First novel Cancer vaccine • First pilotless commercial aircraft • First protein folding AI • First reversal of human ageing • First room temperature superconductor • First virtual food. And many more.

TIMELINE:

2020 to 2070



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2019 STARBURST REVIEW

IN THE 2019 Starburst I extended the timeline to 2060, an increase from the 2018 Starburst which only extended to 2040, and tracked the development of 169 of the years most significant emerging technologies, across 12 major categories, one of which "Intelligence" was a new addition. I also promoted 28 new emerging technologies, and demoted 28. For the first time the Starburst also visualised 25 General Purpose Technologies (GPT) that will drive innovation and disruption across multiple sectors.

In 2019 there were more notable world firsts than in 2018, especially in the field of Artificial Intelligence (AI). However, there were also noticeable breakthroughs in Advanced Manufacturing, Computing, Robotics, and Synthetic Biology.

2019's stand out world firsts included: Achieving Quantum Supremacy • AI beats superstar human gamers • An evolving AI that developed new tools • Beef 3D printed in space • First 8 base pair synthetic DNA organism • First aerosol based mRNA in vivo genetic engineering therapy • First AI counsellor • First AI designed vaccine • First AI signed by a record label • First AI strategy development platform • First AI written book • First fully autonomous EV energy grid • First fully autonomous vertical farm • First in vivo autonomous robot voyage • First lab grown fillet steak • First living metabolising material • First metamaterial invisibility cloak • First plasma light sabres • First programmable DNA computer • First programmable living robots • First replicating synthetic cells • First synthetic human genome designed by an AI • First ultrasound tractor beam. And many more.

TIMELINE:

2019 to 2060

2018 GRIFFIN Emerging Technology Starburst
311
Institute.com
Global Advisory
Forecasting
Innovation
Strategy
2040
2035
2030
2025
ADV MFRING
- 3D HOLOGRAPHIC PRINTING
- 3D PRINTING
- 3D ULTRASONIC PRINTING
- 4D PRINTING
- BIO-MANUFACTURING
- BIO-PRINTING
- BIO-REACTORS
- MOLECULAR ASSEMBLERS
- NANO-MANUFACTURING
- RAPID LIQUID PRINTING
BIOTECH
- ANTI-AGEING DRUGS
- BIOELECTRONIC MEDICINE
- BIOLOGICAL TELEPORTER
- BIONIC IMPLANTS
- CHIMERAS
- CRYONICS
- GENE EDITING
- GENE THERAPY
- HI RESOLUTION FMRI
- LABS ON CHIPS
- MEDICAL TRICORDER
- MICROBIOME MEDICINE
- NANO MEDICINE
- PERSONALISED MEDICINE
- REGENERATIVE MEDICINE
- SEMI-SYNTHETIC ORGANISMS
- SMART DRUGS
- SMART NEUROPROSTHETICS
- SMART PILLS
- SYNTHETIC GENES
- SYNTHETIC STEM CELLS
- TISSUE ENGINEERING
- TISSUE NANOTRANSFECTION
CONNECTIVITY
- 6G
- COGNITIVE RADIO
- HIGH ALTITUDE PLATFORMS
- INTER-PLANETARY INTERNET
- LIFI
- MOLECULAR COMMUNICATIONS
- MULTEFIRE
- NANO SATELLITES
- NIL COMMUNICATION
- NO POWER WIFI
- QUANTUM INTERNET
- TERABIT NETWORKS
- WIGIG
ENERGY
- ARTIFICIAL PHOTOSYNTHESIS
- BACKSCATTER ENERGY SYSTEMS
- BIOFUELS
- BIOMECHANICAL HARVESTING
- ELECTROMAGNETIC DRIVES
- ELECTRONIC BLOOD
- FUEL CELLS
- FUSION
- GRAPHENE ENERGY SYSTEMS
- GRID SCALE ENERGY STORAGE
- LITHIUM AIR BATTERIES
- MOLECULAR ENERGY SYSTEMS
- NANO GENERATORS
- NANOWIRE BATTERIES
- PHOTOVOLTAICS
- PLASMA DRIVES
- QUARK ENERGY
- THERMOELECTRIC DRIVES
- THIN FILM BATTERIES
- THORIUM REACTORS
- TRAVELLING WAVE REACTORS
- WIRELESS ENERGY
GEO
- ARCHOLOGIES
- CARBON SEQUESTRATION
- CLIMATE ENGINEERING
- DESALINATION SYSTEMS
- TERRAFORMING
MACHINE SYSTEMS
- 3D CHIPS
- AFFECTIVE COMPUTING
- ARTIFICIAL INTELLIGENCE
- BLOCKCHAIN
- CHEMICAL COMPUTING
- CODELESS COMPUTING
- COGNITIVE COMPUTING
- CONTAINERISATION
- CREATIVE MACHINES
- DECENTRALISED COMPUTING
- DNA COMPUTING
- FOG COMPUTING
- LIQUID COMPUTING
- MACHINE VISION
- MICROMOTES
- MOLECULAR COMPUTING
- NEUROMORPHIC COMPUTING
- PHOTONIC COMPUTING
- QUANTUM COMPUTING
- RE-CONFIGUREABLE ELECTRONICS
- SMART DUST
- SWARM INTELLIGENCE
- TANGLE
MATERIALS
- ATOMIC KNOTS
- BIO-MATERIALS
- FLEXIBLE ELECTRONICS
- GRAPHENE
- LIQUID ARMOUR
- LIVING METALS
- MEGA MATERIALS
- META MATERIALS
- NANO CERAMICS
- NANO MATERIALS
- NANOPHOTONIC MATERIALS
- NANOTUBES
- POLYMERS
- PROGRAMMABLE MATTER
- QUANTUM MATERIALS
- REACTIVE MATERIALS
- ROOM TEMPERATURE SUPERCONDUCTORS
- SELF-HEALING MATERIALS
- SMART MATERIALS
- SPRAY ON MATERIALS
- VASCULARISED NANOCOMPOSITES
ROBOTS
- BIOHYBRID ROBOTS
- BOTS
- CO-BOTS
- DRONES
- EXO SUITS
- MOLECULAR ROBOTS
- NANO ROBOTS
- ROBOTS
- SOFT ROBOTS
- SWARM ROBOTICS
- UTILITY FOG
SECURITY
- ARTIFICIAL IMMUNE SYSTEMS
- BEHAVIOUR BASED SECURITY
- BIOMETRICS
- DNA ENCRYPTION
- HACKPROOF CODE
- HIGH ASSURANCE PLATFORMS
- IDENTITY BASED ENCRYPTION
- MORPHEUS COMPUTING PLATFORM
- ONE TIME PROGRAMS
- POST QUANTUM CRYPTOGRAPHY
- QUANTUM CRYPTOGRAPHY
- SELF DEFENDING SYSTEMS
SENSORS
- BACKSCATTER SENSORS
- BIOMETRIC SENSORS
- BIOSENSORS
- ELECTROMYOGRAPHY SENSORS
- ELECTROPHORESIS SENSORS
- GRAPHENE SENSORS
- HYPERSPECTRAL SENSORS
- MICRO ELECTRO-MECHANICAL SENSORS
- MULTISPECTRAL SENSORS
- NANO ELECTRO-MECHANICAL SENSORS
- QUANTUM SENSORS
USER EXPERIENCE
- 1:1K DISPLAYS
- 360 DEGREE VIDEO
- AUGMENTED REALITY
- AVATARS
- FAR FIELD CONTROL
- GESTURE
- HAPTICS
- HOLOGRAMS
- NAKED EYE 3D
- NATURAL LANGUAGE TRANSLATION
- NATURAL INTERFACES
- NEURAL ASSISTANTS
- PERSONAL ASSISTANTS
- SCREENLESS DISPLAYS
- TOUCH
- ULTRA HI DEF RENDERING
- VIRTUAL REALITY
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2018 STARBURST REVIEW

IN THE 2018 Starburst, which displays 169 of the world's most significant emerging technologies, each with an addressable market value of over $500 Billion spread across 11 categories, I expanded the timeline from 2035 to 2040, promoted 42 new emerging technologies and demoted 42.

In 2018 I saw a notable increase in the number of world firsts compared to 2017, especially in the fields of Computing and Materials. There were also note worthy breakthroughs in Advanced Manufacturing, Artificial Intelligence (AI), Computing, Neural Interfaces, and Synthetic Biology.

2018's stand out world firsts included: A million core Neuromorphic computer that simulated a whole mouse brain • An AI made out of DNA • An AI made out of glass • Development of the world's most durable material • Estonia becoming the first nation capable of re-booting itself • First 3D printed AI • First 5G robot remote surgery • First AI generated art sold at auction • First AI politician • First AI Robo-Coder • First AI Synthetic Content generators • First conscious robot • First game of human telepathic Tetris • First million core Neuromorphic computer • First Quantum Compass • First space elevator trials • First successful regenerative medicine trial to re-grow severed frog limbs • Living human memories edited for the first time • Memories transferred between living animals • Video's replayed from bacterial biological computers • Weaponisation of neural networks. And many more.

TIMELINE:

2018 to 2040

2017 GRIFFIN Emerging Technology Starburst
311 Institute.com
Global Advisory Forecasting Innovation Strategy
2035
2030
2025
2020
ADV MFRING
- 3D PRINTING
- 4D PRINTING
- BIO-MANUFACTURING
- BIO-PRINTING
- BIO-REACTORS
- MOLECULAR ASSEMBLERS
- NANOMANUFACTURING
- RAPID LIQUID PRINTING
BIOTECH
- ANTI AGEING DRUGS
- ARTIFICIAL BODY PARTS
- BIOELECTRONIC MEDICINE
- BIOMECHANICAL SYSTEMS
- BIONIC IMPLANTS
- CHIMERAS
- CRYONICS
- EPIGENETICS
- GENE EDITING
- GENE THERAPY
- HI RESOLUTION FMRI
- LABS ON CHIPS
- MICROBIOME MEDICINE
- NANO MEDICINE
- NEUROPROSTHETICS
- OPTOGENETICS
- PERSONAL GENETIC SEQUENCING
- PERSONALISED MEDICINE
- REGENERATIVE MEDICINE
- SMART DRUGS
- SMART PILLS
- SONOGENETICS
- STEM CELL THERAPIES
- SYNTHETIC GENES
- TISSUE ENGINEERING
CONNECTIVITY
- 5G
- AIRBORNE NETWORKS
- COGNITIVE RADIO
- HIGH ALTITUDE PLATFORMS
- INTERPLANETARY INTERNET
- LIFI
- MESH NETWORKS
- MOLECULAR NETWORKS
- MULTEFIRE
- NANO SATELLITES
- NO POWER WIFI
- SELF HEALING NETWORKS
- SMALL CELL NETWORKS
- TERABIT NETWORKS
- WIGIG
- WIRELESS PERSONAL AREA NETWORKS
ENERGY
- 5D ELECTRONIC BLOOD
- ARTIFICIAL PHOTOSYNTHESIS
- BIOFUELS
- BIOMECHANICAL HARVESTING
- CONDUCTIVE ENERGY SYSTEMS
- ELECTROMAGNETIC DRIVES
- FILM BASED BATTERIES
- FUEL CELLS
- FUSION
- LIQUID METALS
- LITHIUM AIR BATTERIES
- MICROWAVE ENGINES
- MOLECULAR ENERGY SYSTEMS
- NANOWIRE BATTERIES
- NANOGENERATORS
- PHOTOVOLTAICS
- PIEZOELECTRIC POWER GENERATORS
- PLASMA ENGINES
- QUANTUM WIRES
- THERMOELECTRIC DRIVES
- THORIUM REACTORS
- TRAVELLING WAVE REACTORS
- WIRELESS ENERGY
GEO
- ARCHOLOGIES
- CARBON SEQUESTRATION
- CLIMATE ENGINEERING
- TERRAFORMING
MACHINE SYSTEMS
- 3D CHIPS
- ARTIFICIAL INTELLIGENCE
- BLOCKCHAIN
- CHEMICAL COMPUTING
- COGNITIVE COMPUTING
- DEEP LEARNING
- DNA COMPUTING SYSTEMS
- FOG COMPUTING
- MACHINE LEARNING
- MACHINE VISION
- MEMRESISTOR
- MICROMOTES
- NEUROMORPHIC CHIPS
- OPTICAL COMPUTING
- QUANTUM COMPUTING
- RECONFIGURABLE ELECTRONICS
- SENTIENT SOFTWARE
- SWARM INTELLIGENCE
MATERIALS
- ADAPTIVE MATERIALS
- BIO-MATERIALS
- GRAPHENE
- LIQUID ARMOUR
- LIQUID METALS
- META MATERIALS
- NANO MAGNETS
- NANO MATERIALS
- NANO-CERAMICS
- NANOFOAMS
- NANOPHOTONIC MATERIALS
- PROGRAMMABLE MATTER
- REACTIVE HEALING MATERIALS
- SELF HEALING MATERIALS
- SEMICONDUCTORS
- SMART MATERIALS
- SPRAY ON MATERIALS
- STRETCHABLE ELECTRONICS
- SUPER ALLOYS
- SUPERCONDUCTORS
- SYNTHETIC MATERIALS
- THERMO BIMETALS
- THERMOELECTRIC MATERIALS
ROBOTS
- ARTIFICIAL IMMUNE SYSTEMS
- BEHAVIOUR BASED SECURITY
- BIOMETRIC SECURITY
- HACKPROOF CODE
- HIGH ASSURANCE PLATFORMS
- HOMORPHIC ENCRYPTION
- IDENTITY BASED SECURITY
- MICRO MOVEMENTS
- POST QUANTUM CRYPTOGRAPHY
- QUANTUM CRYPTOGRAPHY
- SELF PATCHING DEFENCE SYSTEMS
- VISUAL FINGERPRINTING
SECURITY
- BIOMARKERS
- BIOMETRIC SENSORS
- ELECTROMYOGRAPHY SENSORS
- HYPERSPECTRAL SENSORS
- MICRO ELECTRO-MECHANICAL SENSORS
- NANO SENSORS
- NOTEBOOK SENSORS
- SENSOR FUSION
- SMART DUST
- TIME OF FLIGHT SENSORS
SENSORS
- 360 DEGREE VIDEO
- 8K RESOLUTION
- AUGMENTED REALITY
- AVATARS
- EMOTION TRACKING
- FLEXIBLE ELECTRONICS
- GESTURE CONTROL
- HAPTICS
- HOLOGRAMS
- NEURAL INTERFACES
- PERSONAL DIGITAL ASSISTANTS
- SCREENLESS DISPLAYS
- TELEPRESCENCE
- TOUCH
- ULTRA HI DEF RENDERING
- UNIVERSAL NATURAL LANGUAGE
- VIRTUAL REALITY
USER EXPERIENCE
- BIO-BOTS
- BOTS
- CO-BOTS
- DRONES
- EXO-SYSTEMS
- HARDWARE ROBOTS
- NANO-BOTS
- SOFT ROBOTS
- SWARM ROBOTICS
- UTILITY FOG
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2017 STARBURST REVIEW

IN THE 2017 re-designed Starburst, which displays 169 of the world's most significant emerging technologies, each with an addressable market value of over $500 Billion spread across 11 categories, I expanded the timeline to 2035, promoted 38 new emerging technologies and demoted 38.

2017 lagged 2016 for technology world firsts which, but it has to be said that many of those world firsts were Artificial Intelligence (AI) related.

Despite this though unlike 2016 the world firsts I witnessed in 2017 were spread across a much broader range of themes including Advanced Manufacturing, AI, Computing, Creative Machines, Food Manufacturing, Holography, Nano-Medicine, Quantum technology, Robotics, and Synthetic Biology.

2017's stand out world firsts included: A biological teleporter • An AI created by another AI • An AI run autonomous organisation • Brain controlled drug delivery Nanobots • Designer babies • First human in vivo cancer vaccines and gene editing trials • First inter-continental Quantum network • First self-evolving self-fabricating robots • Self-coding and self-learning AI's • The creation of a six DNA base pair alien life form.

2017 was also the year we saw the first architectures, and prototypes, for the first Artificial General Intelligence (AGI) agent, a serious Blockchain competitor, and the emergence of the first viable DNA, Chemical, Liquid, and Photonic computing platforms. And I am just getting started!

TIMELINE:

2017 to 2035

DECODING THE EXPONENTIAL FUTURE

TRYING TO decode the future often feels like trying to decrypt some confounding puzzle. There are billions of different possible combinations and outcomes, and trying to use brute force is just a hiding to nothing. However, with access to the right breadth and depth of insights putting the big picture together and forecasting what the future could look like and, perhaps more importantly, when and how it's going to arrive - the What, How, and When of futures forecasting - although difficult certainly isn't impossible.

After all, as they say: The future is often hidden in plain sight. You just have to know where to look.

In order to forecast the future as accurately as is practically possible I do my best to work with what I call full network insights. That is to say I work with the academics, entrepreneurs, governments, inventors, investors, multi-nationals, and regulators who are all in one way or another adopting, building, combining, developing, scaling, testing, or regulating tomorrow's exponential technologies, products, and services, or concepts as I'll call them from here on in.

It's this rich tapestry of contacts, that cuts across every geography and industry, combined with a deep understanding of how hundreds of exponential technologies can be combined together to solve challenging yet valuable problems that, in part at least, helps me to piece together our puzzle with a high level of accuracy and detail. But, as mentioned previously, and to re-iterate the point - it's no easy feat.

In order to decode the future you must look at many different things and connect many different "dots," so it's important to remember that while all the technologies in this codex play a vital role in helping shape the future, and it's important you know and understand them, they're only part of our puzzle.

Inevitably, as I discuss in more detail later in this codex in the chapter Building Exponential Enterprises and in the separate How To Build Exponential Enterprises Codex - accurately decoding the exponential future relies on your ability to discover valuable problems worth solving, identifying the technology combinations that could be used to innovate solutions to them, and then tracking a host of market forces and metrics that, if they align, could make those concepts mainstream.

Fail to track all of these and forecast out their future and not only will your forecasts be inaccurate but you could

Notes:

miss by miles, and your concepts - if you're building any - could quickly turn into expensive failures whose potential is never realised.

BACK TO TECHNOLOGY

Switching back to technology, since that's what we're focusing on in this particular codex, with so many different emerging technologies it's inevitable that some of them will compliment each other and that some won't. It'll also be inevitable that some will be more impactful and world changing than others.

Furthermore, when these new technologies do finally emerge from the R&D labs then it's down to you and I, and increasingly our capable synthetic counterparts, the Creative Machines - which I also discuss later - to combine them to create tomorrow's must have concepts.

One of the greatest challenges for analysts, foresight teams, futurists, industry watchers, and investors alike however is the fact that all our dots can be combined in billions of new, unique, and exciting ways to create a limitless number of new concepts, and that seeing through the fog to pinpoint the most likely winners - the ones to bet on and watch closely - can be challenging. Furthermore, as the number of new technologies and dots increase over time this task only gets more complicated.

Personally, and it's more through experience than by design, I've found that if we are using a tech-first approach then the best way to cut through this fog is to divide the universe in twain. On the one hand we have the promising, individual emerging technologies, and on the other we have the problems they could be used to solve, the new concepts they could be used to create, and the markets.

Evaluating the technologies comes first because unless a specific technology can be bought to market affordably and in the timeline we care about then it follows that it won't get the opportunity to be used to create a concept. In which case we can rule it in or out of our foresight exercise.

Then, once we've filtered them it's a fairly straight forward process of ideating all of the different ways in which they can be combined together to create new concepts which can then be evaluated on their own merits and used to inform our future views.

As you'll see from this codex I've tried

Notes:

to make it easy for you, as easy as it can be under the circumstances, to quickly evaluate the maturity, merits, and status of the hundreds of the exponential technologies I track, after which you should then be able to categorise the ones that you feel are the most relevant to your industry or market, explore them in more detail, and develop a base you can work from as you progress through your forecasting program.

As the pace of change continues to accelerate, as the borders between industries continues to erode, and as science fiction increasingly becomes science fact, the future will belong to those individuals and organisations that have the foresight to see change coming, and who are agile and strong enough to adapt to it, shape it, and lead it.

DECODING EXPONENTIAL DISRUPTION

IF YOU step back a decade or so ago the word on everyone's lips was innovation and, frankly, if you didn't have it thrust into your face at least thirty times a day by every executive or ad man or woman you met then it's likely because you were in a coma. Or dead. Or both.

Fast forward to today and now they have a new buzz word - Disruption. But is disruption today as commonplace and accelerating as quickly as people will have us believe, or is it just hype and a word that executives and eager Silicon Valley startups throw around with impunity in the vain hope of convincing people that they're innovating at the bleeding edge and pushing boundaries?

Well my friend, let's take a journey together. Let's cut through the marketing fog, summit the hype cycle, and crack open an genetically modified beer while we raise cynical eyebrows and take a deeper look at the world that's unfurling around us.

YOU ARE THE MOST POWERFUL YOU HAVE EVER BEEN

The emergence of increasingly powerful exponential technologies that are increasingly decentralised, democratised and demonetised, now means that individuals have more power than ever before to create exponential products that change the world at an increasingly furious rate.

YOUR POWER AND POTENTIAL . MAGNIFIED.

DISRUPTIVE TECHNOLOGIES are nothing new. After all, the wheel was disruptive, and even the humble screwdriver was disruptive in its own right, let alone the myriad of other technologies we could spend a lifetime discussing. But when it comes to discussing the speed and impact that new digital and physical products can have on the world at large today it's very different from the times of old.

Today, for example, it is easier than ever before for a single individual to find problems to solve and innovate, produce, and distribute their products at global scale at a speed that would have been unimaginable even just a decade ago, and in doing so have an out sized impact on the future. However, this is all just the beginning, especially when you then consider that the products themselves are infinitely more capable and powerful than ever as well.

As a consequence of all these factors as all these powerful innovations and technologies become increasingly democratised, decentralised, digitised, and demonetised, in short become cheaper and simpler to access and use, we are also seeing the power that individuals have to transform the world become magnified as well.

The result of all this is that today, and then even more so tomorrow, that not only will the rate of change continue to accelerate, in old fashioned cyclical terms, but that the impact of those individual changes will continue to be magnified as well. The combination of these two factors, especially as they continue to be further amplified and magnified over time, will then have titanic consequences on our society, for better and worse - consequences that, arguably, we're not prepared for.

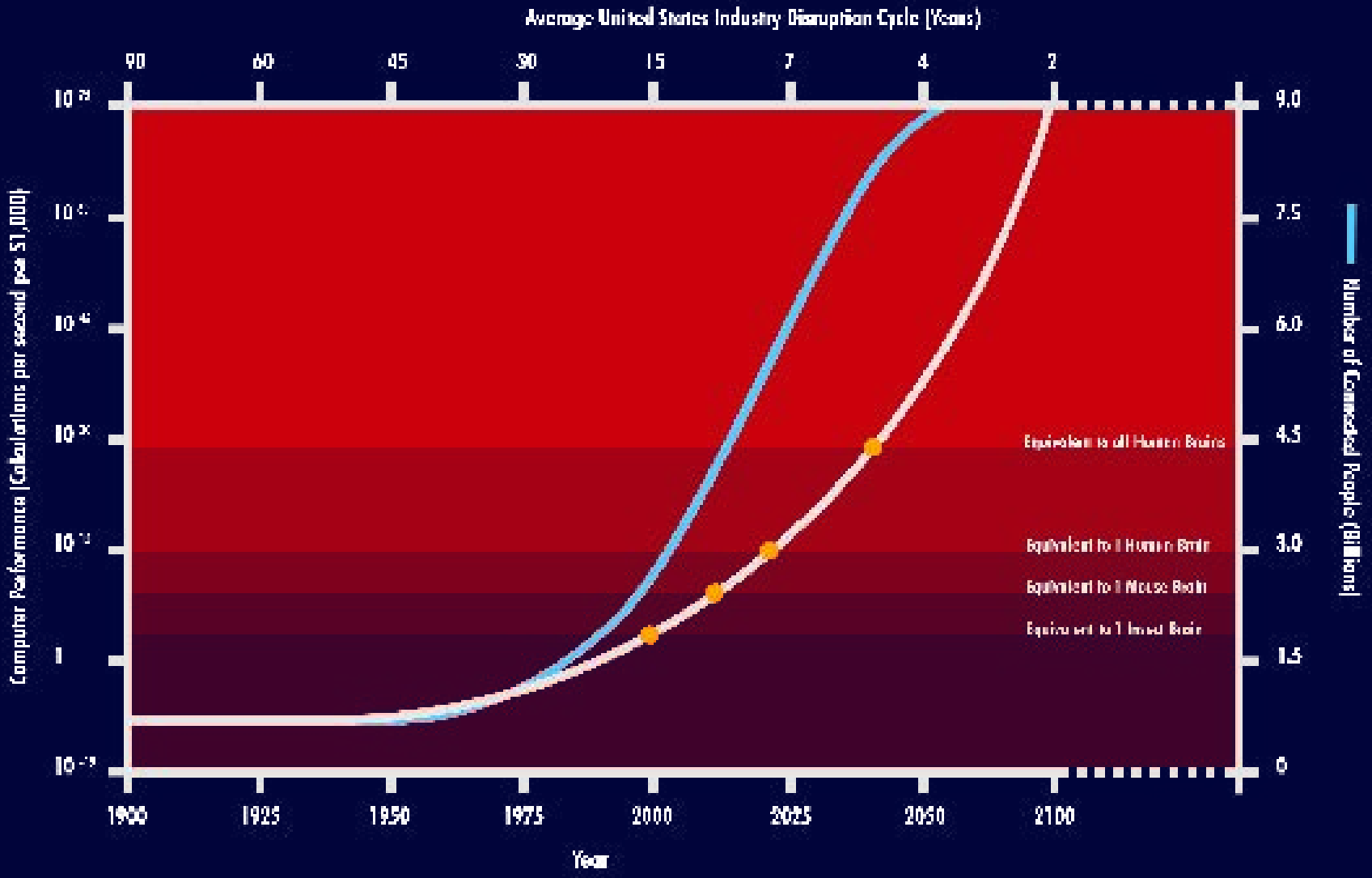
A POWERFULLY HEALTHY EXAMPLE

In order to demonstrate this point, that individuals can increasingly change industries at global scale for increasingly paltry sums of money, let's run through an example, just one of possible millions.

Traditionally if you'd wanted to give the billions of people on the planet who don't have access to primary or secondary healthcare access to potentially life saving services you would have had to have built out expensive infrastructure and hired professional staff at the cost of many billions of dollars.

Today, however, suitably skilled students can access one of the world's most powerful AI platforms for free, develop an algorithmic model in just a few weeks, integrate it with the camera and sensors on an internet connected smartphone, and now, all of a sudden, you have a smart device that can diagnose everything from ADHD, cancers, and disease, as well as the onset of dementia, diabetes, heart disease, and PTSD for free with above a 90 percent accuracy.

That's revolutionary, and now just think of the impact of that - access to free healthcare, albeit in particular niches for now, anywhere on Earth on tap. And that is just one of the millions examples of how today individuals, not just corporations, are changing the world we live in for the better by using increasingly powerful technologies and tools.



TECHNOLOGY FUELLED DISRUPTION IS ACCELERATING

As increasingly powerful exponential technologies emerge and are democratised, with computing power being just one example, and as the world becomes increasingly digital and connected industry disruption times plummet.

THE ACCELERATING RATE OF DISRUPTION .

THE CORRELATION is obvious, but it's worth discussing nevertheless. If you want to disrupt the status quo, or an individual organisation or industry, it's not just good enough to have the technologies, tools, and resources that you need to bring your idea to life, but you also need to be able to get it into the hands of as many consumers as possible as fast as possible.

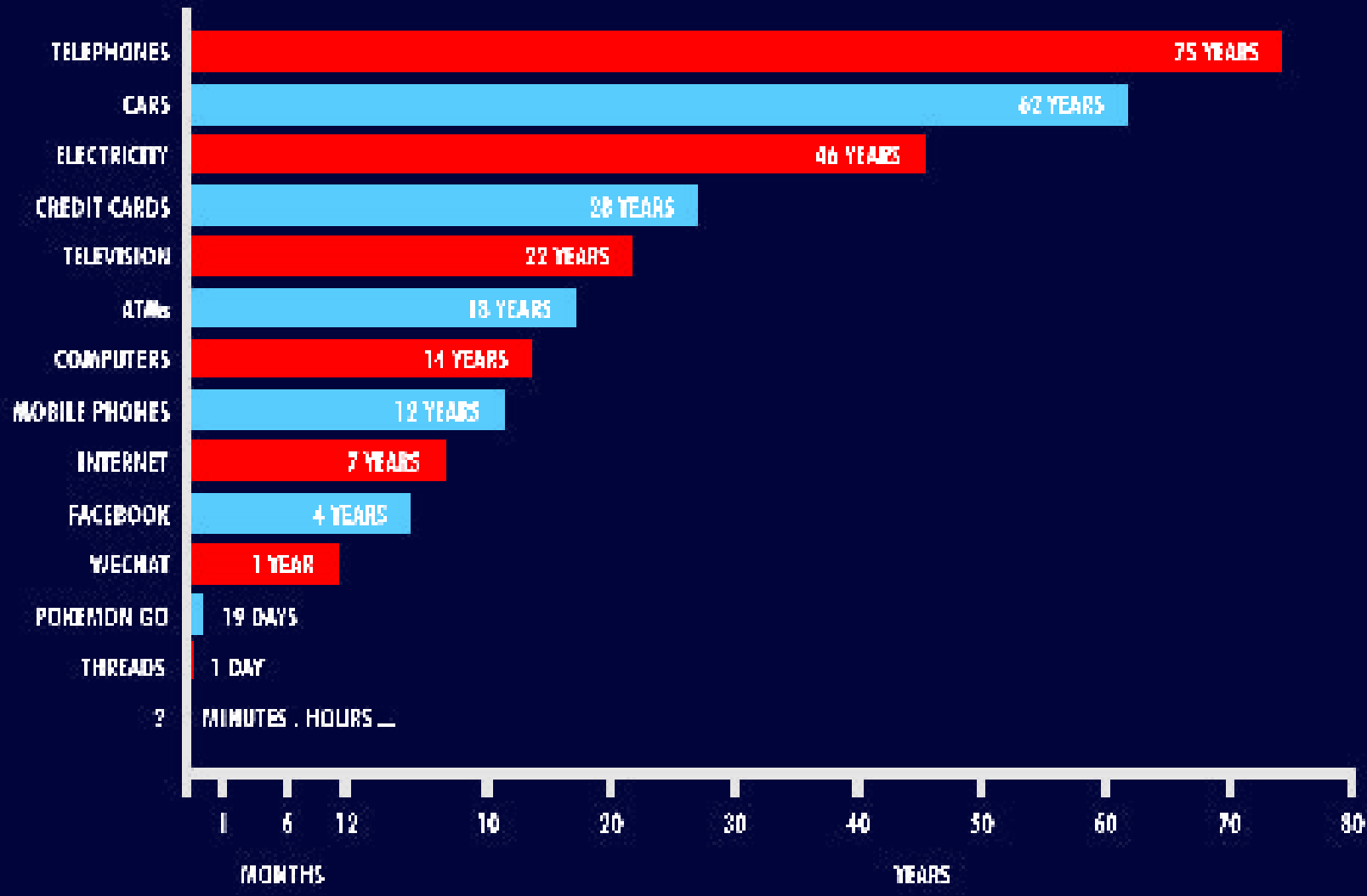
Historically when products were predominantly physical, not digital, and the only markets that entrepreneurs had easy access to were local ones, trying to disrupt anything at speed and scale, let alone a global industry, was not only an immense challenge but it also took an inordinately long time and cost a staggering amount of money to achieve. The consequence of this was that ultimately the rate of disruption was quite slow.

Today, however, increasingly digitised products and an increasingly connected society now means it's easier than ever before for entrepreneurs and organisations alike to take their idea global - in the blink of a digital eye.

Just like their forbears though today's entrepreneurs still have to be skilled enough to discover customer frictions and valuable problems worth solving, but unlike their forbears they now have access to technologies, tools, resources and finally markets that are a match for their lofty ambitions.

As a consequence it is now easier than ever before for one individual to disrupt the status quo faster than ever before, and as more of the world's population goes online, and as technologies and tools become even more powerful, this is a trend that is only going to accelerate which is why, over the past century the average time that it takes to disrupt a global industry has fallen from 90 years to just a few years.

However, as we'll see in the next section, soon disrupting a global industry within just a few years will seem slow ...



THE TIME TO REACH 50 MILLION USERS DROPS TO HOURS

As industries become increasingly digitised and as the world becomes increasingly connected it's only a matter of time before we see an industry disrupted in a day and a multi-billion dollar enterprise built and launched in hours or minutes - a trend that is further accelerated by the emergence of Creative Machines.

GLOBAL DISRUPTION IN A DAY . EVERY DAY .

TODAY OUR increasingly connected and digital society makes it possible for entrepreneurs and organisations to market, distribute, and sell new products to a global audience at just a fraction of the cost and time that it used to take.

The upshot of this is that new products and services can be adopted and taken up by millions, tens of millions, hundreds of millions, or even billions of people in or near real time which consequently means we have already reached the point in time when global business, culture, and society can be disrupted and transformed in just a single day.

To highlight this point it took 75 years for 50 million people to adopt the telephone. It then took just 19 days for Pokemon Go to hit the same milestone and just 6 days for 100 million people to adopt Call of Duty.

Then, to crown it all and to really drive the point home, when Facebook launched its cryptocurrency Libra in June 2019 had the regulators approved it then in the words of the chairmen of the Bank of England, European Central Bank, People's Bank of China, and the US Federal Reserve, it would have "changed the state's control of money and the global financial system overnight."

Languishing on those statements for a moment, and to put this new disruptive world reality into perspective, Facebook could have launched Libra in the morning and could have had hundreds of millions, and possibly billions of people, using it - their new product - come the evening.

In fact, the only reason why this didn't happen was because the central banks, governments, and regulators didn't trust Facebook. But, as they said at the time, while the organisation behind it was "flawed" the technology and the concept itself was sound.

Accelerating the rate of global disruption in this way is one thing, however, new technologies - Creative Machines - are emerging that let us extend this paradigm to hardware as well and cut the time it takes organisations to go "from concept to shelf," as they say, by up to 99% or more.

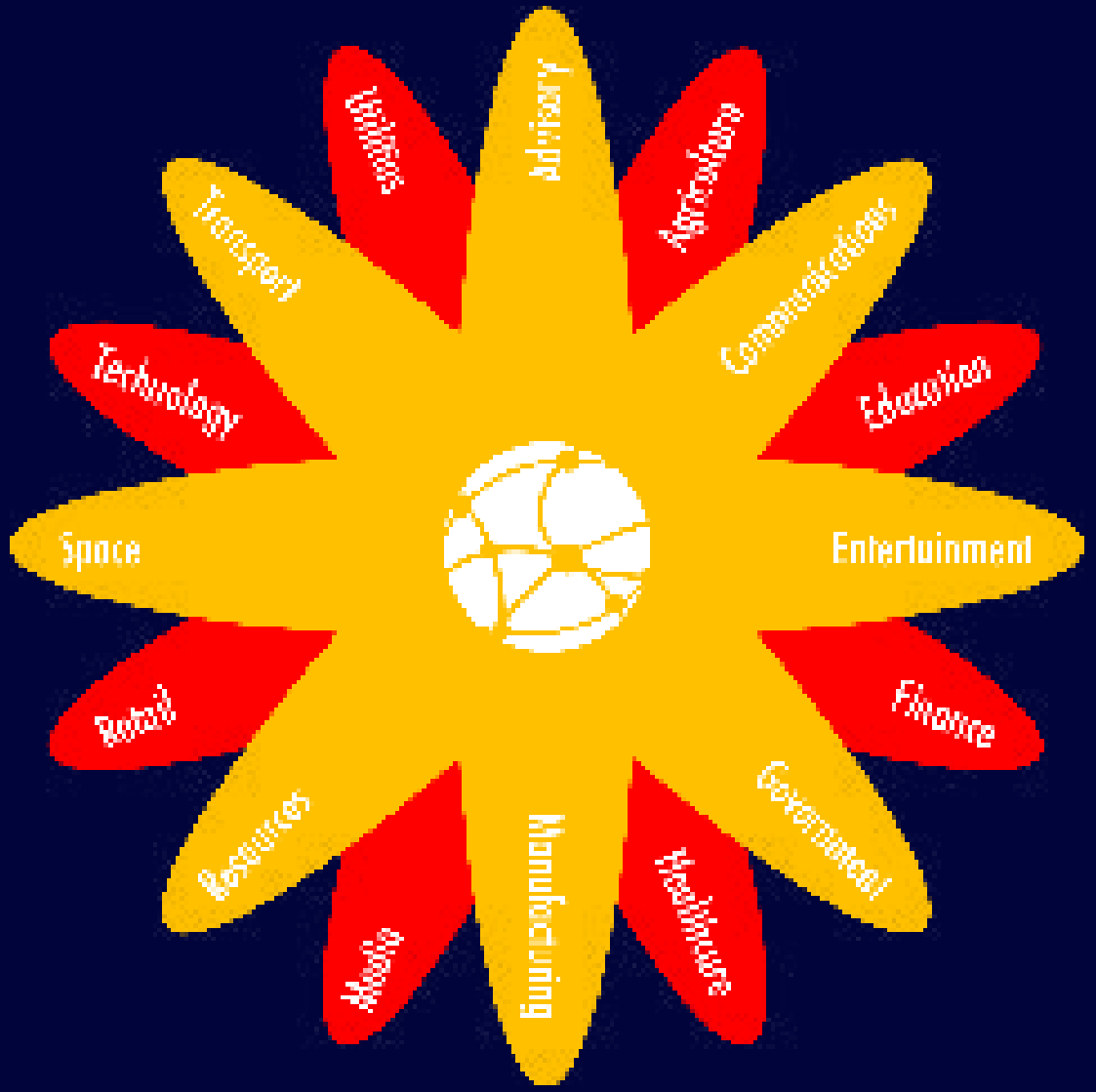
THE RISE OF CREATIVE MACHINES

Creative Machines - Artificial Intelligence "machines" that can design and innovate new products in virtual simulation, and then via 3D printing manufacture them in real time on demand - have arrived. And they are already accelerating the rate of hardware innovation by up to 99% or more.

Capable of designing, innovating and producing new digital and physical products, from content and software, to batteries, cars, clothing, computer chips, and pharmaceutical drugs, and much more, in real time Creative Machines are truly game changing.

AUTONOMOUS ORGANISATIONS

But it doesn't end there. Now add in the emergence of fully autonomous organisations and all of a sudden you have an ever accelerating virtuous cycle of disruption - all operating at exponential speed.



INDUSTRIES WITHOUT BORDERS

All industries are connected with one another and as digitisation erodes the borders that kept them all distinctly separate not only do changes in one affect the others faster but it's also now easier than ever before for organisations in one industry to enter and disrupt other industries, thereby accelerating the overall rate of disruption.

THE END OF INDUSTRY BORDERS AND SECTORS .

AS THE global rate of disruption accelerates towards real time, as I've discussed, we have yet another force at play which, in its own way, also helps accelerate the overall rate of disruption.

While it has always been the case that changes in one industry would eventually ripple out and affect other industries, when it comes to accelerating the rate of global and industry disruption digitisation simply adds rocket fuel to the already white hot fire.

As organisations and industries accelerate their own rates of digitisation one of the most significant impacts of digitisation is the erosion of the individual borders and boundaries that previously kept all of these industries separate and distinct from one another - a phenomenon that also means that as more organisations take a technology first stance and many of them pivot to become super apps we're also seeing the metaphoric death of sectors.

Today we see this effect manifesting itself time and time again, where organisations who've traditionally only operated in one industry sector are now able to branch out easier and faster than ever before to capitalise on market opportunities in others.

The best and most obvious examples of this trend today are in the technology sector where companies in the so called MATBAG collective, or Meta, Alibaba, Tencent, Baidu, Amazon, and Google, now seem to be able to develop new products and services that cross previously unassailable industry boundaries with impunity.

Amazon, for example, was primarily a E-Tailer, but now the company has interests in everything from finance and healthcare to entertainment. Google meanwhile was originally just an advertising and search engine organisation, but now has interests in everything from communications and energy, to finance, healthcare, and transportation. And so the story goes on for all of the other companies in this collective.

Born in the digital era these so called Digital Natives were unencumbered by the need to produce and sell physical products so their organisations were afforded a level of adaptability, agility, and flexibility that their legacy peers, encumbered by physical assets and products, and the associated long development cycles and capital restrictions thereof, simply couldn't match.

Now though those legacy players are spending hundreds of billions of dollars digitising themselves and trying to catch them up, and once their transformation programs are complete then they too will be able to move into and disrupt adjacent industries with increasing impunity as we've already seen with the likes of JP Morgan who entered the travel sector and Starling Bank who's more of an internet company than a neobank. All of which means that the rate of industry disruption will accelerate even more.

BUILDING EXPONENTIAL ENTERPRISES

CONTRARY TO popular belief, and as obvious as this sounds, there are two reasons why individuals and organisations get disrupted.

Firstly, there are the things that disrupt you because you never saw them coming. In short they blind-sided you and, if you have them, your foresight teams.

Secondly, there are the things that disrupt you because even though you saw them emerging and then ascending you never took the necessary actions to counter them. And while the markets and stakeholders will sometimes forgive executives for the former, they rarely forgive them for the latter - especially in a world where disruption is an ever present stalking horse.

Needless to say, disrupting a competitor, an industry, or even a country, is complex, but while many people often like to think of disruption as a singular event it's actually a series of events that, in the majority of cases, have clearly identifiable milestones and markers that we can monitor and track.

However, while everyone agrees that disruption has always been with us and that it can take many forms, from the asteroid that wiped out the dinosaurs to the emergence of Netflix who wiped out the video-saurs, one thing that many people still struggle to understand is how the nature of the animal's changed over time and how it will continue to evolve in the future.

Often the reason for this is because sometimes they're looking for disruption in the wrong places, trying to predict it based on historical perspectives, and sometimes it's just because they haven't been exposed to it before. And as for those among you who believe that the majority of disruptions are behind us I can assure you they aren't, and trust me when I say you haven't seen anything yet.

MAPPING THE DISRUPTION LABYRINTH

The process of disrupting anything, whether it be a competitor, an industry, or even perhaps a country, is generally so complex it's positively labyrinthine.

Like all of us though I've lived through many disruptive events and it's these experiences and the impact they had, on enterprises and workforces alike, that drove me to map the labyrinthine-like process of disruption so that companies could understand it, navigate it, use it to their advantage, and ultimately come to

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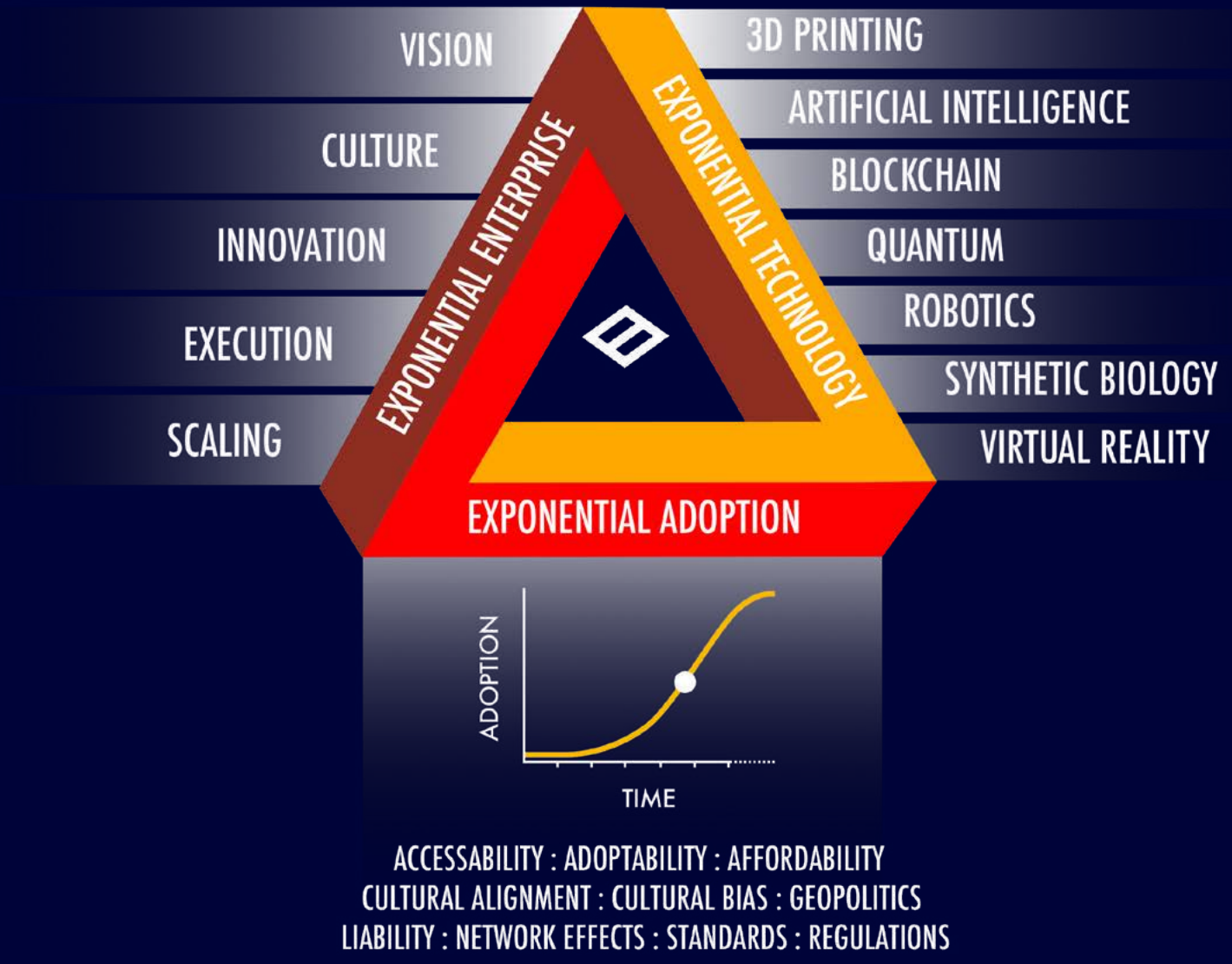
terms with a world that operates using a new rule book and that no longer behaves like it used to.

As highlighted in earlier chapters, irrespective of how fast disruption seems to materialise it isn't a single event - it's a complex series of events that, in the majority of cases, have clearly identifiable milestones and markers that we can monitor and track, and it's these events that will be the focus of at least part of your discovery process and that will help the vigilant among you identify the next disruptors and disruptions long before they have a chance to wreak their havoc on our companies.

Similarly, these events, and how they combine and the timings of their combinations, also help explain why only a fraction of companies ever make it through the labyrinth to claim cult disruptor status, so let's dive in and have a look at them.

" DISRUPTION ISN'T A SINGLE EVENT . IT'S A COMPLEX SERIES OF EVENTS WITH CLEARLY IDENTIFIABLE MILESTONES & MARKERS . "

- Matthew Griffin, Founder, 311 Institute



THE DISRUPTION TRIANGLE

The likelihood that a new product or service an enterprise or industry, can be assessed by its progress against three main axes - namely the Exponential Enterprise axis, the Exponential Technologies axis, and finally the Exponential Adoption axis, all of which are intrinsically inter-connected with one another.

THE THREE AXES OF DISRUPTION .

IN MY experience the likelihood that a new concept will disrupt a market can be assessed by its progress against three main axes as shown in the diagram on the previous page - namely the Exponential Enterprise axis, the Exponential Technologies axis, and finally the Exponential Adoption axis, all of which are intrinsically linked with one another.

EXPONENTIAL ENTERPRISE

If you're one of those individuals who doesn't want to change the world, and let's face it, not everyone does, and that's fine, then it's unlikely you ever will - at least on purpose. But, if you feel that it's your calling and you can't think of anything else then with the right approach and support you may well just pull it off - never say never, especially in a world where it's easier than ever before for one individual or one company to impact and influence the lives of billions of people.

However, while a determined rebel unit with a disruptive mindset within an enterprise will often be able to change the attitudes and opinions of those who fall within their sphere of influence it has to be argued that true change within an enterprise must be inspired and promoted from the top down.

Over the past decade I've made it my mission to understand what sets enterprises that achieve cult disruptor status, as well as fabled Unicorn status, apart from the rest of the pack and frankly it's a myth that a company's ability to disrupt itself or a market is based on its ability to outperform its competitors in just one single area. In my estimation it's their ability to outperform them in over thirty different areas, often simultaneously, that makes the difference. From the way they build and communicate their culture, values, and visions, to the way they identify valuable problems worth solving and develop their products, ecosystems, and go to markets, and much more, it all counts.

In short, and to be crystal clear, it's not any one thing, it's many, and that's the reality that anyone wanting to build an Exponential Enterprise has to contend with - you're either all in or you might as well go home, anything less and you'll be increasing your likelihood of failure.

Furthermore, it's not simply enough to be moderately better than your competitors, whoever they are and whatever industry they hail from, you have to outpace, out perform, and out think them all in almost every one of these areas.

Now we've covered the basics let's dive in and have a look at what makes these serial disruptors we're all fond of so special.

In order to make it easier to digest I'm going to divide the DNA of an Exponential Enterprise into five foundations. In order these are Vision, Culture, Discovery, Prototyping, and Execution, and within each of these individual foundations there are at least six main areas that, when performed well and combined, will move the dial in the company's favour.

Firstly comes their Vision, something that conveys a huge amount of information about their over arching purpose and

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culture, and ultimately acts as their North Star.

Visions and vision statements are normally the aggregated result of a company's ambition and purpose, their discovery and due diligence process, their internal and external deliberations, their framing and the time frame they're working within, and their view of the intersecting trends that they believe will help them achieve their goals.

Generally speaking many of the enterprises that have the greatest impact on the world today and the ones with the greatest disruptive potential are the ones that have bold and ambitious visions with grand aims that, in the words of Elon Musk, get people excited about waking up every morning and feeling inspired by the work they do.

Secondly, and by far the most important of all the five foundations is Culture, which is, among other things, the aggregated result of structural and behavioural company alignment, authentic, inspirational leadership, honest communication, and, again, the company's vision.

We are continuously reminded about the power of culture and it's power to help companies overcome all manner of obstacles. But while creating a winning culture can take years to build and is arguably one of the hardest things for any leadership team to accomplish if you aren't vigilant it can be torn apart in just months.

Furthermore, from a disruptors perspective at least, I like many people have lost count of the number of times I've heard stories about how a company's corporate immune system was responsible for killing the latest innovative concepts - either because they were disruptive to the company's core business, which is obviously laughable under the circumstances, or because of some other political motivation.

Thirdly comes one of the most exciting foundations, in my opinion at least, Discovery, which is the aggregated result of internal and external conversations, collaborations, and partnerships, exploration, envisioning, and observation, and much more. This foundation is also often the natural home of the majority of a company's entrepreneurs, rebels, and visionaries - the teams of individuals who all too often want to rip up the rule books, go above and beyond, and disrupt the status quo.

And as the rate of disruption accelerates, and as more enterprises feel the effects

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of disruption on their balance sheets it's no surprise that over the past number of years many of the teams in this space have been the beneficiaries of significant uplifts in funding and new programs as the companies work hard to improve their competitiveness, and defend and extend their consumer bases.

All that said, however, it obviously goes without saying that new funding and programs by themselves can't be counted on as magic bullets that guarantee success. Again, it's not one thing, it's many things working in harmony, which, neatly brings me back to the importance of having the right culture and environment.

Fourthly we have the Prototyping foundation, where companies begin to build products that address the problems and opportunities uncovered during the Discovery foundation. This foundation is the aggregated result of conversations, collaboration, and partnerships, experiential and design thinking, ideation and problem solving, to name but a few. One of the most understated areas of this foundation though is the use of beta consumers and, where appropriate, the importance of the investors black books - both of which help companies secure early testers and consumers that eventually hopefully convert into paying consumers and references, with the added benefit that, with the right management these activities and consumers will help generate hype around the products that then, in some cases, propel them into the hands of millions of consumers.

Fifthly, and by no means least is the Execution foundation that, when done right, which is obviously harder said than done, ensures your amazing new product doesn't get left on the metaphorical shop shelf to die.

The aggregated result of everything from ensuring the right balance of consumer value and the right business model and go to market strategy this is where many companies ambitions to disrupt markets fail. As they say - everyone has a plan until they're punched in the face, or in company speak everyone has a plan until it meets reality.

However, for the lucky companies that do make it past this last hurdle to disrupt a market - whether they're lucky by design or by fluke - this is the stage where all their hard work, everything I've discussed, albeit lightly so far, pays off.

This is also the point at which the incumbents in a market realise that a disruptor has just parked their UFO

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on the company's front yard, before laughing at it, shrugging it off, and getting eaten by the aliens hoards inside...

Noone ever claimed disruption was easy but throughout my travels and conversations with executives from all manner of industries all around the world it's clear that almost everyone underestimates the complexity and size of the challenge. However, while disrupting any market is difficult it's also clear that the size of the prize, which is often the opportunity to lead and own a market, is worth the effort.

EXPONENTIAL TECHNOLOGIES

Once a company has started its journey to become an Exponential Enterprise and found interesting and valuable problems worth solving next they turn to technology, explicitly combinations of technologies, to develop their products and help get them into the hands of consumers.

And, as you can see from the Griffin Exponential Starburst in the earlier chapters and by reading the other codices in my Codex of the Future Series, there are hundreds of exponential technologies that enterprises can choose from to help them change the economics of their industries, and develop new disruptive products. And more are appearing all the time.

One of the phrases you'll hear me refer to many times throughout this codex is the word exponential, a term that I'm sure you've heard a million times that's often used to refer to technologies that emerge, develop, and mature very quickly, and often at a rate that very few people anticipate or predict.

The term is also a hangover from Moore's Law where Gordon Moore, Intel's co-founder, in 1965 predicted that the number of transistors on a computer chip would double every 18 months, leading to an exponential increase in computing Price-Performance, and today we're seeing the same pattern emerge in many other technologies - from Artificial Intelligence (AI) and Quantum Computing, to 3D Printing and Gene Editing, and many others.

Although, when it comes to digital technologies, such as AI and Creative Machines, for example, their rates of development even make Moore's Law look positively lethargic, and this is yet another trend that's accelerating disruption.

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As the rate of technological development accelerates though there is also another trend you should familiarise yourselves with called “Jumping the S-Curve,” and it’s important because, in short, it refers to the way that different technologies supersede one another. Furthermore, as the number of exponential technologies that are emerging continues to accelerate and increase this is yet another accelerating trend that you have to take into account when deciding which technologies to use to build your new products and go to market strategies.

The phrase S-Curve refers to the rate of development of a particular technology - like a squashed S first the rate of development starts slow, then it accelerates dramatically, and then it flattens off as researchers struggle to eke out further gains. Furthermore, today, and more so in the future, as the period of time it takes to reach higher levels of Price-Performance accelerates you’ll no doubt find that trying to keep pace with all these developments gets even harder.

Jumping the S-Curve then refers to a company’s ability to move from one older technology to a newer one, for example, moving from the logic based x86 computers that we use today to tomorrow’s ultra-powerful Quantum Computers. Unlike the past though where there were only a few S-Curves to jump now there are potentially hundreds - all of which can be combined in new and interesting ways to further fuel the rate of disruption.

EXPONENTIAL ADOPTION

Of course though, while having an enterprise with the right culture that’s capable of identifying valuable problems and opportunities, and which is highly adept at leveraging talent and technology to build great products is a great start the fact remains that you have to get those products into consumers hands.

So, as part of your Execution strategy, it should come as no surprise that there are plenty of areas left that, on the one hand could stop you dead in the water, or, on the other boost you into the hall of fame. And these areas are so important that I decided to give them their own axis.

While I’ve already discussed how disruption is a process and not a single event this is the stage where, if you want to disrupt a market, you have to gain as much traction as possible in as short a time frame as possible in order to stymie your competitions ability to counteract you with their own messaging and

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variants.

Getting your product into the hands, hearts, and minds of consumers though at enough scale to disrupt a market and permanently change the status quo though is obviously difficult. But that said while, yes, you still have to overcome many hurdles, and successfully pull all the right levers you should be able to take comfort from the fact that today, as I've highlighted in previous chapters, it's easier to disrupt the status quo than it ever has been before.

Navigating this part of the labyrinth though is complicated which is why the majority of enterprises struggle to realise their lofty ambitions, and sometimes all it takes is for one key piece to be out of alignment and everything falls down like a deck of cards.

For example, build a great product that the regulators block and you're going nowhere, or build a great product that the regulators approve that is unethical, and yep, again you're going nowhere. And so it goes on - you get the picture.

So, as you can see again gaining mass adoption of your product isn't down to getting one thing right it's down to getting many things right. These include, but are not limited to, your products accessibility, adoptability, and affordability, as well as other factors including cultural alignment and bias, ethics, the geo-political situation, the impact of insurance and liability, network effects, and, of course, standards and the regulatory environment.

Get one of these wrong or get side slammed by one of them, as well as fail to adequately address or solve your company's culture and resolve the vagaries of your company's corporate immune system or shareholders, and it could be game over for you and your new products.

SUMMARY

Today we live in a world full of opportunity where the rate of change is accelerating every day, and where exponential technologies are force multipliers for multi-national companies, and levellers for startups - the result of which means that whereas yesterday you had tens of competitors in your rear-view mirror today you have hundreds - or more. It's fun to be you.

However, as amazing as all this is it will all soon be eclipsed by an even bigger, and even more disruptive revolution, because a new breed of entrepreneur,

one that can out think and out perform humans a million fold to one, and build fully autonomous multi-billion dollar empires within days and months is already emerging.

I am, of course, talking about the rise of Creative Machines, synthetic entrepreneurs if you will, and for those of you who think that such talk of machines that can design and innovate products, and operate and scale companies is far fetched the first fully autonomous enterprises have already been built and they're already operating on two continents.

Today is the slowest rate we will ever move again, but you've seen nothing yet. So pause, take a deep breath, and prepare yourself for what's coming.

CODEX
FREE DOWNLOAD

HOW TO BUILD EXPONENTIAL ENTERPRISES
CREATE . BUILD . LAUNCH . REPEAT

EXPONENTIAL TECH COMBINATIONS

HUMANITY'S STORY is one that is inextricably intertwined with technology, in all its forms, from, for example, the early railways that connected our early cities to the telegraph lines that connected our early communities. But, as generations came and went the memory of the power and impact of these early exponential technologies faded, and now they're consigned to the history books and museums as relics of the past.

However, while our memories of those early technologies might have faded their legacies live on, and today the transformative power of the descendants of these and other exponential technologies have become even more impactful, and they're transforming our world in new previously unimaginable ways at a faster than ever rate that is itself accelerating.

The telegraph, for example, was replaced by faster more convenient fixed line telephone systems, which in time were themselves usurped by faster, superior mobile communications technologies.

First came 1G, then 2G, 3G, 4G, and now 5G, with 6G on the horizon. And just eight generations on from the original telegraph system that connected

FORGET ABOUT EXPONENTIAL TECHNOLOGIES ...

... THINK INSTEAD EXPONENTIAL COMBINATIONS!

people using mechanical clicks and whirs our world lives online, and people have embraced a new type of clicks, finger, keyboard, and mouse clicks, and communicate and experience life in bits and bytes in a world where science fiction is increasingly difficult to differentiate from science fact.

However, the transformations we've witnessed over the centuries aren't thanks to the development of any single technology, they're the result of many technologies all working in combination with one another, and this is why individuals, as well as organisations, must move away from today's rather siloed thinking where we tend to talk and think about the impact and opportunities of individual technologies, and instead think about the impact and opportunities of "Exponential Combinations."

After all, even today's most powerful exponential technologies are simply blank slates that themselves rely on the development of a host of other exponential technologies, as well as an army of human and increasingly machine based entrepreneurs, that develop, shape, and combine them to create new amazing concepts.

It's these combinations, of not tens, but hundreds of exponential technologies, like the ones displayed on my Griffin Emerging Technology Starbursts, that enable us to transform every corner of global society, from the way we live our lives and how long we live, to where and how we work, and beyond.

Furthermore, thanks to the wireless communications technologies such as those I mentioned earlier, communities and individuals that were once limited by connectivity and distance now all have increasingly easy and low cost access to a single "Global brain" and global resources that can help even the most modest among us change and transform the world in new and exciting ways. And, as these technologies become increasingly decentralised, digitised and democratised, the speed and impact of that change will only accelerate from here.

AND... EVERY
TECHNOLOGY HAS
TWO SIDES.

TECHNOLOGY IS
JUST A BLANK
SLATE...

AND... EVERY
TECHNOLOGY HAS
TWO SIDES.

AS WIDE ranging and as powerful as all the exponential technologies that I discuss in this codex are though the fact remains that until someone uses them and combines them together to innovate new products and services they're all just shelfware - blank slates, and technologies without a purpose.

> Every technology is a blank slate that can be used for both good or bad purposes. It's down to us to develop and use them in ethical and moral ways that benefit society.

Furthermore, as these exponential technologies and the products and services they can be used to create become more powerful they then give us a moral and ethical dilemma because, just as they can all be used to do great good and benefit society, in the wrong hands they can also be weaponised and cause great harm in a huge variety of ways - many of which we have yet to even imagine.

Take, for example, Artificial Intelligence. On the one hand it has the power to revolutionise healthcare, identify, treat and cure disease in new ways, and discover new powerful drugs and vaccines, but on the other it's also already being weaponised to create a new generation of Robo-Hackers that can hack and exploit vulnerabilities in critical computer systems hundreds of millions of times faster than human hackers, and that's before we discuss how it's also being used to generate fake content and fake news that undermines our trust in one another and democracy.

These world changing examples are just the snowflake on the tip of the giant melting iceberg, and an example of what good and bad actors alike can do with just a single powerful technology. But there are billions of other examples I could use, including our ability to save lives by using drones to deliver critical first aid supplies including blood and medicines to remote areas, or spray crowds with bullets from drone mounted machine guns.

While this is where I'm going to leave it for now I can spin similar examples and stories for every exponential technology which is why it is absolutely vital that as organisations and governments, as leaders and individuals, and as a global society we do our utmost to understand the pros and cons of these technologies and work together to maximise the upsides while doing our best to mitigate, regulate and police the downsides.

THE ACELERATING RATE OF CHANGE

IF YOU ask people whether they think the global rate of change is faster today than it was a decade ago you, like I do, will find that almost all of them think it is. Furthermore, if you ask them whether they think the rate of change in another decade's time will be faster, the same, or slower, than it is today, then again the vast majority of them will answer "faster."

In fact, putting a statistic on it, when I ask the audiences I present to around the world this very question ordinarily over 98 percent of them feel things today are changing faster than in the past and that that rate is only going to accelerate, with only a very few of them either sitting on the fence or disagreeing.

Putting this into context, at the start of this millennium, for example, smartphones as we know them didn't exist, and just three decades before that hardly anyone owned a computer. And as for the internet? Well, in 1983 that was still pretty much just a pseudo-military experiment in an American lab.

When you think about technology in this way it's staggering to see just how far we've come in such short period of time and within just a couple of generations. Fast forwards to today and billions of people have a hand held supercomputer that, in one Reddit user's words, "Puts all the world's information at their fingertips." And much more.

So, intuitively at least, we can be forgiven for thinking that technology is progressing faster than ever. But is it really or is this accelerating rate of change just a figment of our collective imaginations?

Well, as it turns out the rate of technology development is absolutely is accelerating, and in this chapter I'm going to explore the driving forces behind this change and the surprising implications of technology's acceleration.

MOORE'S LAW IS EVERYWHERE

Ever since the first computer chip came onto the market back in 1965 they've become increasingly powerful while costing less and giving you more bang for your buck. That's because over the last five decades or so the number of transistors, or the tiny electrical components that perform basic computing operations, on a single chip have been doubling approximately every two years.

This exponential doubling, coined Moore's Law after Graham Moore

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who first observed it, is the reason why today's smartphones can pack more power than a 1990's supercomputer into such a small package.

While the computer chip's technological development is well documented surprisingly when it comes to exponential technologies computer chips aren't unique, a range of other technologies demonstrate similar exponential growth trajectories - whether it's the amount of data we can store on hard drives, flash drives, and then tomorrow in atoms, DNA, and polymers, advancements in digital camera technology, or the speed at which we can sequence genomes. And that's just for starters.

Irrespective of the technology though the outcome is all too often the same - over time their functionality and performance increases exponentially, by thousands, millions, and even billions fold, while their costs fall exponentially.

So, what's going on here? Well, this is where a new law conveniently called the Law of Accelerating Returns comes into play.

According to the law, which was first coined by Ray Kurzweil back in 1995, the pace of technological progress speeds up exponentially over time because there is a common force driving it forward. Being exponential, as it turns out, is all about evolution.

LESSONS FROM NATURE

Let's begin with biology, a familiar evolutionary process. Biology is highly adept at honing "natural technologies" so to speak – after all as we keep getting told today DNA is just "the software of life," and just look at how we're manipulating it in new and incredible ways with Synthetic Biology, for example.

Recorded within the DNA of living things are blueprints of useful tools known as genes, and due to selective pressure, or "Survival of the fittest," advantageous innovations are passed along to offspring.

As this process plays out generation after generation across the eons, chaotically yet incrementally, incredible growth takes place. By building on genetic progress rather than starting over from scratch every time organisms have increased in complexity and capability over time, and this innovative power is evident everywhere we look on Earth today – from the frigid Arctic to the scorching Sahara.

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Biology's many innovations include bones, brains, cells, eyes, and thumbs, and from thumbs and brains, technology. According to some technology is also an evolutionary process, like biology, only it moves from one invention to the next much faster, in most cases exponentially faster.

It's plain for all to see that civilisations themselves advance by re-purposing the ideas and breakthroughs of their predecessors, from the Aztecs and Egyptians, and the Mayans to modern society. Similarly, each generation of technology builds on the advances of previous generations creating a positive feedback loop of continuous improvement, meaning that each successive generation of technology is superior to the last.

Additionally, because each generation of technology improves over the last the rate of progress from generation to generation, and also within generations, speeds up. Imagine for example having to design and produce a simple chair, in the past a human designer would design it and a craftsman would build it. Fast forwards in time and those craftsmen were replaced with automated factory production lines, and then fast forwards again and those same chairs are now designed by Creative Machines, powered by AI, and 3D printed on demand in just a fraction of a time it used to take. And in the future they could be assembled by molecular assemblers.

This acceleration can be measured in terms of the "returns" of the technology, such as its efficiency, functionality, price-performance, and overall "power," many of which, if not all of which, improve exponentially as well.

Furthermore, as exponential technology becomes more capable it attracts more attention, including increased investment and R&D, and new developer ecosystems, all of which further accelerate its development. Then, once it's commercialised the development process accelerates yet again as all of a sudden billions of people have the opportunity to develop it and innovate on top of it.

JUMPING THE S-CURVE

It's this tsunami of new focus, funding, and resources which then triggers a second wave of exponential growth, where the rate of exponential growth is effectively boosted, and then we see the rate of acceleration itself accelerating.

All that said though an individual

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technology's exponential growth rate will never last forever because it's almost impossible to keep those kinds of gains up ad infinitum so these technologies grow until they've exhausted their growth potential, at which point they become superseded by a new exponential technology - something that's known as "Jumping the S-Curve," or to put it another way, jumping from one type of technology to the next.

For example, in the case of computers and Moore's Law this means moving from silicon based computer platforms to new biological, chemical, DNA, liquid, neuromorphic, photonic, and quantum computing platforms – all of which are many hundreds of millions times more powerful than today's computers.

ACCELERATING ACCELERATION

As for the implications of all this fury the net result is that overall our rate of technological progress is doubling every decade now, which in layman's terms means that in the next 100 years we won't experience 100 years or progress we'll experience over 20,000 years worth. And that's at today's rates, bearing in mind that today's rate, as we've discussed, is itself accelerating.

The consequence of all this suggests that the horizons for amazingly powerful technologies may be closer than we realise, whether they be in the form of self-evolving AI's and self-learning robots, or the development of human supercomputers, space based power stations, and space colonies. And as for science fiction, well, for the most part, from holograms and molecular assemblers to light sabres and tractor beams, it's all already science fact.

So, rounding this out, is technology progressing faster than ever? Are the things we can achieve with it increasingly out of this world? Absolutely, and the ride's only just beginning – welcome to the Exponential Era.

EXPONENTIAL TECHNOLOGIES IN FOCUS ...

DIGITAL CAMERA TRENDS OVER TIME

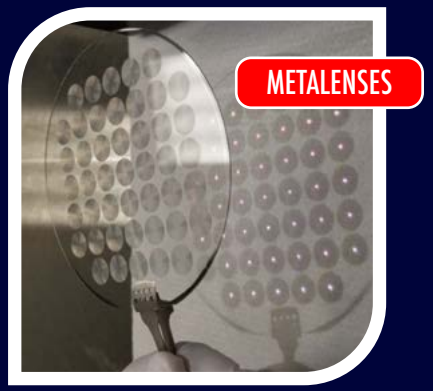
IN TIME MOST TECHNOLOGIES MINIATURISE AND THEIR COST-PERFORMANCE IMPROVES EXPONENTIALLY ...

	1976	1998	2019	CHANGE
	KODAK	SONY FD71	SMARTPHONE CAMERA	AFTER 43 YEARS **
Resolution :	0.01 Megapixels	0.35 Megapixels	48 Megapixels	4,800 x Improvement
Size :	1.8 Kgs	0.3 Kgs	20 Grams	900 x Smaller
Original Cost / Adjusted * :	$10,000 / $72,000	$799 / $1,466	$2	-
Price per Megapixel * :	$7,200,000	$4,178	$0.041	1,756,097,560 x Cheaper

* Modern Day Price Equivalent (MDPE) adjusted for inflation, UK BOE Data ** Calculated for years with data and calculated using MDPE

JUMPING THE S-CURVE

... BUT WHEN THOSE GAINS DO EVENTUALLY START TO SLOW WE THEN JUMP THE "S-CURVE" TO A NEW TYPE OF TECHNOLOGY AND THE RATE OF EXPONENTIAL TECHNOLOGY DEVELOPMENT STARTS ALL OVER AGAIN.



DID YOU KNOW that Metalenses are flat lenses, and that Photonic cameras can take pictures round corners because they can capture individual photons and use AI to re-create the images?

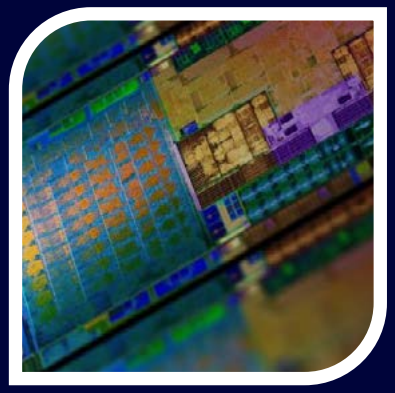
#AmazingInnovations

2019	2022	2025 +	CHANGE *
SMARTPHONE CAMERA	HARVARD UNIVERSITY	EPFL	REMEMBER THEY'RE DECEPTIVE
48 Megapixels	?	1 Megapixel	48 x Decrease
20 Grams	0.00000000001 Grams	0.05 Kgs	200,000,000,000 x Smaller
$2	Est. $20	Est. $1,500	-
$0.041	?	Est. $1,500	36,585 x More Expensive

* Comparing largest and smallest numbers against Smartphone Camera

INTEGRATED CURCUIT TRENDS OVER TIME

IN TIME MOST TECHNOLOGIES MINIATURISE AND THEIR COST-PERFORMANCE IMPROVES EXPONENTIALLY ...

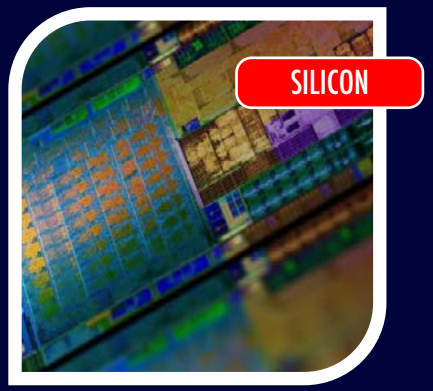


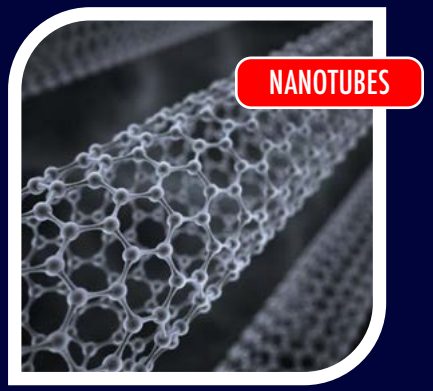
	1947	1971	2018	CHANGE
	BELL LABS	INTEL 4004	INTEL CORE I9	AFTER 71 YEARS **
Transistor Count :	1	2,300	7 Billion	7,000,000,000 x Increase
Transistor Size :	3 Inches	10,000 Nm	14 Nm	5,442,857 x Smaller
Speed :	-	0.00074 Ghz	4.80 Ghz	6,486 x Faster
Original Cost / Adjusted * :	-	$1 / $13	$0.00000024	4,166,666 x Cheaper

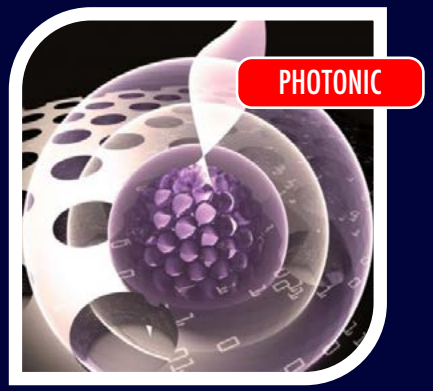
* Modern Day Price Equivalent (MDPE) adjusted for inflation, UK BOE Data, and cost per transistor ** Calculated for years with data and calculated using MDPE

JUMPING THE S-CURVE

... BUT WHEN THOSE GAINS DO EVENTUALLY START TO SLOW WE THEN JUMP THE "S-CURVE" TO A NEW TYPE OF TECHNOLOGY AND THE RATE OF EXPONENTIAL TECHNOLOGY DEVELOPMENT STARTS ALL OVER AGAIN.







2018	2025 +	2025 +	CHANGE **
INTEL CORE I9	MIT	KARLSRRUHE INSTITUTE	REMEMBER THEY'RE DECEPTIVE
7 Billion	?	?	-
14 Nm	1 Nm	0 Nm *	Infinite x Smaller
4.80 Ghz	Est. 48Ghz +	?	10 x Faster
$0.00000024	?	?	-

* Photons effectively have zero size

** Comparing largest and smallest numbers against Intel Core i9

STORAGE TRENDS OVER TIME

IN TIME MOST TECHNOLOGIES MINIATURISE AND THEIR COST-PERFORMANCE IMPROVES EXPONENTIALLY ...

	1956	1990	2019	CHANGE
	IBM 350 HARD DRIVE	MAXTOR 7000 HARD DRIVE	WD ULTRASTAR DC	AFTER 63 YEARS **
Storage Capacity :	5 Mb	40 Mb	20 Tb	4,000,000 x Increase
Size :	970 Kgs	1.3 Kgs	0.6 Kgs	1,616 x Smaller
Original Cost / Adjusted * :	$120,000 / $4.1 Million	$360 / $824	$1,100	-
Price per Gb * :	$820 Million	$20,600	$0.055	14,909,090,909 x Cheaper

* Modern Day Price Equivalent (MDPE) adjusted for inflation, UK BOE Data ** Calculated for years with data and calculated using MDPE

JUMPING THE S-CURVE

... BUT WHEN THOSE GAINS DO EVENTUALLY START TO SLOW WE THEN JUMP THE "S-CURVE" TO A NEW TYPE OF TECHNOLOGY AND THE RATE OF EXPONENTIAL TECHNOLOGY DEVELOPMENT STARTS ALL OVER AGAIN.

2019

WD ULTRASTAR DC

20 Tb
0.6 Kgs
$1,100
$0.055

2019

SANDISK FLASH MICRO SD

1 Tb
25 Grams
$250
$0.25

2025 +

SYNTHETIC DNA STORAGE

526 Pb
1 Gram
$1 Million
$115

CHANGE *

REMEMBER THEY'RE DECEPTIVE

26,300 X Increase
600 x Smaller
-
2,090 x More Expensive

* Comparing largest and smallest numbers against WD Ultrastar DC

READINESS LEVELS

WITH SO many different exponential technologies already here and with many more emerging it can often be a difficult task to figure out which of them are mature enough to be used to build your organisations next generation of products and services - let alone future generations.

However, as I have discussed many times throughout this codex, and at its most basic level, when it comes to envisioning the future and deep future stakeholders care about the "What," the "How," and the "When."

Identifying the problems, and the technologies we can use to solve those problems, is the classic innovation and product development problem and is the What [the future looks like] and the How [we do it].

Technology readiness levels in the meanwhile help us in part at least - along with the other factors I mentioned in the Building Exponential Enterprises section - with the When. However, just to be clear at this point it's also worth pointing out that there are three types of When we care about.

The first is "When will different technologies be mature enough for us to use to create our future products and services?" the second is "When will we be able to manufacture those new products?" and the third is "When will we be able to sell those products to customers [and how fast will they adopt them]?"

Technology readiness levels help us answer the first two questions.

And as for answering the third that's reliant on all the different factors highlighted on the Exponential Adoption segment of the Disruption Triangle aligning - as highlighted in the Building Exponential Enterprises section - which includes factors such as your new products accessibility, affordability, desirability, reliability, and supportability, as well as other factors including customer culture, liability, the regulatory environment, and many others.

So, as you can see while technology readiness levels aren't the whole answer to the What, How, and When, they do play a crucial role in helping you develop, manufacture, and commercialise your future products, as well as plan your future roadmaps and strategy.

TECHNOLOGY READINESS LEVEL CHART

Technology Readiness Levels are a type of universal measurement system that are used to assess the maturity level of a particular technology and its fitness to be used in particular use cases or environments.

TECHNOLOGY READINESS LEVEL . TRL .

THE TECHNOLOGY Readiness Level (TRL) system is a universal measurement system that's used to assess the maturity level of individual technologies and their fitness to be used in particular use cases, products, or environments.

First developed by NASA and adopted by organisations all around the world each technology development project that an organisation undertakes can be evaluated against specific parameters and assigned an appropriate TRL rating.

Overall, as you can see from the chart opposite, there are nine technology readiness levels with TRL 1 being the lowest and TRL 9 being the highest.

THE DIFFERENT LEVELS

When a technology is at TRL 1 scientific research is beginning and those results are being translated into future research and development. TRL 2 occurs once the basic principles of that technology have been studied and practical applications can be applied to those initial findings.

Obviously though TRL 2 technology is very speculative as there is little to no experimental proof of concept for the technology. When active research and design begin the technology is elevated to TRL 3. Generally both analytical and laboratory studies are required at this level to see if a technology is viable and ready to proceed further through the development process, and it's often during this stage when a proof of concept model is constructed.

Once the proof of concept technology is ready it then advances to TRL 4 where all of its individual component pieces are tested with one another. TRL 5 is a continuation of TRL 4, however, a technology that is at 5 is identified as what's often referred to as a breadboard technology and must undergo more rigorous testing than technology that is only at TRL 4. Simulations should be run in environments that are as close to realistic as possible. Once the testing of TRL 5 is complete, a technology may advance to TRL 6. A TRL 6 technology has a fully functional prototype or representational model.

TRL 7 technology then requires that the working model or prototype be demonstrated in a relevant environment that closely mirrors its final environment, or use case. TRL 8 technology has been tested and qualified and it's ready for implementation into an already existing technology or technology system. And, now that the technology has been successfully proven it can be elevated to TRL 9, after which it can then be developed further, commercialised, and manufactured.

ONTO THE NEXT STAGE

It is at this is the point at which our next technology readiness level, the so called Manufacturing Readiness Level (MRL), comes into play, and I discuss that on the next page.

MANUFACTURING READINESS LEVEL CHART

Manufacturing Readiness Levels are a type of universal measurement system that are used to assess the maturity of manufacturing readiness for a particular product, and they are similar to how Technology Readiness Levels are used to assess technology readiness.

MANUFACTURING READINESS LEVEL . MRL .

THE MANUFACTURING Readiness Level (MRL) is a universal measurement system that organisations can use to assess the maturity, or "Manufacturing Readiness," for new product concepts, and it's similar to how Technology Readiness Levels (TRL) are used to assess the maturity and readiness of individual technologies.

As a result MRL's are often used in general industry assessments, for example when organisations are looking to manufacture new products and new manufacturing processes, or for more specific applications such as assessing the capabilities and manufacturing maturity of potential suppliers. Used by organisations all around the world at a high level each new manufacturing project can be evaluated and be assigned a MRL rating based on the projects progress.

Overall, as you can see from the chart opposite, there are nine MRL levels with MRL 1 being the lowest, and MRL 9 being the highest.

TECHNOLOGY CATEGORY DIVES

THE FUTURE will be amazing and it will all be made possible by entrepreneurs and visionaries, both human and synthetic, who have the resources and drive to combine today's and tomorrow's technologies together to create new concepts that will allow us all to do things that we all thought were unthinkable just a few decades before.

NEW EXPERIENCES

On Uranus´small moon Miranda there's a monumental cliff wall more than ten kilometres high that dwarfs Everest called Verona Rupes, and it's the tallest cliff in the known solar system. Needless to say this extreme height, combined with Miranda's low gravity, of just 0.018 Earth gravity, would make for a spectacular base jump.

After taking the leap from the top edge you'd free fall for over twelve minutes and you'd have to use a small rocket to brake your descent and land safely on your feet at the base of the wall, but while you'd be looking down the people already at the base would be looking up and they'd see you silhouetted against a magnificent backdrop, the pale turquoise of Uranus.

While today this extreme base jump is nothing more than fantasy, in the future you'll be able to buy this experience, and many more like it, from a tour operator.

The future will be amazing in ways you've never imagined, and it's all just around the figurative corner.

DIVE IN

In this section, as we dive into the thirteen technology categories listed on the Griffin Emerging Technology Starburst I'll be shining a light on hundreds of emerging technologies that will make this, and many other unimaginable things, a reality and part of people's every day.

ADVANCED MANUFACTURING

BOOK AN EXPERT CALL

EVERYTHING IN the universe, in one way or another, is manufactured. Atoms born from ancient stars combine to form molecules and compounds that in turn combine to create everything we know, from the smartphones in our hands, to the galaxies at the edge of interstellar space.

As a consequence, as our ability to unravel the mysteries of how things are constructed, whether it's human tissue, or new materials, progresses at an exponential rate, all that's then left is to develop the technologies and tools we need to manufacture them ourselves, with our own twists. And fortunately for us our arsenal has never been fuller.

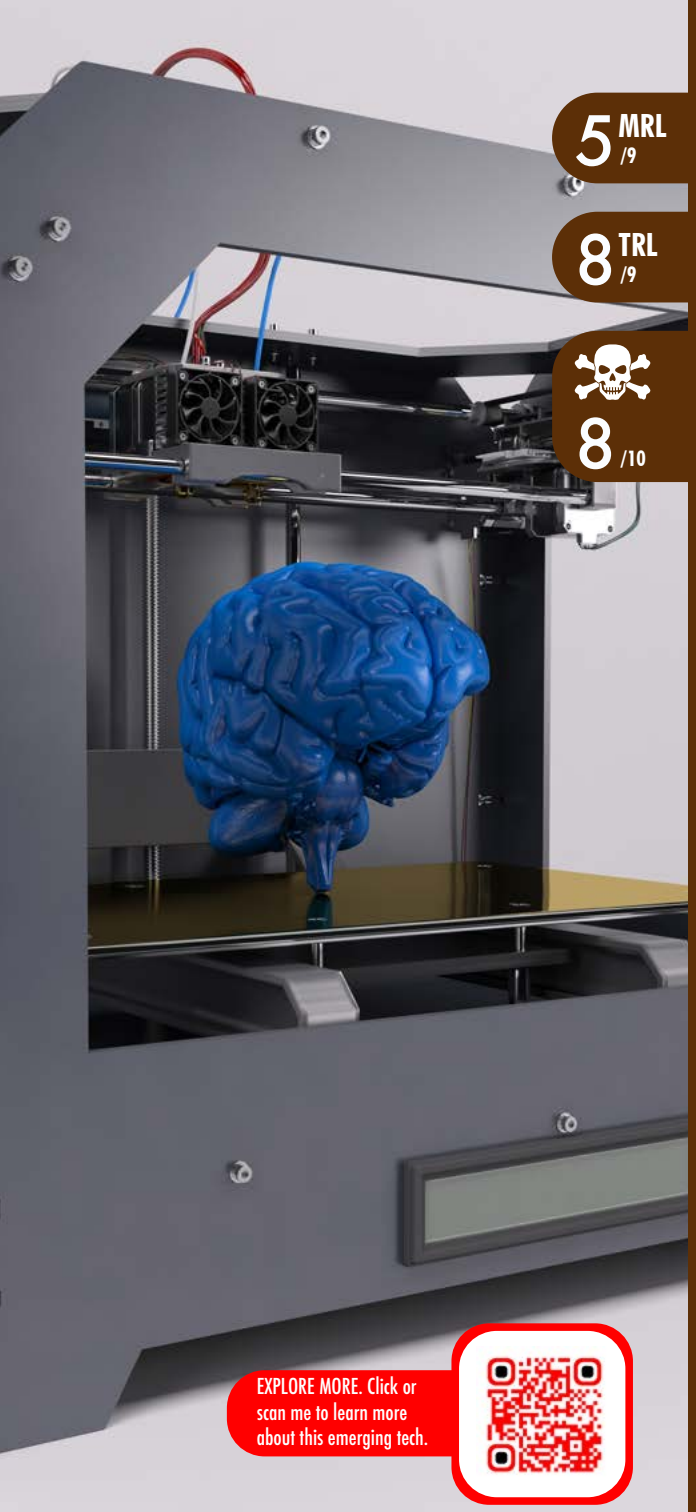
Today the Advanced Manufacturing category is being driven, primarily, by advances in three significant and ascending technology fields, namely 3D Printing, Bio-Manufacturing and Nano-Manufacturing, but I am also seeing an up tick in the amount of interest in, and investment in, 4D Printing, Bio-Printing, Bio-Reactors and even Molecular Assemblers, which have crossovers with Chemical Computers, all of which will, in their own time, have a significant impact on the marketplace.

In this section you will find details of the emerging technologies that made it into this years Griffin Emerging Technology Starburst along with details of other impactful emerging technologies:

1. 3D Bio-Printing
2. 3D Holographic Printing
3. 3D Printing
4. 3D Ultrasonic Printing
5. 4D Bio-Printing
6. 4D Printing
7. Atomic Manufacturing
8. Bio-Conversion
9. Bio-Manufacturing
10. Bio-Reactors
11. Molecular Assemblers
12. Multi-Material 3D Printing
13. Nano-Manufacturing
14. Rapid Liquid Printing
15. Space Based Manufacturing
16. Xolography Additive Printing

In addition to these emerging technologies there are many others that have yet to get an entry in this codex. These include, but are not limited to:

17. Biosynthesis
18. Cold Forming
19. DNA Nanoscience
20. Extreme Ultraviolet Lithography
21. Screen Printing



5 MRL /9

8 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

3D BIO-PRINTING

3D BIO-PRINTING, a GENERAL PURPOSE TECHNOLOGY, is a revolutionary technology that first burst onto the global stage in earnest in 2011 when researchers first began using it to 3D print replacement human bones, tissues and organs on demand. Over time, as significant progress has been made in the complimentary fields of Gene Editing and Stem Cell research it is increasingly clear that this technology will have a significant impact on improving peoples longevity and quality of life, and that, as a result, its downstream impacts on other industries will be dramatic.

DEFINITION

Bio-Printing is the combination of 3D Printing technology with materials that incorporate viable living cells.

EXAMPLE USE CASES

While the future use cases are, arguably, only limited by what we can genetically engineer and combine together, it is highly likely we will see the technology used to manufacture soft robots, and highly customised, personalised organic, and even hybrid, human organs and tissues that over time are increasingly embedded with electronic components and sensors, meanwhile, today's use cases already include the ability to 3D print functioning human brain, heart, kidney and muscle tissue, as well as bone, cartilage, pluripotent stem cells, skin and much more.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see the birth of a healthcare revolution. Consequently, as the acceptance, economics, efficiency, quality and repeatability of the technology all continue to improve, and as the number of organisations, both public and private, who see its promise swells it is inevitable that interest in the sector will become increasingly buoyant. However, while the interest and investment in the field is accelerating the organisations and regulators involved are keen to point out that there is still a long road ahead before we see the technology deliver on its full promise.

While Bio-Printing technology is still in the ascending phase one day it is highly likely that it will be replaced, and complimented by, new Molecular Assembler technologies.

MATTHEW'S RECOMMENDATION

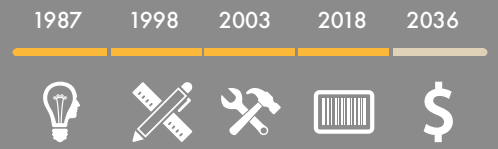
3D Bio-Printing is a highly disruptive technology that has already been productised, albeit at an early stage. Companies should perform a thorough assessment of its medium to long term impact on their business and, as appropriate, experiment with it.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19

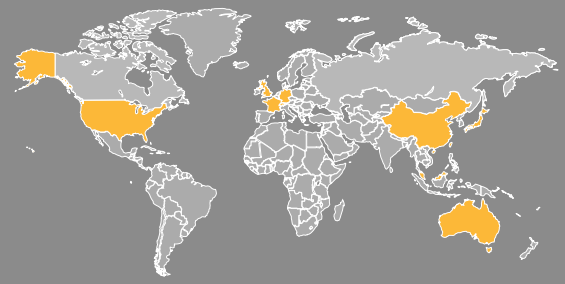
IMPACT

STATUS



Accessibility	3
Affordability	6
Competition	2
Demonstration	6
Desirability	9
Investment	3
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



9 MRL /9

9 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

University of California, Berkeley

3D HOLOGRAPHIC PRINTING

3D HOLOGRAPHIC PRINTING unlike traditional 3D Printing, that manufacturers products by building them up in layers, first arrived on the scene in 2018 and is the novel combination of 3D printing like technology combined with light and photosentitive materials that allow manufacturers to produce an increasingly wide range of products thousands of times faster than they could with traditional 3D printing. As the processes and technology advances it will have a revolutionary impact on global supply chains, and how we manufacture products on demand.

DEFINITION

3D Holographic Printing uses a combination of laser light and photosentitive materials to manufacture products in vats thousands of times faster than traditional 3D printing.

EXAMPLE USE CASES

While there are huge range of use cases the early use cases for the technology evolve around manufacturing sports wear and apparel, such as shoes and trainers, and the production of basic implanted medical devices.

FUTURE TRAJECTORY AND REPLACABILITY

Given the substantial boosts in on demand manufacturing speeds it is likely that this technology will see a medium to rapid rate of development. Furthermore, as more compatible materials become available, with an increasingly wide range of characteristics, and as the technology is refined, it becomes increasingly easy to see how the impact of this technology could be substantial.

While 3D Holographic Printing is still in the ascending phase one day it is highly likely that it will be replaced, and complimented by, faster 3D Printing and 4D Printing technologies, and eventually Molecular Assembler technologies.

MATTHEW'S RECOMMENDATION

3D Holographic Printing is a highly disruptive technology that is showing early signs of commercialisation. Companies should perform a thorough assessment of its medium to long term impact on their business, and, as appropriate, experiment with it.

15 SECOND SUMMARY

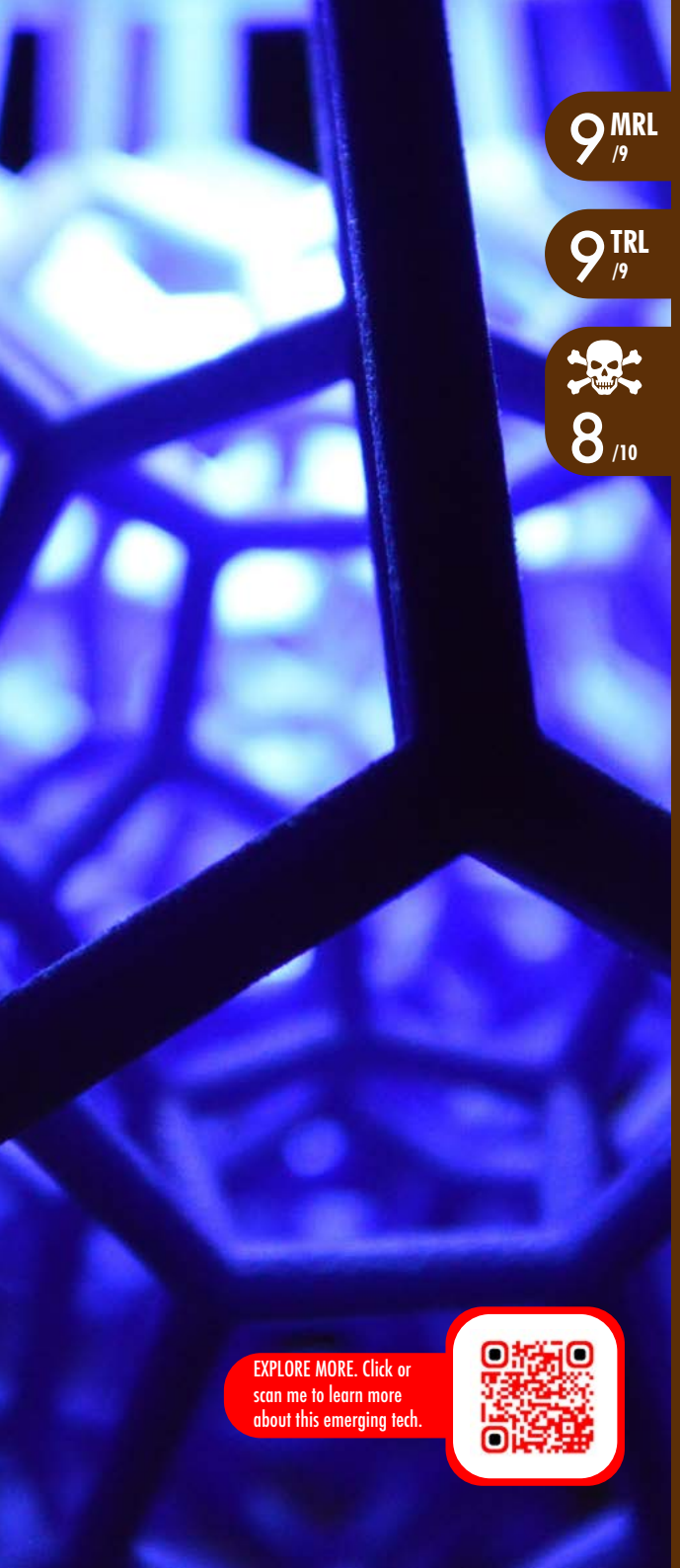
STARBURST APPEARANCES: '18, '19, '20, '21

IMPACT

STATUS

Accessibility	2
Affordability	5
Competition	4
Demonstration	4
Desirability	8
Investment	1
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



9 MRL /9

9 TRL /9

8 /10

3D PRINTING

3D PRINTING, a GENERAL PURPOSE TECHNOLOGY, which is also known as Additive Manufacturing, is an increasingly revolutionary manufacturing technology that first burst onto the global stage back in 2010 after being under development in the shadows and in the labs for over three decades. Its impact, and its ability to decentralise and change the economics and shape of the global manufacturing industry, collapse and eliminate entire sections of the global supply chain and its ability to disintermediate and disrupt entire industries should not be under estimated. Today's 3D printers can produce a wide variety of large, up to the size of cars, and small, down to 40nm, products using a mixture of metallic, organic and non-metallic materials.

DEFINITION

3D Printing the process of making a physical object, of almost complexity, shape, size or type, from a 3D digital file, by laying down many thin layers of a material in succession.

EXAMPLE USE CASES

While the future use cases for the technology are, arguably, limitless, today's use cases, which are already varied, include the ability to 3D print clothing, basic electronics, enterprise grade industrial components and machinery, human organs, lighting systems, solar cells, synthetic stem cells, vehicles and much more.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade, as the components and processes that underpin the technology mature and become increasingly accessible, affordable, capable and reliable the rate of expansion of the technology's ecosystem, and the emergence of new specialist sub-categories that include, but are not limited to, 3D Bio-Printing, 3D Holographic Printing, 3D Ultrasonic Printing, 4D Printing, and Nano-Manufacturing, the variety of use cases, and ergo the rate of global adoption, will continue to accelerate.

While 3D Printing technology is still in the ascending phase one day it is highly likely that it will be replaced, and complimented by, new Bio-Manufacturing and Molecular Assembler technologies.

MATTHEW'S RECOMMENDATION

3D Printing is a highly disruptive technology that has already been productised, albeit at an early stage. Companies should perform a thorough assessment of its medium to long term impact on their business and, as appropriate, experiment with it.

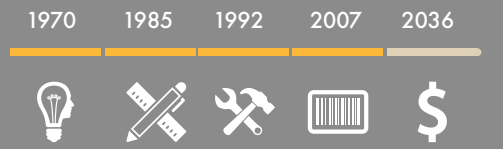
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

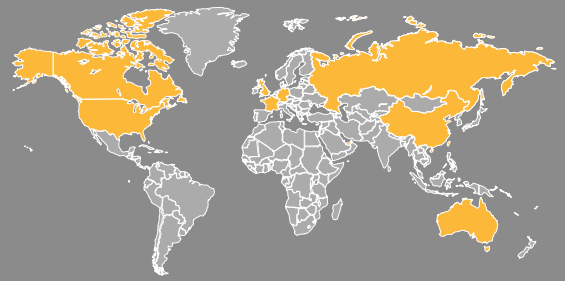
IMPACT

STATUS



Accessibility	3
Affordability	3
Competition	2
Demonstration	7
Desirability	9
Investment	5
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



2 MRL /9

4 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

3D ULTRASONIC PRINTING

3D ULTRASONIC PRINTING first appeared on the scene in 2018 after scientists in the Ukraine combined ultrasonic Tractor Beam technologies with traditional 3D printing technology to create a single 3D printer capable of manufacturing and assembling electronics within one device. Needless to say there is the opportunity for this technology to help decentralise manufacturing and assembly at both a global and regional scale, but as the teams developing the technology work in the comparative shadows it's likely that the commercialisation of the technology will be further away than it should be.

DEFINITION

3D Ultrasonic Printing prints then manipulates objects in situ within the printer using ultrasonic sound waves before fixing them and completing the assembly process.

EXAMPLE USE CASES

While future use cases for the technology are, arguably, almost limitless, and include a wide range of products, from the traditional to the exotic, where the accurate placement of individual components, whether those are synthetic and, or, biological, is important or crucial, today's use cases are more limited to 3D printing and assembling basic electronic components and electronic products.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade the capability of this technology will increase significantly, although given its developers relatively limited budgets and media exposure there is a good chance that the development of the technology could dead end as the team behind it fail to realise its commercial potential. However, with the right investment and exposure this is a technology that could decentralise the production of increasingly sophisticated and complex products.

While the technology is still very nascent over the longer term there is a good chance that it could be replaced, and perhaps even complimented by 3D Holographic Printing and Molecular Assemblers.

MATTHEW'S RECOMMENDATION

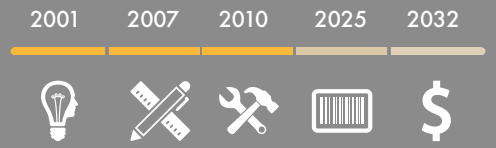
3D Ultrasonic Printing is a disruptive technology that, it can be argued, is the next logical evolution of traditional 3D Printing technology, that could provide companies across a wide range of sectors with significant cost and efficiency savings. Companies should perform a thorough assesment of its medium to long term impact on their business, and, as appropriate experiment with it.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '19

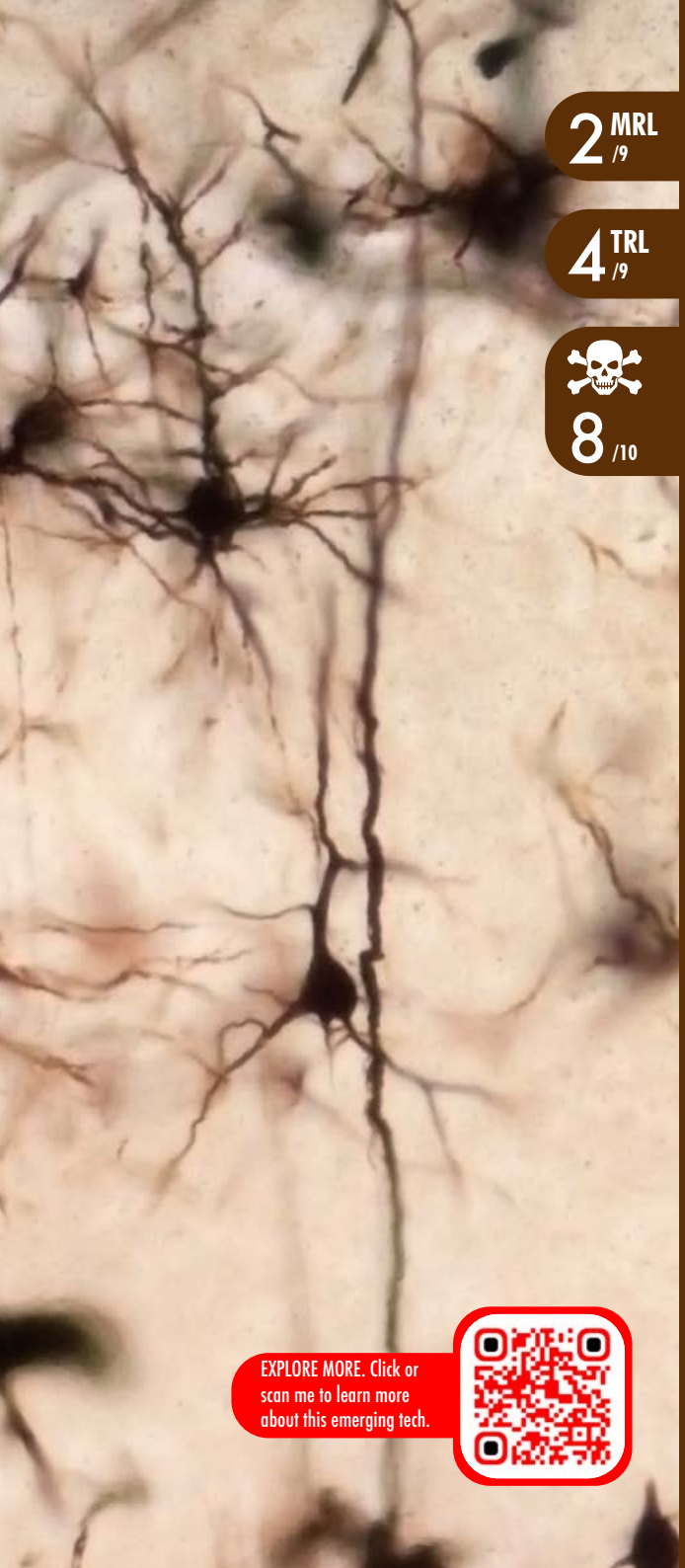
IMPACT

STATUS



Accessibility	3
Affordability	4
Competition	2
Demonstration	5
Desirability	8
Investment	2
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



2 MRL /9

4 TRL /9

8 /10

4D BIO-PRINTING

4D BIO-PRINTING, which is in the Prototype Stage, is the field of research concerned with developing new ways of printing organic based products that change shape and grow over time. Recent breakthroughs in the field include the printing of the first human heart tissue that when transplanted into young patients will grow with them as their bodies grow, something that cannot be accomplished today using traditional 3D Bio-Printing methods.

DEFINITION

4D Bio-Printing is an additive manufacturing technology that uses bioinks to print viable living tissues capable of changing shape and morphing over time in a controllable way.

EXAMPLE USE CASES

Today we are using 4D Bio-Printing to print human tissue that grows with the patient. In the future the primary use cases of the technology will include the wider bio-printing of human organs and tissues as well as being used to help create new classes of Living Robots and Soft Robots, and beyond.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Healthcare sector, with support from univesity grants. In time we will see the technology mature, and as the cost and availability of bio-inks and other materials continue to fall, and as the processes are refined we will inevitably see the technology eventually become commercialised.

While 4D Bio-Printing is in the Prototype Stage, over the long term it will be enhanced by advances in 3D Printing, 3D Bio-Printing, Bio-Inks, Hydrogels, Re-Programmable Inks, and Stem Cells, and one day it will likely be replaced by Molecular Assemblers.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view, and re-visit it every few years until progress in the space accelerates.

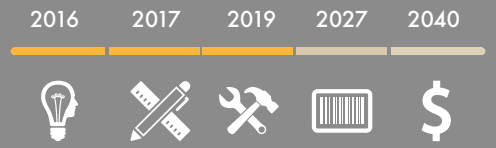
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22

IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	2
Demonstration	5
Desirability	7
Investment	2
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

5 MRL /9

6 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

4D PRINTING

4D PRINTING is an emerging technology whose impact is not, at first, easy to recognise, and it could be argued that it is the logical evolution of 3D Printing. However, 4D Printing's value lies in its ability to create new programmable materials and products that self-assemble and change their properties, functionality and shape, in response to external or internal environmental stimuli, such as electric current, humidity, pressure, temperature and UV light, once they've left the printer.

DEFINITION

Related to 3D Printing 4D is a reference to 3D Printed objects that change and alter shape and properties when they are removed from the printer.

EXAMPLE USE CASES

While many of the future use cases for the technology are yet to be discovered they will undoubtedly include the ability to 4D print new biomimetic and programmable materials, and self assembling, shape shifting buildings, including space stations and shelters, and complex robots. Meanwhile, today's use cases already include the ability to 4D print self assembling furniture and basic robots, shape shifting clothing and medical implants, and next generation, multi-use and multi-modal materials.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade as companies and research institutions increasingly see the value in 4D Printing, and the number of use cases continues to expand, inevitably we will start to see the emergence of a strong, at first, nuclear ecosystem which will likely be centred in the US, and then China and Germany.

While 4D Printing technology is still very nascent it is highly likely that it will be replaced, and complimented by, new Bio-Manufacturing and Molecular Assembler technologies.

MATTHEW'S RECOMMENDATION

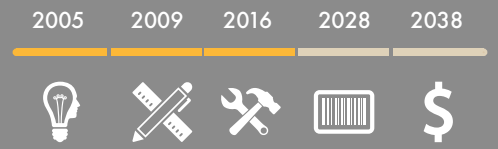
4D Printing is a highly disruptive, and potentially very valuable, technology but it is still at the concept stage. As a result, in the short term, I suggest companies put it onto their radars and keep an eye on it.

15 SECOND SUMMARY

STARBURST APPEARANCES: : '17, '18, '19, '20, '21, '22, '23, '24

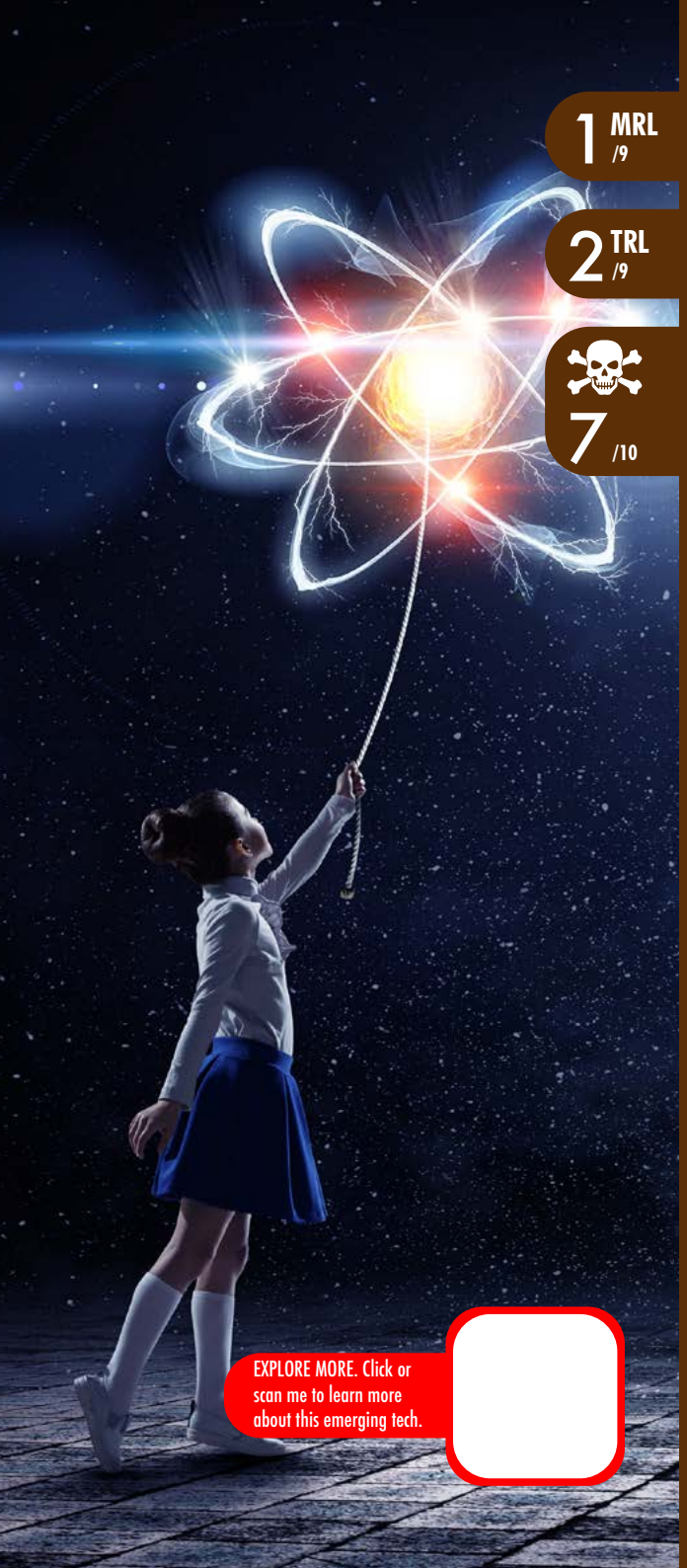
IMPACT

STATUS



Accessibility	1
Affordability	3
Competition	3
Demonstration	5
Desirability	5
Investment	2
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



ATOMIC MANUFACTURING

ATOMIC MANUFACTURING, which is in the early Prototype Stage, is the field of research concerned with using existing and future Nano-Manufacturing expertise and know how to create perhaps the ultimate in precision manufacturing that allows us to add, remove, and transform material at the atomic scale. While this is still a nascent technology field recently researchers have been experimenting with it to create new materials, plastics, and semi-conductors, with future applications including Molecular Electronics and Molecular Robotics, as well as many others especially in the healthcare, manufacturing, and technology sectors.

DEFINITION

Atomic Manufacturing is the atomically precise production of finished goods in a manner such that every atom is in its own precise location without any deviation.

EXAMPLE USE CASES

While there are a variety of use cases for this technology the main ones include producing better and more scalable Molecular Assemblers and Quantum Computers, creating new materials, including Programmable Materials, improving the usefulness of Nanobots and Nano-Machines, reaching the end of Moore's Law, and boosting the efficiency of certain renewable energy technologies such as Photovoltaics, among others.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, albeit from a very low base, primarily led by organisations in the Aerospace, Defense, Manufacturing, and Technology sectors, with limited support from government funding and university grants. In time we will see Atomic Manufacturing be applied to some of the most important and challenging manufacturing applications but it will no doubt take a very long time to commercialise.

While Atomic Manufacturing is in the early Prototype Stage, over the long term it will be enhanced by advances in Artificial Intelligence, Imaging, Molecular Robotics and Nano-Manufacturing, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

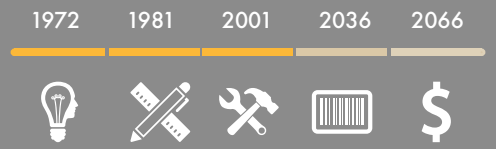
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and re-visit it every few years until progress in this space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '22, '23, '24

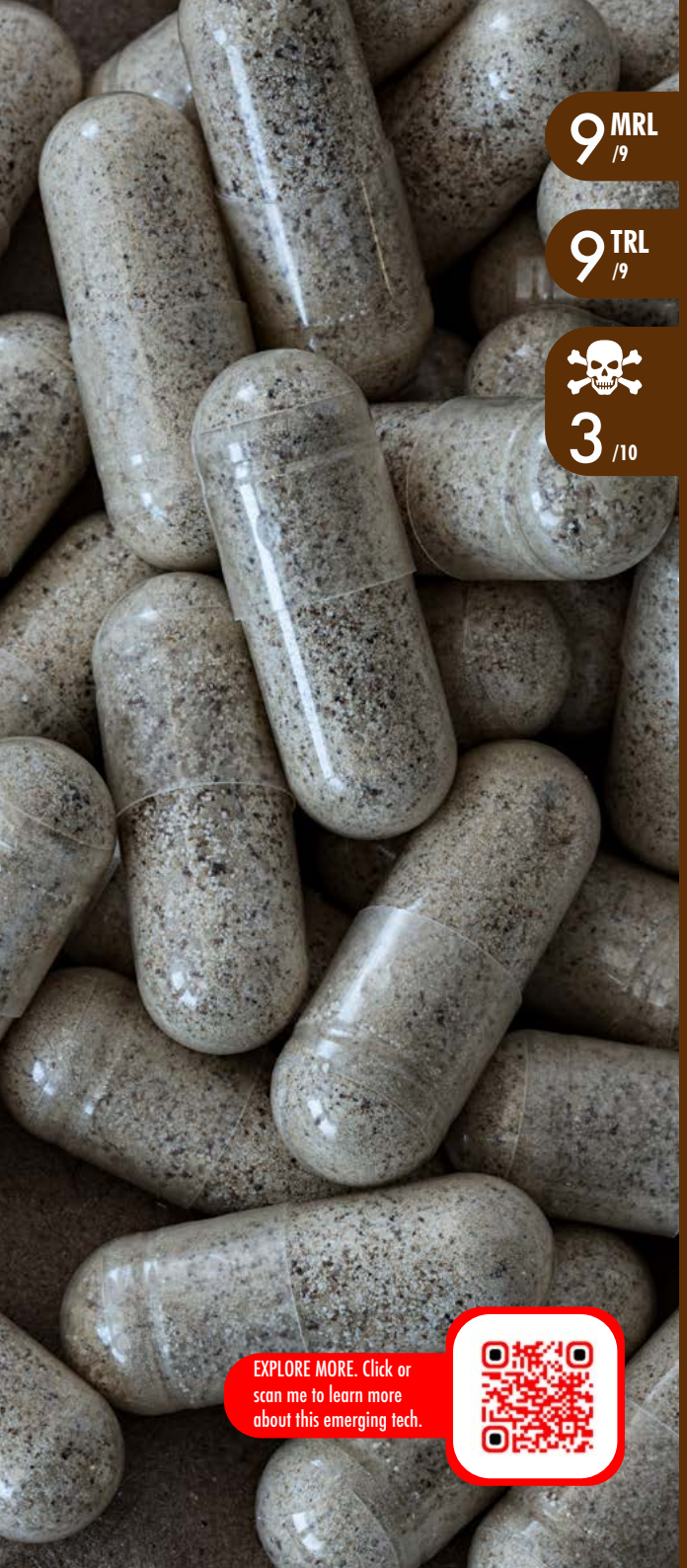
IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	2
Demonstration	5
Desirability	8
Investment	2
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



9 MRL /9

9 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

BIO-CONVERSION

BIO-CONVERSION, which is in the Commercialisation Stage, is the field of research concerned with finding new methods to create and synthesise useful materials and products from the conversion of, and use of, biological matter. Recent breakthroughs in this area include the development of better Biofuels and the increasing use of Synthetic Biology technologies to help synthesise valuable Bio-Materials and chemicals which help organisations develop more sustainable Circular Economy products - many of which are now being used in the construction and fashion industries.

DEFINITION

Bio-Conversion is the conversion of organic matter into useful products using biological agents or processes.

EXAMPLE USE CASES

Today we are using Bio-Conversion to create valuable chemicals such as Bio-Plastics and pharmaceuticals from organic matter, as well as assist in the conversion of organic waste into energy via processes such as Anaerobic Digestion and Gasification in the energy sector. We are also re-engineering bacteria, fungi, and yeast, as well as other organisms, to metabolise biomass components which can be converted into a myriad of valuable products including military grade armour, drugs, polymers, and vaccines through the use of enzymatic pathways and fermentation.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Bio-Conversion increase, primarily led by the Construction, Energy, Manufacturing, and Recycling sectors. While this is still an emerging technology it is proving to be an increasingly valuable one as we find new ways to produce an increasingly wide array of sustainable and valuable materials and products, many of which have novel properties.

While Bio-Conversion is still in the Commercialisation Stage it could be enhanced by advances in Artificial Intelligence, Bio-Manufacturing, CRISPR, Quantum Computing, Synthetic Biology, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

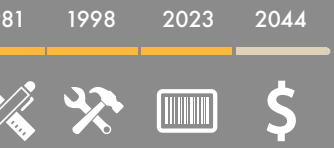
In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

IMPACT

STATUS



Accessibility	4
Affordability	6
Competition	6
Demonstration	7
Desirability	8
Investment	3
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

9 MRL /9

9 TRL /9

8 /10

BIO-MANUFACTURING

BIO-MANUFACTURING, a GENERAL PURPOSE TECHNOLOGY, is a precision manufacturing technology that has been on the rise for decades but on a limited scale and it is only recently, thanks to the significant progress that has been made in the complimentary fields of Gene Editing, Gene Sequencing, Nano-Manufacturing and Stem Cell research, that it is now beginning to emerge from the relative shadows. Based on the concept of nature's own factories, living organisms, Bio-Manufacturing is a revolutionary technology that could one day compliment, and in some areas even supplant and replace, 3D Printing, 3D Bio-Printing and 4D Printing.

DEFINITION

Bio-Manufacturing is the manipulation of living organisms to manufacture a product.

EXAMPLE USE CASES

While the future use cases for the technology are only limited by the cultures and organisms that we can create and genetically engineer, something which itself is beginning to accelerate at an exponential rate, they will likely include the ability to manufacture new bilogics, foods and medicines, as well as new organo-metallic lifeforms that can be used to create new, previously unimaginable materials and products, meanwhile, today's use cases already include the ability to manufacture biofuels, bio-materials, drugs, enzymes, graphene, vaccines and much more.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade Bio-Manufacturing will continue to undergo a major shift, moving out of the academic labs that run and manage single product processes and into more automated, flexible, integrated, multi-product facilities that are run by some of the world's largest companies - especially in the Biotech sector. However, many of the advances in the field will be reliant on advances in other fields such as Gene Editing, and the development of a larger, better funded, global ecosystem.

While Bio-Manufacturing is still in the relatively early stages of its ascendancy it is highly likely that it will be replaced, and complimented by, new Bioreactor and Molecular Assembler technologies.

MATTHEW'S RECOMMENDATION

Bio-manufacturing is a highly disruptive technology that is only just being productised. As a result, in the short to medium term, I suggest companies put it onto their radars and keep an eye on it.

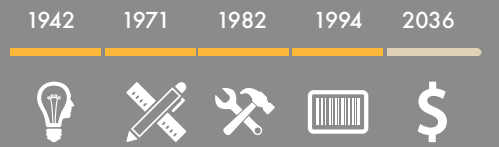
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: : '17, '18, '19, '20, '21, '22, '23, '24

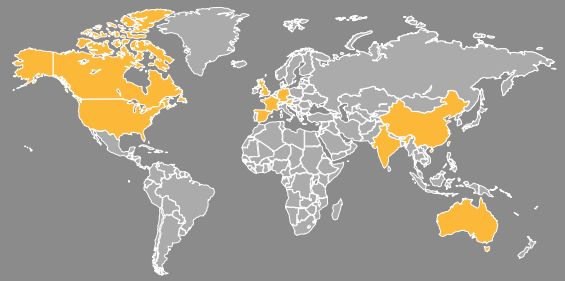
IMPACT

STATUS



Accessibility	4
Affordability	6
Competition	3
Demonstration	8
Desirability	8
Investment	4
Regulation	5
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



9 MRL /9

9 TRL /9

6 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

BIO-REACTORS

BIOREACTORS ARE becoming an increasingly acceptable way to produce a multitude of organic based products on demand, en masse, and at an affordable price, however, they still have some way to go before the cost of the products they produce meet those manufactured using traditional techniques. Over time, as significant progress continues to be made in the complimentary fields of Gene Editing and Bio-Manufacturing this technology will potentially play an increasingly important role in helping feed the world's population, and create new medicines and products.

DEFINITION

Bioreactors carry out and progress natural and synthetic biological reactions on an industrial scale.

EXAMPLE USE CASES

While the future use cases for the technology are varied, ranging from helping to produce new compounds, drugs, materials and vaccines on demand and much more, at very low cost, today's use cases include the ability to grow food, such as steak and turkey meat, and culture algae and microbes that produce alternative, green fuels.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade the technology will continue to mature, and it will be easier for organisations to separate out and refine the products they create. However, while, in part, advances in the field will rely on improvements in the individual processes and components, including membranes, pumps and sensors, that underpin it, the main advances, and therefore interest, in the sector, will be driven by developments in Gene Editing whose contributions will help organisations create a wealth of new products. As a consequence I expect the investment in the field, and the ecosystem, to grow at an incremental rate until 2025 after which it will accelerate.

While Bioreactors are still in the ascending phase one day it is highly likely that they will be replaced, and complimented by, new Bio-Manufacturing and Molecular Assembler technologies.

MATTHEW'S RECOMMENDATION

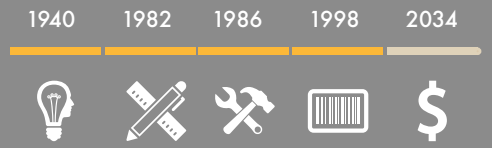
Bioreactors are a highly disruptive technology that has already been productised, albeit at an early stage. Companies should perform a thorough assessment of its medium to long term impact on their business and experiment with it, as appropriate.

15 SECOND SUMMARY

STARBURST APPEARANCES: : '17, '18, '19, '20, '21, '22, '23, '24

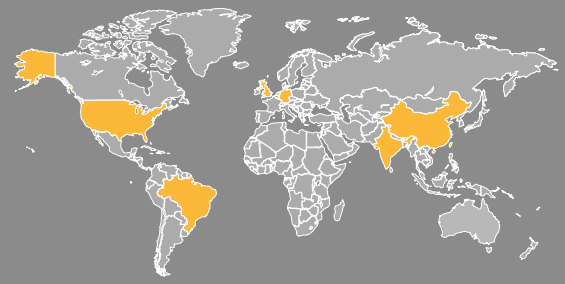
IMPACT

STATUS



Accessibility	3
Affordability	4
Competition	3
Demonstration	6
Desirability	7
Investment	3
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



5 MRL /9

5 TRL /9

7 /10

MOLECULAR ASSEMBLERS

MOLECULAR ASSEMBLERS are increasingly becoming science fact. Originally concieved over four decades ago it has taken time to get to the point where we finally have the basic technological building blocks to create basic, working prototypes that use natural and mechanical engineering principles to manipulate and assemble objects and matter at a molecular level. And as organisations see the potential of the, admitedly, still specialist technology, and the promise of being able to create anything on demand from just basic chemical building blocks, whether it's a new organic lifeform or product, or a highly complex electro-mechanical product, ostensibly out of thin air, it is no surprise that Molecular Assemblers are increasingly being seen as the ultimate manufacturing platform.

DEFINITION

Molecular Assemblers are machines that can build virtually any molecular structure or product from simpler building blocks.

EXAMPLE USE CASES

While the future use cases for the technology are, arguably, limitless, ranging from helping to manufacture everything from complex electronics, such as drones and rocket engines, to everyday items, and everything in between, today's use cases are restricted to manufacturing basic compounds, drugs and very basic drones and robots.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade our ability to create and manipulate nanoscale organic and non-organic machinary and processes that can be used to assemble products at the molecular level will continue to advance and, initially, it is my expectation that we will see a slow, incremental rise in the amount of investment and the size of the ecosystem.

While Molecular Assemblers are still at the concept and early prototype stage, at this point in time the only technology that I can see replacing them is Atomic Assemblers, and the first prototypes of those is still decades away.

MATTHEW'S RECOMMENDATION

Molecular Assemblers are a highly disruptive technology but they are still in the concept and early prototype stage. As a result, in the short and medium term, I suggest companies put it onto their radars and keep an eye on it.

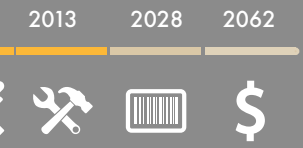
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: : '17, '18, '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	1
Affordability	2
Competition	1
Demonstration	3
Desirability	9
Investment	2
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

8 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

MULTI-MATERIAL 3D PRINTING

MULTI-MATERIAL 3D Printing, which is in the Prototype Stage, is the field of research concerned with developing new ways to 3D Print complex multi-material products that, because of the properties of the technology, will be able to assume complex behaviours that wouldn't otherwise be possible using traditional manufacturing techniques. recent breakthroughs in the space include the 3D Printing of multi-material Soft Robots and other objects.

DEFINITION

Multi Material 3D Printing is an additive manufacturing technology that prints complex multi-material products.

EXAMPLE USE CASES

Today we are using Multi-Material 3D Printing to print small scale multi-material objects such as Soft Robots and basic components. In the future the primary use case of the technology will be all encompassing and include the ability to print any dynamic or static object, whether it is made out of hybrid, non-organic, or organic materials, simple or complex. In short this will be one of the dominant manufacturing technologies of the future.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a low base, primarily led by organisations in the Consumer Electronics and Manufacturing sectors, with support from univesity grants. In time we will see the technology mature to the point where it is one of the defacto manufacturing technologies of the era.

While Multi-Material 3D Printing is in the Prototype Stage, over the long term it will be enhanced by advances in 3D Bio-Printing, 3D Printing, 4D Bio-Printing, 4D Printing, and Materials, and one day it will likely be replaced by Molecular Assemblers.

MATTHEW'S RECOMMENDATION

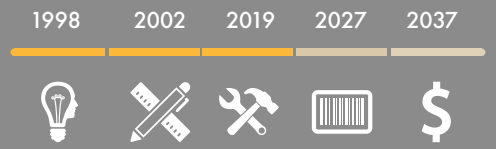
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20

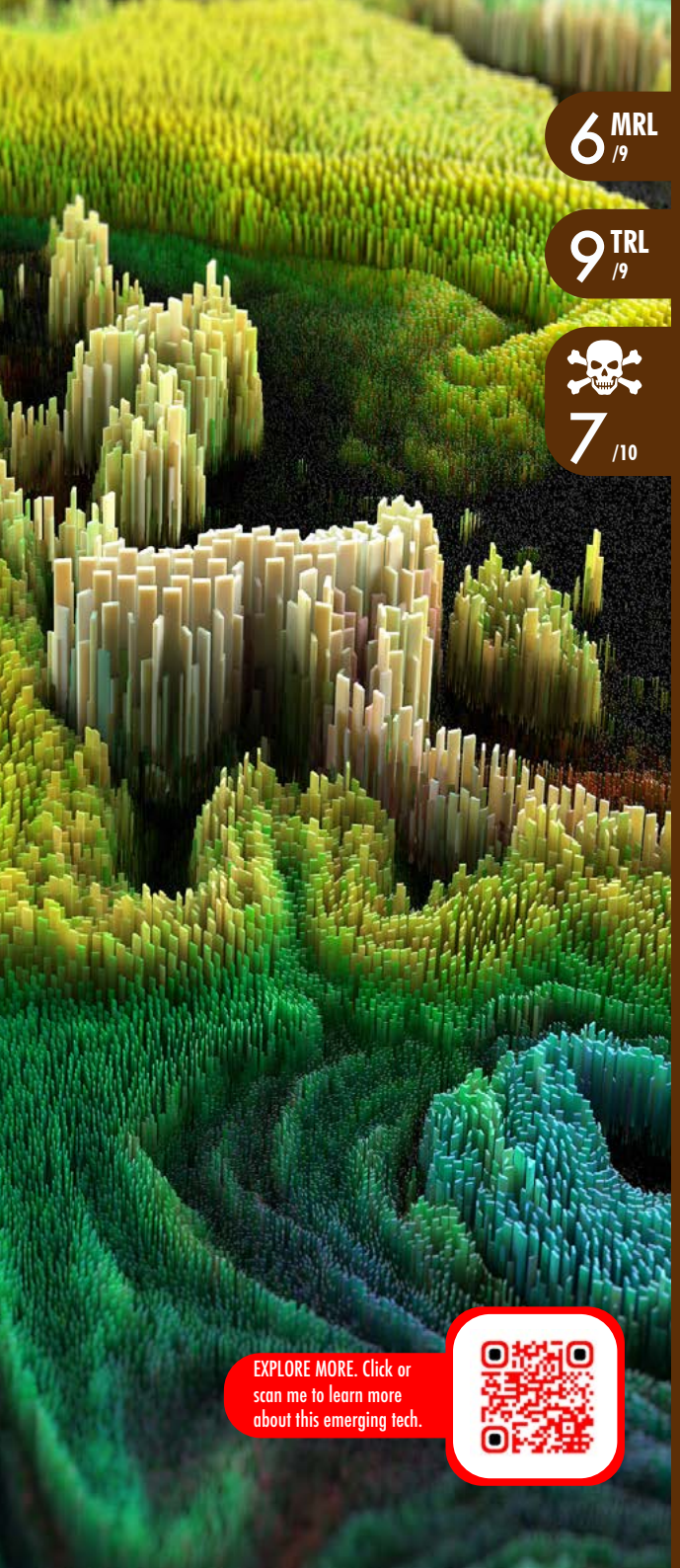
IMPACT

STATUS



Accessibility	4
Affordability	4
Competition	7
Demonstration	6
Desirability	9
Investment	4
Regulation	1
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



NANO-MANUFACTURING

NANO-MANUFACTURING has been on the ascent for the past four decades but its progress was hampered by a lack of expertise and commercially available specialist equipment that could accurately construct products at a scale of a billionth of a meter, a nanometer. However, all of this has changed significantly over the past five years and now companies across all industries are experimenting and bringing nano-manufactured products to market.

DEFINITION

Nano-Manufacturing is both the production of nanoscale products and materials, and the bottom up or top down manufacture of macroscale products using Nano-Manufacturing tools and techniques.

EXAMPLE USE CASES

While the future use cases for the technology are varied, ranging from being able to replace harmful fats and sugars in everday foods with healthier nano-manufactured alternatives to creating new brain-machine interfaces, nanoscale computing platforms and nanobots that explore and repair our bodies, today's use cases include creating new anti-venoms and commercial packaging, and manufacturing new materials and nanoceramics that can be used to boost the power efficiency of nuclear reactors, protect drones from laser attack, and manufacture new healthcare products, high performance clothing, running tracks, and much more.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade the technology will continue to progress and mature at an accelerating rate, and the number of use cases will continue to grow at an almost exponential rate. As a consequence, as the accessibility and affordability of the technology continues to improve, and as regulators increasingly green light its use, the global ecosystem will continue to expand and grow, and the adoption of the technology will continue to accelerate.

While Nano-Manufacturing technology is still in the ascending phase one day it is highly likely that it will be replaced, and complimented by new Atomic Manufacturing, Bio-Manufacturing and Molecular Assembler technologies.

MATTHEW'S RECOMMENDATION

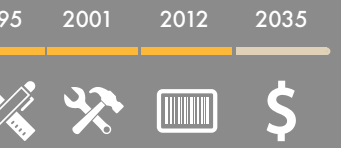
Nano-Manufacturing is a highly disruptive technology that has already been productised. Companies should perform a thorough assessment of its medium to long term impact on their business and experiment with it, as appropriate.

15 SECOND SUMMARY

STARBURST APPEARANCES: : '17, '18, '19, '20, '21, '22, '23, '24

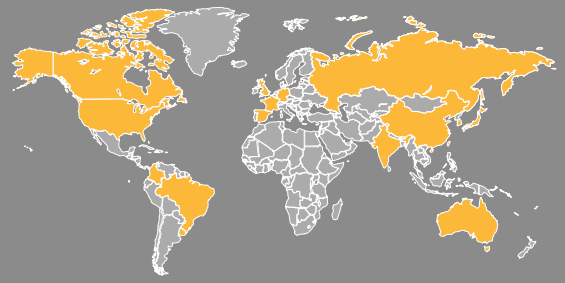
IMPACT

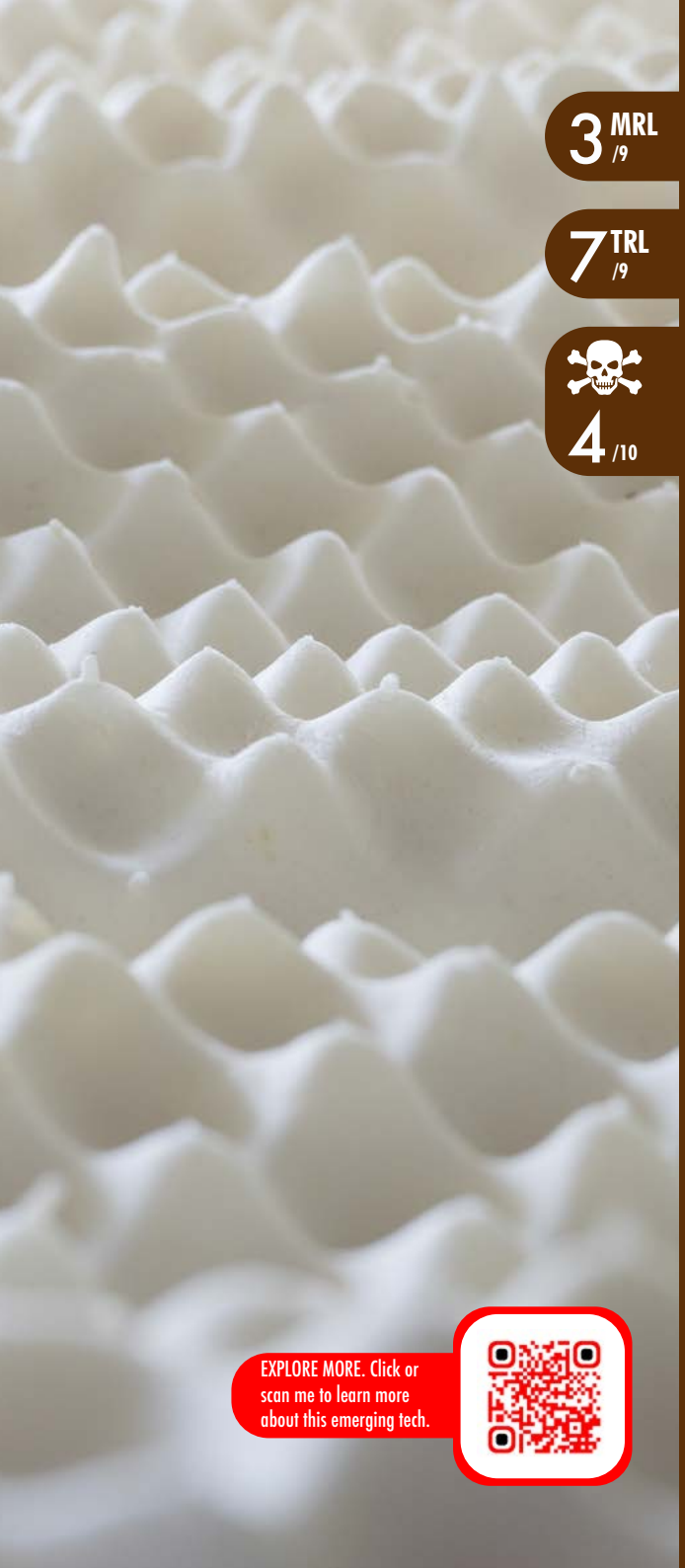
STATUS



Accessibility	5
Affordability	5
Competition	4
Demonstration	8
Desirability	8
Investment	5
Regulation	4
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





3 MRL /9

7 TRL /9

4 /10

RAPID LIQUID PRINTING

RAPID LIQUID Printing is a relatively new emerging technology and it is a twist on existing 3D Printing tools and techniques. Unlike 3D Printing that creates products by printing them in layers Rapid Liquid Printing printers draw and create products in a supportive, gel filled 3D space. When the technology is more mature it could not only supplant 3D Printing for some use cases, for example, where 3D Printers rely on scaffolds to create delicate, or flexible, products, such as implanted healthcare devices, but also make today's injection moulding and casting techniques obsolete.

DEFINITION

Rapid Liquid Printing is a production technique that uses a supportive, gel filled 3D space to create products and devices.

EXAMPLE USE CASES

While the future use cases for the technology are varied, ranging from being able to create everything from delicate and soft medical devices and implants, to soft robots, today's use cases are more limited to making experimental objects and furniture.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade it is likely that the interest in the technology, particularly in the healthcare and robotics sectors, will continue to accelerate, but as it is coming off of a small, relatively nuclear base its rise will be incremental.

While Rapid Liquid Printing technology is still in the ascending phase one day it is highly likely that it will be replaced, and complimented by, new Bio-Manufacturing and Molecular Assembler technologies.

MATTHEW'S RECOMMENDATION

Rapid Liquid Printing is a moderately disruptive technology that it is still in the concept and early prototype stage. As a result, in the short to medium term, I suggest companies put it onto their radars and keep an eye on it.

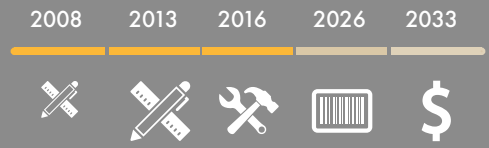
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: : '17, '18

IMPACT

STATUS



Accessibility	1
Affordability	4
Competition	4
Demonstration	7
Desirability	8
Investment	2
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

5 MRL /9

7 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SPACE BASED MANUFACTURING

SPACE BASED MANUFACTURING is starting to take shape as advances in multiple categories, from robotics to reusable launch systems, help democratise and lower the cost of accessing space by over a hundred fold, and make it increasingly possible to build small scale, fully autonomous factory platforms. First conceived of in the 1960's there are now a small number of private organisations that are opening up this new frontier and making it a reality.

DEFINITION

Space manufacturing is the production of manufactured goods in an environment outside a planetary atmosphere.

EXAMPLE USE CASES

While almost everything could be, and perhaps one day will be, made in space, whether it is for on Earth of off Earth colonies in the here and now companies are exploring manufacturing new drugs and new materials in zero gravity environments.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade there will be a marked increase, from a low base, of companies offering space based manufacturing capabilities, but for now the products they will manufacture on these platforms will be for specific niche requirements and expensive.

While Space Based Manufacturing is still in the ascending phase it is highly unlikely to be superseded, simply complimented by new Advanced Manufacturing technologies, and improved automated and robotic fabrication techniques.

MATTHEW'S RECOMMENDATION

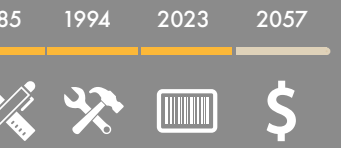
While certain aspects of space based manufacturing are revolutionary, in terms of the novel products that can be manufactured in this way, it is a long way from becoming a main stream technology. As a result, in the short and medium term, I suggest companies put it onto their radars and keep an eye on developments in the space.

15 SECOND SUMMARY

STARBURST APPEARANCES: : '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	2
Affordability	1
Competition	3
Demonstration	3
Desirability	5
Investment	2
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

2 MRL /9

4 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

XOLOGRAPHIC 3D PRINTING

XOLOGRAPHIC 3D PRINTING, which is in the early Prototype Stage, is the field of research concerned with trying to use 3D volumetric printing technologies and techniques to create simple machines with moving parts today, and increasingly complex and sophisticated machines tomorrow - of various scales - that can be printed in one session without the need for any form of post assembly. Recently there have been a number of breakthroughs in the field, most of which are thanks to the development of new gelatinous and liquid printing materials, which have allowed researchers to 3D print basic functional machines, complete with working moving mechanical-like components down to a scale of just 25 microns wide, that have a variety of applications.

DEFINITION

Xolographic 3D Printing is the use of light beams of different wavelengths to induce local polymerisation inside a confined monomer volume.

EXAMPLE USE CASES

An off shoot of 3D Volumetric Printing this technology is still nascent, but nonetheless it has a lot of promise. In time it will be used to create all manner of complex Micro-Machines and Nano-Machines, as well as different robotics systems and individual modular components, of all manner of scales. As a result you can think of it as a way to 3D print working machines and products with integrated and interdependent parts - especially mechanical parts - that can be manufactured in one session without the need for any post assembly.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, albeit from a very low base, primarily led by organisations in the Manufacturing sector. In time it is likely that we will see Xolographic 3D Printing become one of the primary ways to create products with intricate working components, however it is likely that they will be smaller products for the foreseeable future which can leverage the technologies unique abilities.

While Xolographic 3D Printing is in the early Prototype Stage, over the long term it will be enhanced by advances in 3D Volumetric Printing, Artificial Intelligence, and Materials, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

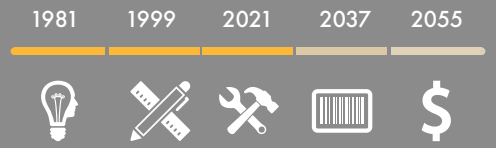
Xolographic 3D Printing is a technology with high disruptive potential but it is still in the early prototype stage. As a result, in the short and medium term, I suggest companies put it onto their radars and keep an eye on it.

15 SECOND SUMMARY

STARBURST APPEARANCES: '22

IMPACT

STATUS



Accessibility	3
Affordability	4
Competition	3
Demonstration	6
Desirability	8
Investment	2
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

BIOTECH

LIFE, BUT not as we know it. Today we are conditioned and educated to believe that life exists in one form - biological. And that it is based on the same genetic building blocks that gave birth to the first ever life on Earth, and every other organism that's ever existed - including us. But as we continue to unravel life's secrets and find new ways to harness life's universal code for our own ends we are now creating a range of entireley new biotech based computing platforms, intelligences, and life forms - alien life forms - based on six and eight base pair synthetic DNA, not four, with non-organic and organic components that give these new systems capabilities and properties that go far beyond anything our imaginations have been able to comprehend thus far.

In this section you will find details of the emerging technologies that made it into this years Griffin Emerging Technology Starburst along with details of other impactful emerging technologies:

1. Anti-Ageing Drugs
2. Artificial Body Parts
3. Bio-Electronic Medicine
4. Bio-Hybrid Organs
5. CAR-T Cell Therapy
6. Cellular Recorders
7. Chimeras
8. Chromosome Engineering
9. Contagious Vaccines
10. CRISPR Gene Editing
11. Cryogenics
12. Electrogenetics
13. Gene Drives
14. Genetic Firewalls
15. Genetic Kill Switches
16. High Resolution fMRI
17. Human Hybrid Immune Systems
18. In Vivo Gene Therapy
19. Inhalable RNA Therapy
20. Injectable Neuroprosthetics
21. Labs on Chips
22. Living Pharmacies
23. Magnetic Wormholes
24. Mechano-Genetic Stimulation
25. Medical Tricorders
26. Memory Editing
27. Nano-Medicine
28. Neuro-Prosthetics
29. Neurology
30. Organoids
31. Personalised Medicine
32. Phage Therapy
33. Predictive Vaccines
34. Rapid Gene Sequencing
35. Regenerative Medicine
36. Resurrection
37. Self-Deleting DNA
38. Semi-Synthetic Cells
39. Smart Drugs
40. Smart Medicines
41. Stem Cell Technology
42. Synthetic Blood
43. Synthetic Cells
44. Synthetic DNA
45. Synthetic Lifeforms
46. Synthetic Proteins
47. Tissue Engineering
48. Tissue Nanotransfection
49. Xenotransplantation

In addition to these emerging technologies there are many others that have yet to get an entry in this codex. These include, but are not limited to:

50. Liquid Biopsy
51. Living Bio-Therapeutics
52. Microbiome Medicine
53. Molecular Diagnostics
54. Nano-Bionic Plants
55. Nano-Particles
56. Neural Hacking
57. Neuro-Bio Feedback
58. Neuro-Electrical Stimulation
59. Neuroimaging
60. Optogenetics
61. Organ Printing
62. Personal Genetic Sequencing
63. Programmable Organisms
64. Quantum Biology
65. Reverse Vaccines
66. RNA Based Therapeutics
67. Semi-Synthetic Organisms
68. Sensolytics
69. Sonogenetics
70. Synthetic Anti-Bodies
71. Synthetic Molecules
72. Synthetic Organisms
73. Synthetic Stem Cells
74. Transcranial Magnetic Stimulation
75. Transgenic Species
76. Transgenics
77. Universal Organs
78. Wetware Feedback

3 MRL /9

4 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ANTI-AGEING DRUGS

ANTI-AGEING DRUGS have long been positioned as the modern equivalents of the Fountain of Youth, but so far decoding the intricate and often ellusive mysteries of the human ageing process and all of the factors that contribute to it has been at best difficult. That said though over the past five years there have been what many people regard as significant progress in the field in the areas of understanding cellular communication and cell death, as well as Epigenetics, genetics, mitochondrial science and Stem Cell research. The result of all this progress now means that there are a small number of promising Anti-Ageing Drugs headed to human trials, which in lab conditions have been shown to extend the lifespans of rodents by 30 percent or more.

DEFINITION

Anti-Ageing Drugs are drugs and treatments that can halt or reverse the ageing process.

EXAMPLE USE CASES

While the technology has applications within all manner of sectors obviously its primary use case will be to reduce the mental and biological age within humans, and in time lead to the development of Age as a Service.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade, as the sector gains more attention and focus, it's likely that we will see fundning and investment levels increase, and the introduction of increasingly powerful technologies and tools, such as Artificial Intelligence, Gene Editing and Therapies, and Stem Cell Technology make a significant difference to the rate of progress in the space. However, until ageing is classified as a disease researchers ability to bring any significant game changing treatments to market will be significantly hindered.

While Anti-Ageing Drugs are still predominantly in the Prototype Stage it is currently unclear whether anything, asides from Avatars, Memory Transfer, and Robot technologies could replace them as a way to "Re-Juvinate" people.

MATTHEW'S RECOMMENDATION

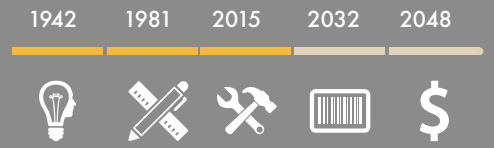
Anti-Ageing Drugs are a highly disruptive technology, not just because of their possible impact on human longevity, but also because of the wider implications on society, but the technology is still primarily in the Prototype Stage. In the short and medium term, I suggest companies put it onto their radars and keep an eye on it.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	2
Demonstration	4
Desirability	8
Investment	3
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

ARTIFICIAL BODY PARTS

ARTIFICIAL BODY PARTS have long promised to help improve the quality of life for patients, and significantly extend lifespans. However, up until recently, understanding how to fabricate functional artificial human body parts, whether those are synthetic or organic, that mimic and replace the real thing, has been a difficult issue to overcome. Fortunately though as those barriers continue to fall the uptick in the number of new advanced manufacturing technologies, in particular 3D Bio-Printing and Stem Cell Technology, that are now coming through, have been of great help in helping scientists create the first prototypes and products that now include a wide range of replacement body parts including blood vessels, bone, cartilage, corneas, skin, and teeth, and brain, heart, kidney, liver, nerve and spinal tissue.

DEFINITION

Artificial body parts restore specific functions or groups of functions in the body by replacing a natural organ with a manmade replacement.

EXAMPLE USE CASES

The primary use case for Artificial Body Parts is to help improve the quality of life, and extend the lives of patients. Today these products are being used in hospitals to replace damaged and diseased bones and tissues, including heart and skin tissue, as well as teeth, but in time the range of approved, regulated products will increase.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade progress in the space will continue to accelerate, the breadth of products available will increase, and the more basic of those products will become commercialised. As investment and interest in the space continues to grow, and as the technologies involved in making these products become better understood and more capable, and as human trials progress and regulators begin developing a deeper point of view, it is highly likely that Artificial Body Parts will begin to slowly experience more widespread adoption.

While the technology is still primarily in the prototype stage over time these artificial body parts will eventually become enhanced with other technologies, in time being combined with both inorganic components, such as electronics, as well as more sophisticated genetically engineered products.

MATTHEW'S RECOMMENDATION

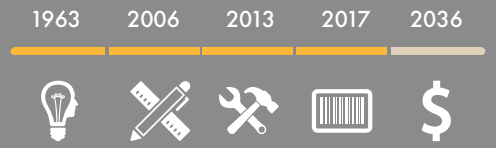
Artificial Body Parts are a disruptive technology that is still largely in the prototype stage. As a result, in the short to medium term, I suggest companies put it on their radars and begin examining, and where appropriate, experimenting with the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '19, '20

IMPACT

STATUS



Accessibility	3
Affordability	3
Competition	3
Demonstration	5
Desirability	8
Investment	4
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

4 MRL /9

8 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

BIO-ELECTRONIC MEDICINE

BIO-ELECTRONIC MEDICINE, which is still largely in the Prototype Stage and early Productisation Stage, is the field of medicine concerned with trying to understand how Bio-Electronic signals affect and influence chronic conditions, disease and disease factors within the human body. As the body of research increases it is becomming clear that human health is heavily influenced by the trillions of Bio-Electronic signals that regulate everything from brain activity and breathing, to the mechanics underpinning cellular and intra-cellular communication, and the behaviours of bacteria and viruses.

DEFINITION

Bioelectronic Medicines and treatments include drugs and implanted medical devices capable of deciphering and modulating bio-electrical signals in order to achieve specific therapeutic effects.

EXAMPLE USE CASES

Today we are using Bio-Electronic Medicine to turn bacteria "on and off," and turn them into in vivo drug factories, help frogs re-grow severed limbs, modulate neurological disorders and manage chronic pain, and alter the Bio-Electronic signals that control human organ function in order to change their function, and kick start them back into life.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the space will continue to accelerate, and while investment and interest in the space is growing it is a very expensive, and complex field of study. As a result it is highly likely that the bulk of the work in the field will be orientated towards research, and that the flow of new products arriving on the market will at first be a trickle.

While Bio-Electronic Medicine is still largely in the Prototype Stage and early Productisation Stage, over the long term it is likely that it could be enhanced and replaced by new advances in CRISPR Gene Editing and In Vivo Gene Therapy, Nano-Medicine, and Stem Cell Technology.

MATTHEW'S RECOMMENDATION

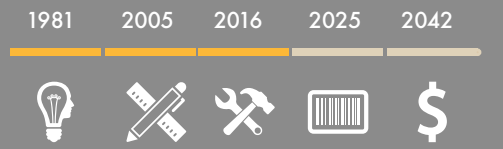
In the short to medium term, I suggest companies put the technology on their radars, explore the field, and establish a point of view.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '22, '23, '24

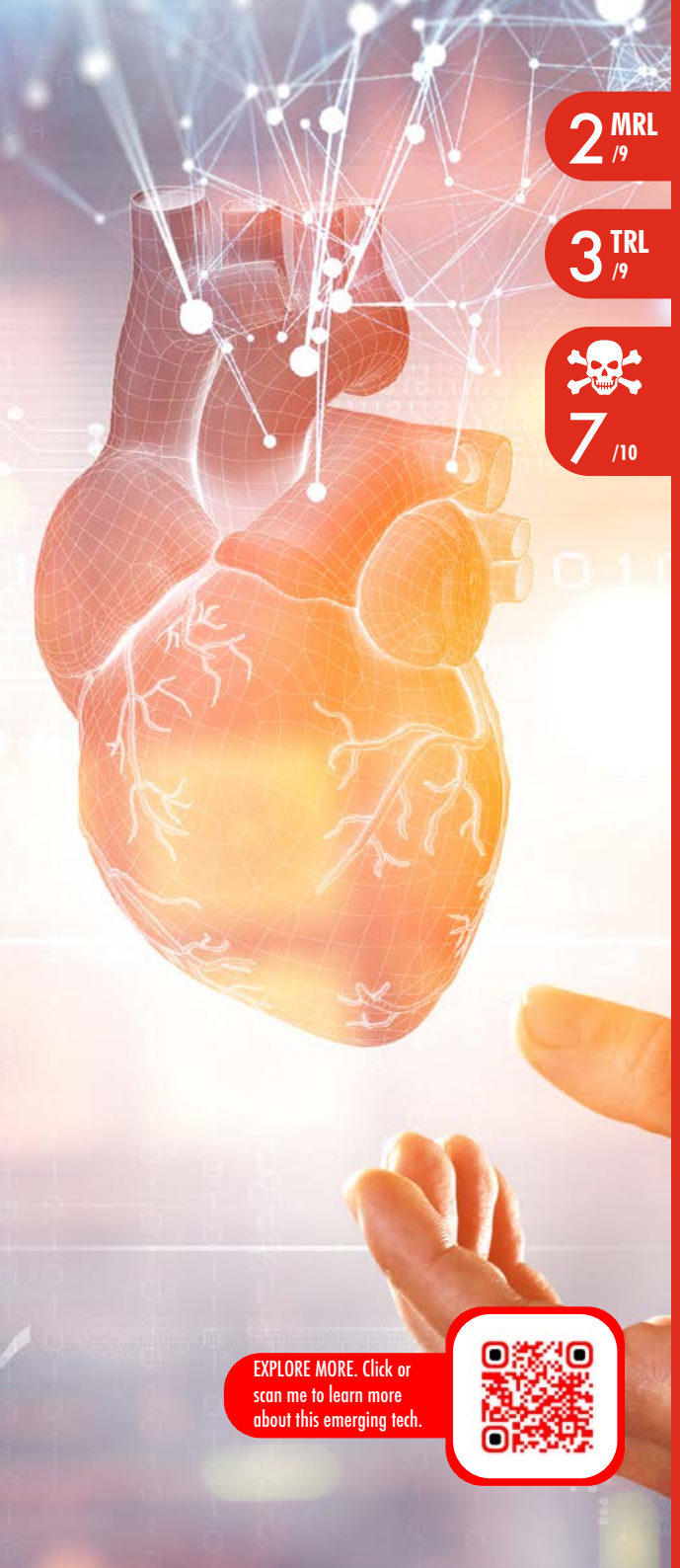
IMPACT

STATUS



Accessibility	3
Affordability	3
Competition	2
Demonstration	5
Desirability	7
Investment	5
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



2 MRL /9

3 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

BIO-HYBRID ORGANS

BIO-HYBRID ORGANS, which are in the Prototype Stage, is the field of research involved with designing and developing hybrid human organs that contain both organic and non-organic elements. Unlike natural organs Bio-hybrid organs can be genetically engineered to be superior to traditional organs, grown or printed, and can be embedded with compute and other electronic components to make them smart. While breakthroughs in the field have been slow so far there has been very notable progress on multiple fronts, including 3D and 4D Bio-Printing, as well as the development of Flexible and Printed Electronics, all of which have allowed researchers in the field to develop the first working prototypes.

DEFINITION

Bio-Hybrid Organs are human or non-human organs, with or without embedded electronics and intelligence, that are part organic and part non-organic.

EXAMPLE USE CASES

Today patients have to wait for replacement donor organs and while Bio-Printing will let institutions print replacement organs on demand being able to design and manufacture smart and sophisticated hybrid organs that are capable of self-diagnosis, self-monitoring, and even self-repair in the event of an issue, is a very attractive proposition with obvious upsides for everyone involved.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Healthcare and Manufacturing sectors, with support from government funding and university grants. In time we will see the products become faster and easier to produce, which will then spur a new innovation arms race as researchers compete to create organs that are increasingly capable and sophisticated, and, most importantly, that never fail.

While Bio-Hybrid Organs are in the Prototype Stage, over the long term they will be enhanced by advances in Advanced Manufacturing, including 3D and 4d Bio-Printing, as well as by advances in Biotech, including Genetic Engineering, Stem Cells and Synthetic Cells, as well as in Compute, Electronics, Intelligence, and Sensor Technologies. In time I expect them to become fully synthetic hybrid organs, and expect that they will have to compete will fully artificial non-organic organs.

MATTHEW'S RECOMMENDATION

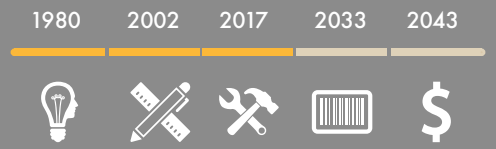
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '21, '22, '23, '24

IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	2
Demonstration	6
Desirability	9
Investment	2
Regulation	1
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

5 MRL /9

9 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

CAR-T CELL THERAPY

CAR-T CELL THERAPY, which is in the Prototype Stage and early Productisation Stage, is the field of research concerned with finding new ways to enhance the human immune system by using different technologies and techniques to augment and engineer it, thereby giving it the non-natural ability to identify, target, and terminate hitherto difficult or impossible to treat conditions and diseases within the human body in new ways. Recently there have been numerous breathroughs in the space with the most notable being the combination of CRISPR Gene Editing with CAR-T Cell Therapy to create first of a kind personalised Cancer therapies that kill hitherto untreatable Grade 4 Leukemias in children. The continued development of this technology will also play a vital role in the development of a new class of Hybrid Human Immune Systems.

DEFINITION

CAR-T Cell Therapy is a treatment in which patients immune cells are technologically modified to attack cancers and pathogens.

EXAMPLE USE CASES

While CAR-T Cell Therapy is still a nascent technology it's shown incredibly robust results within patients who without it would have otherwise died. At the moment most of the research in this area is focused around the development of new powerful Cancer treatments, including those for blood cancers, lymphomas, and multiple myelomas, but in time it's expected that it will be expanded to treat other hard to treat conditions as well.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will accelerate, primarily led by organisations in the healthcare sector, with support from government funding and university grants. In time we will see CAR-T Cell Therapy commercialise and mature, but despite recent regulatory approvals it's unlikely we will see this technology reach its full potential within the next decade.

While CAR-T Cell Therapy is still in the Prototype Stage and early Productisation Stage it could be enhanced by advances in AI, CRISPR Gene Editing, Hybrid Human Immune Systems, Quantum Computing, and other technologies, however over the long term it could be replaced by Human Hybrid Immune Systems.

MATTHEW'S RECOMMENDATION

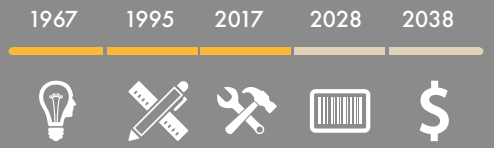
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

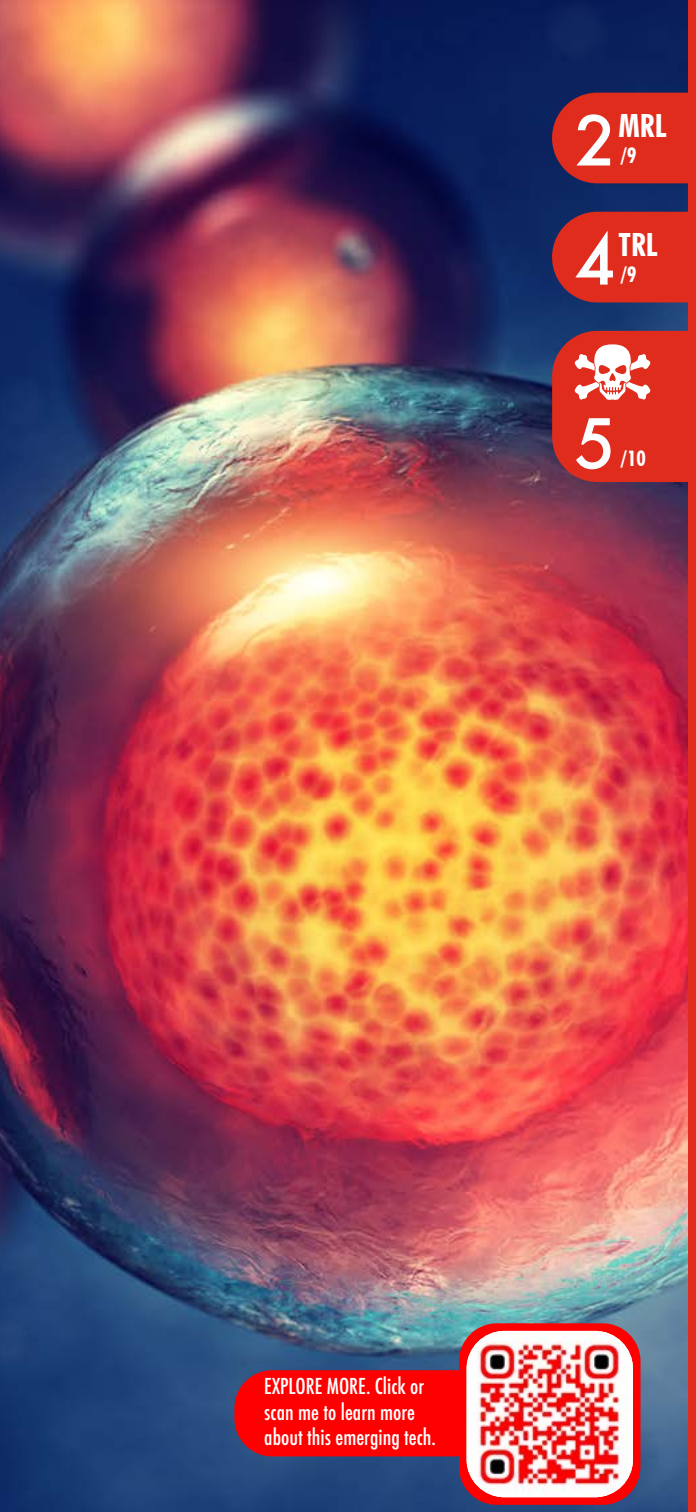
IMPACT

STATUS



Accessibility	6
Affordability	5
Competition	4
Demonstration	7
Desirability	8
Investment	5
Regulation	4
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



2 MRL /9

4 TRL /9

5 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

CELLULAR RECORDERS

CELLULAR RECORDERS, which are in the Prototype Stage, is the field of research concerned with developing new ways to record the individual events that are taking place within living cells. Recent breakthroughs in the field including building the first in vivo DNA recording devices that can chronologically record every single event that transpires within living cells so that researchers have a single source of the truth that they can refer to when trying to discover why a cell, for example, went cancerous.

DEFINITION

Cellular Recorders are intra-cellular DNA based memory devices that can chronologically record individual cellular events within living cells.

EXAMPLE USE CASES

Today we are using Cellular Recorders to mainly identify the individual events that lead up to a cell becoming cancerous in the hope that the insights will be able to help researchers develop new preventitive cancer treatments and vaccines. In the future the primary use of the technology will be to record all of the events taking place within an organism so that the results can be analysed for research purposes.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Healthcare sector. In time we will see the technology mature to the point where it is easy to deliver to in vivo locations, but it is highly likely that the technology will face significant regulatory hurdles before it becomes commercialised.

While Cellular Recorders are in the Prototype Stage, over the long term they will be enhanced by advances in Biological Computing, DNA Computing, Nanobots, Nano-Machines, Semi-Synthetic Cells, Synthetic Cells, Synthetic DNA, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

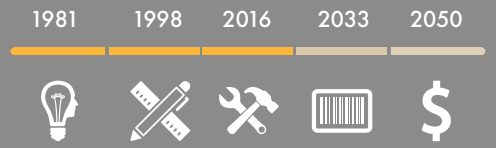
In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20

IMPACT

STATUS



Accessibility	2
Affordability	5
Competition	3
Demonstration	7
Desirability	7
Investment	2
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

5 MRL /9

9 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

CHIMERAS

CHIMERAS, which are in the early Productisation Stage, is the field of research concerned with creating hybrid organisms that are comprised of two or more genetically distinct populations of genetically distinct cells and tissues. Recently there have been a number of breakthroughs in the field with several chimeric organisms being used to grow transplantable and viable human organs. However, while many people associate this technology with animals humans can also be chimeric under certain conditions.

DEFINITION

Chimeras are single organisms comprised of two or more populations of genetically distinct cells and tissues that originate from different organisms.

EXAMPLE USE CASES

While there are a lot of ethical and moral concerns about the development and use of Human-Animal chimeras this technology it is seen by some as providing us with a way to grow human organs on demand, such as Human-Pig hearts and livers, and Human-Mouse Pancreases, and other examples, that can then be used in human transplants and as a tool to solve today's transplant crisis. However, while this is the most common use case another use case that is emerging is Viral Chimeras which might lead to new medical treatments.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, albeit from a low base, primarily led by organisations in the healthcare sector. In time we will see Chimeras become more common place, but given people's ethical concerns it's unlikely that they will ever become mainstream even though they will become increasingly commercialised.

While Chimeras are in the early Productisation Stage, over the long term they will be enhanced by advances in Genetic Engineering, however over the longer term they will likely be replaced by 3D Bio-Printing and Artificial Body Parts.

MATTHEW'S RECOMMENDATION

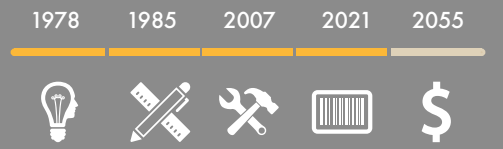
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '22

IMPACT

STATUS



Accessibility	5
Affordability	5
Competition	5
Demonstration	9
Desirability	7
Investment	6
Regulation	7
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

4 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

CHROMOSOME ENGINEERING

CHROMOSOME ENGINEERING, a GENERAL PURPOSE TECHNOLOGY, which is in the early Prototype Stage, is the field of research concerned with trying to edit and modify organisms chromosomes wholesale and is a technology that, in genetic engineering terms, takes us from editing individual genetic sentences to the equivalent of engineering and modifying entire chapters. Recently there have been a number of breakthroughs in the field including researchers use of it to accelerate the "natural biological evolution" of mammals by millions of years in mere months. As a result when mature this technology literally has the potential to change all life as we know it and enable all manner of new cross sector innovations in fields such as Biomanufacturing.

DEFINITION

Chromosome Engineering is the controlled generation and manipulation of chromosomal deletions, inversions, or translocations with defined endpoints to create organisms with new or enhanced characteristics.

EXAMPLE USE CASES

While Chromosome Engineering has been in development for decades its prime use cases have centered around improving the performance and productivity of plants, namely crops, and lower animals. As it develops though increasingly it will be used to create genetically identical human cells, except for the gender of those cells, which can be used as models to further researchers understanding of the different effects that medicines have on men and women. It will also be used to supress populations of pests, such as crop pests and Mosquitos, and perhaps most importantly in the long run enable researchers to accelerate the rate of evolution of biological organisms and systems containing biological components, such as Living Materials, etc, by billions fold.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in this field will accelerate, primarily led by organisations in the healthcare sector. In time we will see the technology commercialise and mature but it will likely face increasingly high regulatory hurdles given its power and potential for both good and bad.

While Chromosome Engineering is still in the early Prototype Stage it could be enhanced by advances in AI, Genetic Firewalls and Kill Switches, Quantum Computing, CRISPR Gene Editing, Synthetic Biology, Synthetic DNA, Synthetic Organisms, and other technologies, however over the long term it's unclear what it could be replaced by.

MATTHEW'S RECOMMENDATION

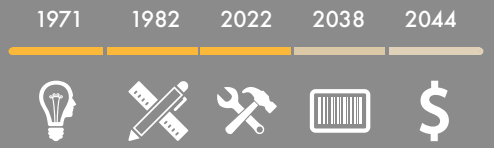
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23, '24

IMPACT

STATUS



Accessibility	3
Affordability	3
Competition	2
Demonstration	7
Desirability	9
Investment	3
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

2 MRL /9

6 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

CONTAGIOUS VACCINES

CONTAGIOUS VACCINES, which are in the Prototype Stage, is the field of research trying to find new ways to rapidly boost the herd immunity of populations to disease. Recently there have been a number of breakthroughs in this field, some of which have been practical and others theoretical. While researchers have managed to create self-spreading vaccines using recombinant viruses that target the Ebola and Lassa viruses most research groups are now working on developing patent-pending genetic safeguards that allow them to control the number of times the vaccine can multiply - thereby limiting its lifetime. Meanwhile, on the theoretical side of things algorithmic models have shown that contagious vaccines could reduce Lassa viruses by 95% in rodents in less than a year.

DEFINITION

Contagious Vaccines are vaccines capable of replicating in a hosts body and spreading to others without active intervention.

EXAMPLE USE CASES

While there's little doubt Contagious Vaccines could put a quick end to epidemics and pandemics due to concerns about biosecurity, ethics, informed consent, and regulation, it's unlikely that they will ever be used in human populations. However, that said one of their primary use cases could be to control damaging livestock disease outbreaks - many of which like Bird Flu and Swine Flu are on the rise.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate albeit from a very low base, predominantly led by the Healthcare sector, and government grants. While the idea of contagious vaccines is very attractive, especially when it comes to their ability to quickly contain and quash disease outbreaks, unsurprisingly the biggest hurdle to bringing them to market is due to understandable regulator nervousness, the lack of guarantees about their spread and the risk of bio-contagion, and the seemingly unsurmountable ethical hurdles. That said though the research continues, but without meaningful real world trials and stakeholder engagement it may well be consigned to stay in the shadows.

While Contagious Vaccines are still in the Prototype Stage they could be enhanced by advances in AI, CRISPR Gene Editing, Genetic Firewalls and Kill Switches, and other technologies, however over the long term it's unclear what it could be superceded by.

MATTHEW'S RECOMMENDATION

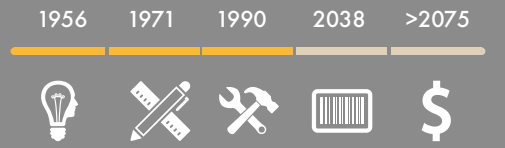
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

IMPACT

STATUS



Accessibility	4
Affordability	4
Competition	2
Demonstration	7
Desirability	7
Investment	2
Regulation	1
Viability	9

, 2020

PRIMARY GLOBAL DEVELOPMENT AREAS

6 MRL /9

9 TRL /9

10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

CRISPR GENE EDITING

CRISPR GENE EDITING, a GENERAL PURPOSE TECHNOLOGY, which is still largely in the Prototype Stage and early Productised Stage, is one of the most powerful and revolutionary gene editing technologies to emerge in the history of the field. As a result over the past few years there has been a literal frenzy of interest and development in the space with new CRISPR Cas-9 and Cas-3 developments that have made the tool even more powerful and easy to use. As interest and investment in all Biotech fields continues to surge, and as we continue to see the early signs of significant advances across the 3D Bio-Printing, Bio-Manufacturing, In Vivo Gene Therapy and Stem Cell Technology fields it is clear that the technology will be potentially one of the most transformitive of our time, on a par with Artificial Intelligence.

DEFINITION

CRISP Gene Editing is the manipulation of the genetic material of a living organism by deleting, replacing, or inserting a DNA sequence.

EXAMPLE USE CASES

In short any use case that in some way involves, or relies on DNA is a potential target for this technology. Today the technology has already been used to create the world's first Cancer Vaccines and perform the world's first human In Vivo Gene Therapy to reverse inherited genetic disorders, as well as create the first designer babies and the first Biological and DNA computing platforms.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the space will continue to accelerate, and investment and interest in the space will continue to grow at a significantly accelerating rate. However, the continued productisation of the technology, along with the products and treatments that is will be used to create, will all continue to be heavily impacted, and inevitably slowed down, by the need for trials and subsequent regulatory approvals.

While CRISPR Gene Editing is still largely in the Prototype Stage and early Productisation Stage, over the long term there are still no viable, alternative technologies to replace it.

MATTHEW'S RECOMMENDATION

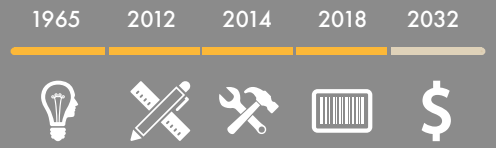
In the short to medium term, I urgently suggest companies put the technology on their radars, explore the field, and establish a point of view.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23, '24

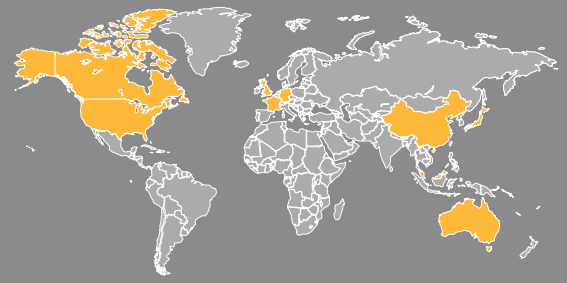
IMPACT

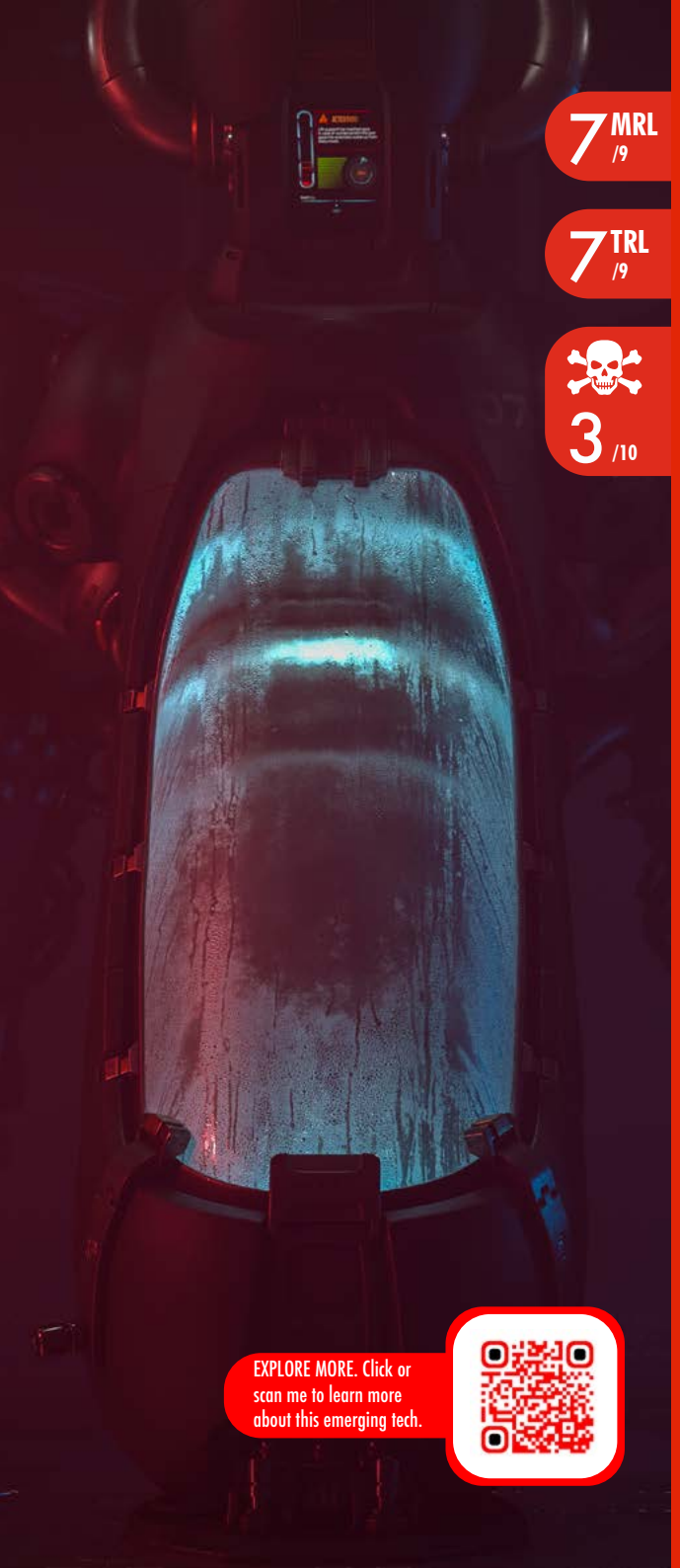
STATUS



Accessibility	4
Affordability	2
Competition	2
Demonstration	7
Desirability	8
Investment	6
Regulation	4
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





7 MRL /9

7 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

CRYOGENICS

CRYOGENICS, which is still largely in the Prototype Stage and very early Productisation Stage, is a science fiction staple. Over recent years advances in the field have been slow but sure as researchers try to piece by piece crack the puzzle of how to freeze and then re-animate living tissues and animals, with an obvious view on one day offering end to end human Cryogenics services rather than the narrow range of freeze only services that they offer today. While investment and interest in the sector grows, but remains marginal still, the eventual hope is that the technology will one day be mature enough to offer consumers a way to "survive death."

DEFINITION

Cryogenics offers the people with degeneritive or terminal conditions the chance to freeze their body in the hopes of coming back to life in the future.

EXAMPLE USE CASES

Today we are using Cryogenics primarily as a way to freeze and store small tissue samples, and experiments on dogs and small animals, and scientists ability to re-animate them after freezing, have been at best questionable.

FUTURE TRAJECTORY AND REPLACABILITY

Over the course of the next decade research in the space will conitnue, with investment and interest growing at a slow to moderate pace. However, while prorgress in the field is slow the research has longevity, and there will always be a market for people wanting to find ways to cheat death.

While Cryogenics is still largely in the Prototype Stage and very early Productisation Stage, over the long term there will be numerous ways to cheat death. These include Cloning people who have died and re-uploading their past experiences using Memory Uploading technologies, new life extending healthcare technologies, as discussed in this Codex, as well as the ability for potential consumers to transfer their living memories into robots and immortal digital Avatars of themselves that persist through the ages.

MATTHEW'S RECOMMENDATION

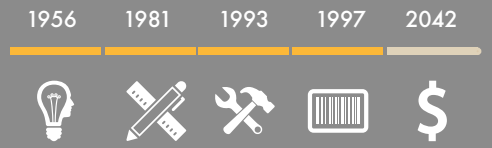
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21

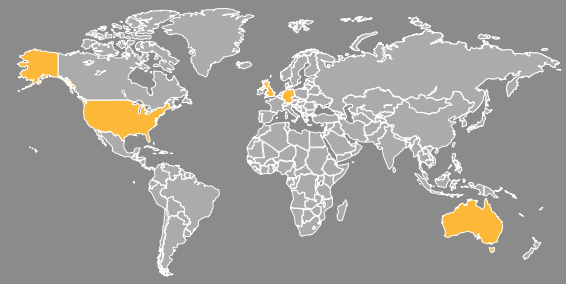
IMPACT

STATUS



Accessibility	4
Affordability	4
Competition	2
Demonstration	7
Desirability	7
Investment	4
Regulation	6
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



1 MRL /9

4 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ELECTROGENETICS

ELECTROGENETICS, which is in the Prototype Stage, is the field of research concerned with trying to activate, alter, and manipulate genes and gene expression using electrical stimuli. A phenomenon first observed in the wild with Electric Eels, whose zaps altered the genetic makeup of the animals they shared their environment with, recently we've seen breakthroughs in this field that include the use of electro-stimulation devices to activate human genes implanted in mice subjects that then went on to produce insulin. And, as sci-fi as this particular technology sounds this first proof of concept could open the door to a whole new chapter in human medicine.

DEFINITION

Electrogenetics is the activation, alteration, and manipulation of genes using electrical stimulii.

EXAMPLE USE CASES

The ability to activate, alter, and manipulate the genes of living organisms with nothing more than a cleverly planned zap from an electro-stimulation device could open up new ways to treat disease, new ways to activate faulty or supressed genes, and will open up a literal Pandora's Box of opportunities.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Electrogenetics increase, albeit form a very low base, primarily led by university grants. As a technology this one is intriguing, not only for the fact that it's possible and exists, but also because over the longer term one day we might be able to control human gene expression with nothing more than a smart watch and an app on our smartphones. While this technology will undoubtedly face many ethical and regulatory challenges at the moment it holds a lot of future promise and potential.

While Electrogenetics is still in the Prototype Stage it could be enhanced by advances in Artificial Intelligence, Bio-Electronic Medicine, CRISPR, Materials, Sensors, Synthetic Biology, and other technologies, however over the long term, although these solutions are less elegant, it could be replaced by alternative genetic technologies such as CRISPR, and Inhalable RNA Therapies to name but two.

MATTHEW'S RECOMMENDATION

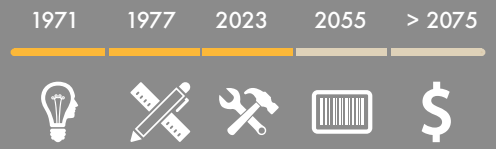
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

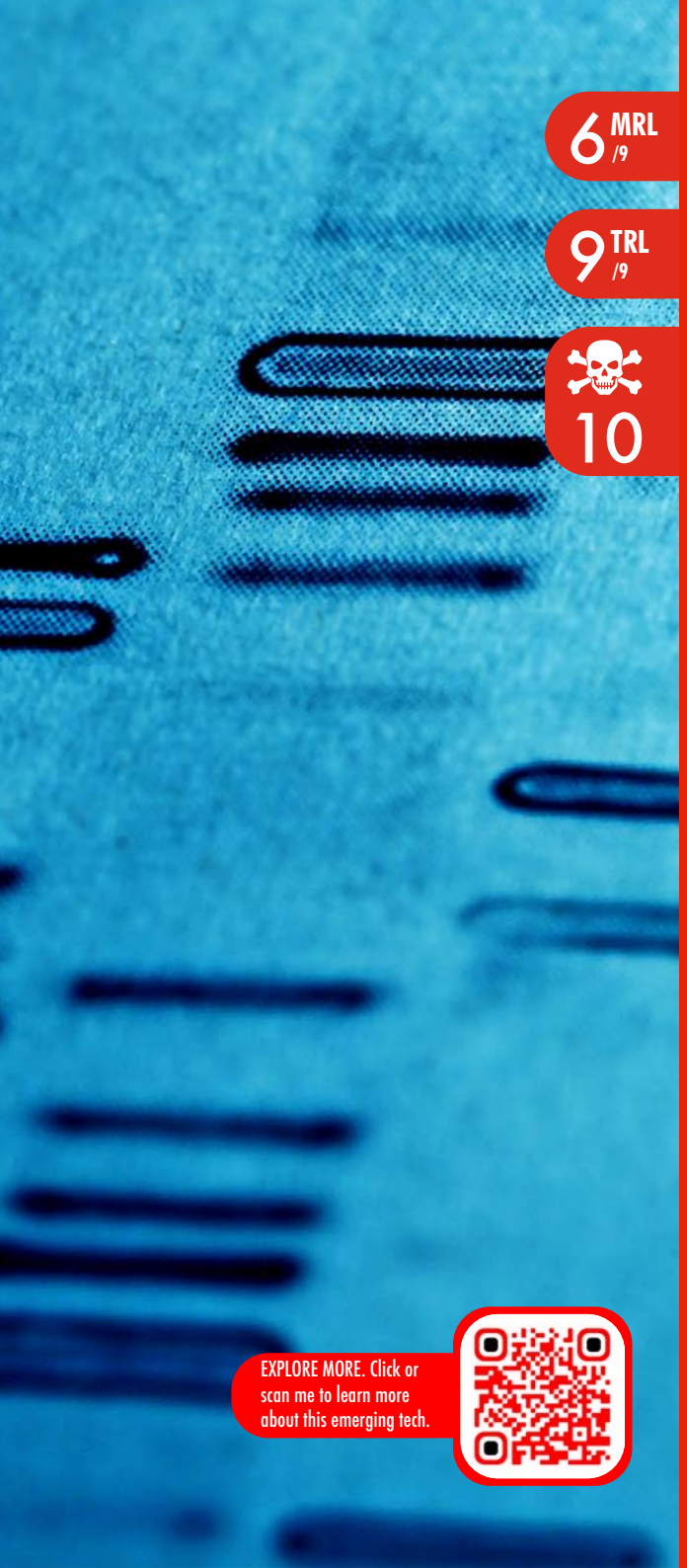
IMPACT

STATUS



Accessibility	2
Affordability	7
Competition	2
Demonstration	7
Desirability	7
Investment	1
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



6 MRL /9

9 TRL /9

10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

GENE DRIVES

GENE DRIVES, which are in the Productisation Stage, are the field of research concerned with developing new ways to pass down genetic modifications, made using gene editing tools such as CAST and CRISPR, to future generations. Recent breakthroughs in the space mean that this technology has now been dubbed the "Extinction Gene" and the most powerful Bio-Weapon in the world according to the United Nations after researchers demonstrated how it could, on the one hand be used with gene editing tools to eliminate genetically inherited diseases from future generations of designer children, and then on the other hand demonstrated in the wild how it can be used to eliminate entire species including mice, mosquitos, and rats.

DEFINITION

Gene Drives are a genetic engineering technology that makes sure specific genes propogate throughout an entire population and are transmitted to all future offspring.

EXAMPLE USE CASES

Today we are combining gene editing tools and gene drives to create designer babies who are not born with their parents inherited genetic conditions, and who don't pass those conditions down to their future descendents, we are also using the technology to eliminate invasive species. In the future the primary use of this technology will be in the healthcare space where it will be used as a tool to create designer humans, for a range of purposes, but it has major implications for any sector or product that has a genetic component to it, from Biological Computing and Biological Electronics through to Bio-Manufacturing and Synthetic Biology.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by organisations in the Healthcare sector. As the technology matures it will face increasing regulatory scrutiny and ethical oversight issues, however, while those would normally be enough to slow the development of a technology down I do not expect that to be the case here.

While Gene Drives are in the Productisation Stage, over the long term they will be enhanced by advances in CAST, CRISPR, Semi-Synthetic Cells, Stem Cells, Synthetic Cells, Synthetic Biology, Synthetic DNA, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

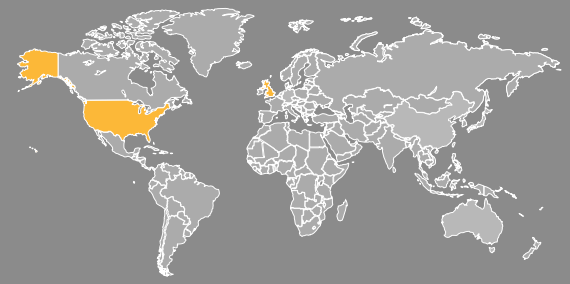
STARBURST APPEARANCES: '20, '21, '22

IMPACT

STATUS

Accessibility	4
Affordability	5
Competition	2
Demonstration	8
Desirability	7
Investment	2
Regulation	4
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

3 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

GENETIC FIREWALLS

GENETIC FIREWALLS, which is in the early Prototype Stage, is the field of research concerned with trying to find new ways to prevent the transfer of genetic material between non genetically modified and Genetically Modified Organisms (GMOs) of all kinds. Recently there have been a few, but not many, breakthroughs in this space including the development of genetic firewalls in genetically engineered bacteria that made them immune to all pathogens on Earth. As synthetic biologists push the envelope of what's possible though and create new GMO's and Synthetic Organisms that are used across sectors, the ability to prevent genetic cross contamination between organisms becomes increasingly important - especially as today we are moving from GMO's in farmers fields and in biomanufacturing facilities to GMO's that biomanufacture medicines within the human body. As a result, any failure to create effective genetic firewalls could have untold consequences.

DEFINITION

Genetic Firewalls are designed to massively reduce or completely block any or all horizontal gene transfers between organisms.

EXAMPLE USE CASES

Today despite best efforts most Genetic Firewalls end up being compromised by the horizontal gene transfer between different hosts because as one movie in particular says "Nature always finds a way." While the technology aims to protect GMO's of all kinds from outside interference its main use cases include being used to prevent lab made GMO's from sharing new genetic traits with wild non-GMO's, as well as preventing bacteria used in the in vivo biomanufacturing of medicines within the human body from being compromised, and many other examples.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in the field accelerate, albeit from a low base, led predominantly by the agricultural, healthcare, and manufacturing sectors. That said though it's capabilities will remain far behind those of the tools and research used to create the GMO's in the first place as regulators also increasingly act as a brake to both.

While Genetic Firewalls are still in the early Prototype Stage it could be enhanced by advances in AI, CRISPR Gene Editing, Synthetic Biology, and other technologies, however over the long term it's unclear what it could be replaced by.

MATTHEW'S RECOMMENDATION

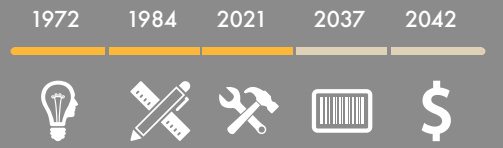
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23

IMPACT

STATUS



Accessibility	3
Affordability	3
Competition	2
Demonstration	5
Desirability	9
Investment	3
Regulation	2
Viability	6

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

3 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

GENETIC KILL SWITCHES

GENETIC KILL SWITCHES, which are still in the early Prototype Stage, is the field of research concerned with developing new methods to terminate Genetically Modified Organisms (GMOs), as well as Synthetic Organisms, on demand when certain criteria are met or when they are subjected to certain stimulii. This field is increasingly crucial as synthetic biologists continue to create GMOs and other non-natural organisms that posess traits and capabilities that could be dangerous in certain environments or situations. Recently breakthroughs include the development of genetically modified microbes that, enabled by genetic circuits that have been designed to sense environmental conditions and respond to them, self-destruct when the temperature around them reaches a particular threshold or when they come into contact with specific chemicals.

DEFINITION

Genetic Kill Switches are genetically engineered systems within organisms that result in cell death under certain conditions.

EXAMPLE USE CASES

Today most use cases center around preventing GMOs with traits that would be detrimental or harmful to other organsisms or ecosystems from replicating or transfering modified genes with other organisms. One example would be to to prevent GMOs altering human cells and destroying society as we know it, while others include the use of this technology to prevent genetically modified mosquitos from transferring infertility genes to other insects, and so on.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate, albeit from a low base, led predominantly by the agricultural, healthcare, and manufacturing sectors. However, as the development of GMOs accelerates this field of research is far far behind where it should be, and regulators so far haven't developed any mandates to protect society from the uninetnded consequences of increasingly powerful and capable GMOs.

While Genetic Kill Switches are still in the early Prototype Stage it could be enhanced by advances in AI, Biological Computing and Electronics, CRISPR Gene Editing, Genetic Firewalls, Quantum Computing, and other technologies, however over the long term it's unclear what it could be replaced by.

MATTHEW'S RECOMMENDATION

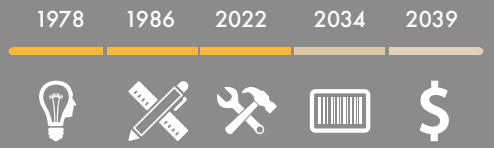
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23

IMPACT

STATUS



Accessibility	3
Affordability	3
Competition	2
Demonstration	6
Desirability	9
Investment	4
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

6 MRL /9

9 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

HIGH RESOLUTION FMRI

HIGH RESOLUTION FMRI, which is now in the Productisation Stage, is an under estimated and powerful technology that is playing a key role in helping researchers unlock the secrets of the human brain by analysing the minute changes in blood flow in the human brain in response to specific stimulii and thoughts. While the technology itself is powerful it is the information it produces, when combined with other technologies, such as Artificial Intelligence and Brain Machine Interfaces, which make it invaluable.

DEFINITION

High Resolution Functional Magnetic Resonance Imaging is a neuroimaging procedure that uses MRI technology to measure brain activity by detecting changes associated with blood flow.

EXAMPLE USE CASES

Today we are using High Resolution fMRI to scan, monitor and analyse the patterns of brain activity in people. While the technology itself is interesting the real magic happens when the outputs are combined with Artificial Intelligence, Brain Machine Interfaces, and Neuroscience, which then give us the power to read people's minds, and live stream their thoughts, from images and movies, to words and sentences, to an array of devices including televisions and the even the internet. Other current use cases also include helping ALS and Locked In patients communicate with loved ones, helping police departments re-construct photo fits, and the development of new neural machine interfaces.

FUTURE TRAJECTORY AND REPLACABILITY

Over the course of the next decade this technology will continue to be refined, improved, and miniaturised, with its resolution being improved by orders of magnitude. As a result this will provide researchers with increasingly detailed and granular information on the inner workings of the human brain which in turn will let them create more accurate brain maps and simulations, and help them further unlock the mysterys of the human brain.

While High Resolution fMRI is now in the Productisation Stage at the moment it is not clear what technologies could replace it.

MATTHEW'S RECOMMENDATION

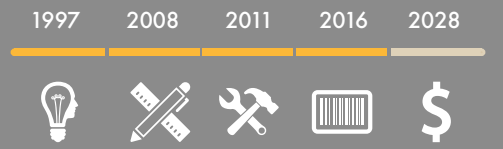
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19

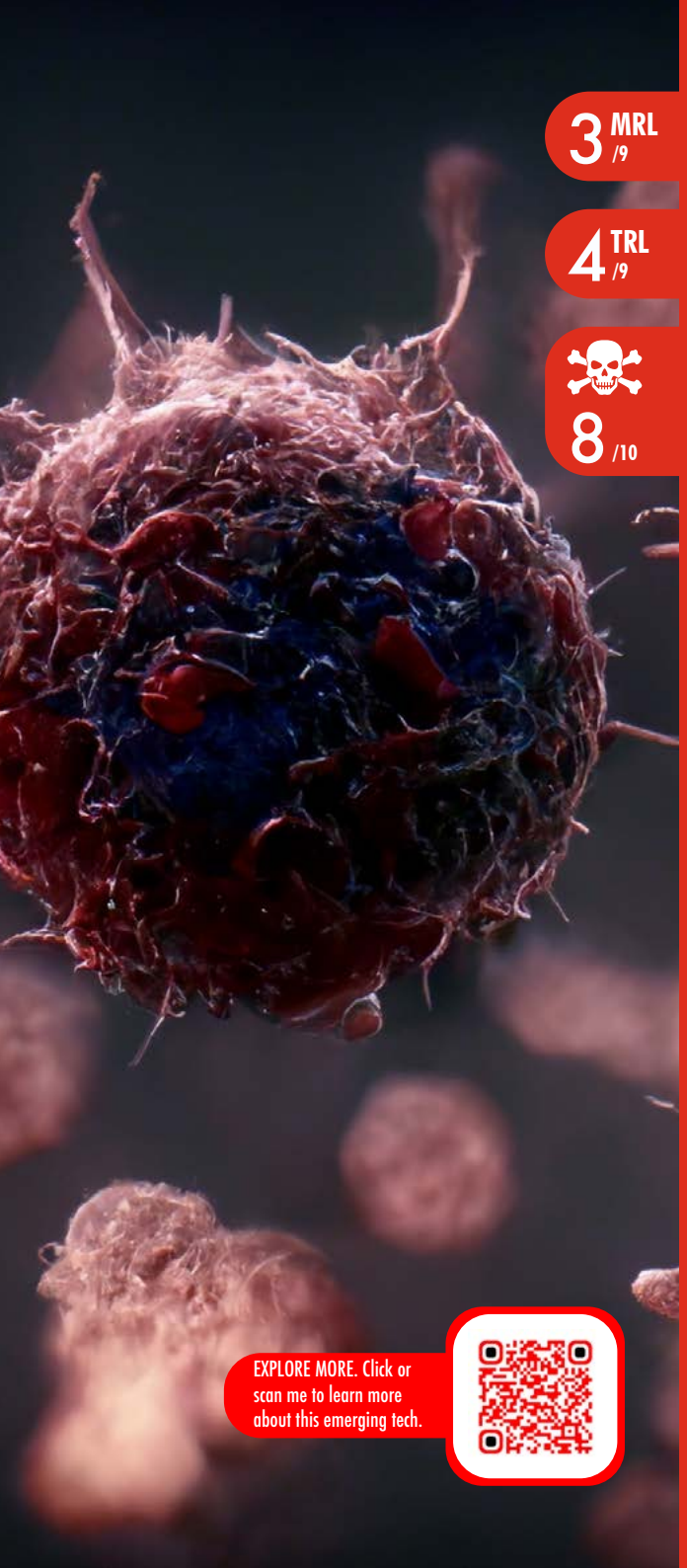
IMPACT

STATUS



Accessibility	7
Affordability	5
Competition	2
Demonstration	8
Desirability	7
Investment	3
Regulation	6
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

4 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

HUMAN HYBRID IMMUNE SYSTEMS

HUMAN HYBRID IMMUNE SYSTEMS, which is in the early Prototype Stage, is the field of research concerned with trying to create non-natural human immune systems that can essentially be "programmed" and embued with new super human capabilities to identify, monitor, and treat disease. Recently there have been a few major breakthroughs in this field including the combining together of CAR-T Cell Therapy treatments with CRISPR Gene Editing to create hybrid human immune systems whose T-Cells were were able to independently identify and destroy specific types of tumors within patients with complete accuracy.

DEFINITION

Human Hybrid Immune Systems are technologically enhanced immune systems that have natural, non-natural, and superhuman-like abilities to fight disease.

EXAMPLE USE CASES

We have all seen how fragile the human immune system really is and despite sci-fi-like technological advances we all saw how during the global pandemic the mutating COVID-19 virus was able to kill more than 10 Million people and infect hundreds of millions more, even with new vaccines. As a result in the long run the primary use case for this technology is to use it to augment everyones immune system with new capabilities and give them the ability to independently identify new and existing diseases on demand and neutralise them before they cause harm.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate, predominantly led by the healthcare sector and government grants. While this technology is proving incredibly powerful its development is likely to be slowed down by regulators concerns and the difficulty associated with running actual human tests to assess the medium and long term risks. That said though creating human immune systems that could mean the end of disease and sickness surely makes this one of the most attractive technologies I track.

While Human Hybrid Immune Systems are still in the early Prototype Stage it could be enhanced by advances in AI, Biological Computing and Electronics, CAR-T Cell Therapy, CRISPR Gene Editing, Quantum Computing, Synthetic Biology, and other technologies, however over the long term it's unclear what it could be replaced by.

MATTHEW'S RECOMMENDATION

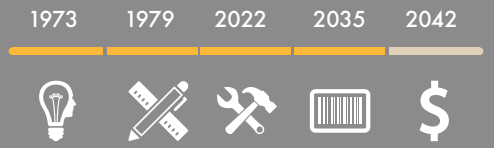
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23, '24

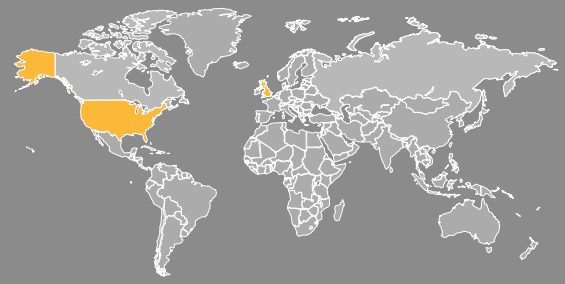
IMPACT

STATUS



Accessibility	2
Affordability	3
Competition	2
Demonstration	7
Desirability	9
Investment	4
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

8 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

IN VIVO GENE THERAPY

IN VIVO GENE THERAPY, which is still largely in the Prototype Stage and very early Productisation Stage, is the almost science fiction like capability of using technology to edit people's genomes in real time to treat, reverse, and cure disease and inherited disorders, and one day to enhance their mental and physical capabilities. Over the past number of years there has been significant progress in the Gene Editing field with the emergence of powerful new technologies such as CRISPR, that when combined with other novel tools and techniques, is increasingly allowing researchers to do the impossible.

DEFINITION

In Vivo Gene Therapy eliminates the need for drugs or surgery by using genetic therapies to treat, reverse and cure disease and inherited disorders.

EXAMPLE USE CASES

Today we are using In Vivo Gene therapy to edit the genomes of patients with life threatening inherited genetic disorders like Hunters Syndrome and cure them. Over time other use cases will involve using the technology to edit the live genomes of any organism, or product, from Bio-Materials to Biological and DNA Computers, that has a biological component.

FUTURE TRAJECTORY AND REPLACABILITY

Over the course of the next decade research in the field will continue to accelerate, and investment and interest will continue to grow at an accelerating rate. However, the eventual wide spread adoption and use of the technology, like all genetic technologies, will continue to be heavily impacted, and inevitably slowed down, by the need for trials and subsequent regulatory approvals.

While In Vivo Gene Therapy is still largely in the Prototype Stage and very early Productisation Stage, at the moment the concept itself does not look like it will be replaced. However, the tools and techniques we use to perform these operations and treatments will change to include the increased use of Semi-Synthetic Cells and Synthetic Cells, Stem Cell Technology, and more accurate and predictable CRISPR Gene Editing technology.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '19, '20, '21, '24

IMPACT

STATUS

Accessibility	2
Affordability	2
Competition	1
Demonstration	6
Desirability	9
Investment	5
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

2 MRL /9

4 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

INHALABLE RNA THERAPY

INHALABLE RNA THERAPY, which is in the Concept Stage and Prototype Stage, is a new and revolutionary type of Gene Therapy that will allow an increasingly wide range of genetic conditions to be treated with inhalers or Nebulisers. While the technology has been discussed and debated for the past couple of decades recent progress in creating the first aerosol based messenger RNA (mRNA) therapy now means that soon the flood gates will open and that more treatments for more conditions will emerge.

DEFINITION

Inhalable RNA Therapies use mRNA in aerosol form to trigger human cells to produce proteins that can be used for the treatment of certain diseases.

EXAMPLE USE CASES

Today there are no commercial products and no products have been trialled in humans, but in lab trials researchers have demonstrated that the technology is a viable way to treat and cure Cystic Fibrosis in humans.

FUTURE TRAJECTORY AND REPLACABILITY

Over the course of the next decade research in the field will stay relatively narrow and niche which will impact its overall rate of development, however, as the technology and its viability improves there will no doubt be an uptick in interest and investment. Before treatments can hit the market though the technology will have to overcome incredibly high regulatory hurdles, meaning that it will likely be decades before we see it available as a commercially available treatment.

While Inhalable RNA Therapy is in the Concept Stage and Prototype Stage, over the long term it could be replaced by a variety of technologies including Bio-Computing, CRISPR Gene Editing, and In Vivo Gene Editing.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23

IMPACT

STATUS

Accessibility	1
Affordability	2
Competition	1
Demonstration	4
Desirability	8
Investment	2
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

4 MRL /9

7 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

INJECTABLE NEUROPROSTHETICS

INJECTABLE NEUROPROSTHETICS, which are in the Prototype Stage, is the field of research concerned with finding new ways to simply and effectively treat people with neurological and neuro-degenerative conditions using little more than designer nanoparticles and micro devices and an injection. Today the insertion of most neuroprosthetics into the human body requires some form of surgery, however recent breakthroughs in this field saw researchers inject nanoparticle solutions made from Magnetorestrictive Materials into patients which were then manipulated using magnetic fields to produce electrical fields which neurostimulated damaged nerves in patients and regenerated them, with the result being the complete restoration of nerve function in cases where originally damage to those nerves meant there was none.

DEFINITION

Injectable Neuroprosthetics are micro devices injected into the body to restore or enhance neurological functions.

EXAMPLE USE CASES

The ability to re-activate and regrow damaged nerves using a relatively straightforward solution of cheap nanoparticles could prove to be a breakthrough for any patients with untreatable nerve damage or degradation. Meanwhile other use cases include immune system modulation, organ repair and regeneration, pain management, targeted drug delivery, wound healing, as well as cardiac interventions, Diabetes management, Opthalmology, and many other use cases.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Injectable Neuroprosthetics increase, primarily led by the Healthcare sector and university grants. The ability to re-activate, re-juvinate, and re-generate nerves within the human body easily and without the need for potentially complicated or expensive interventions make this technology revolutionary which means that, even though research in this area is limited, it could be revolutionary.

While Injectable Neuroprosthetics are still in the Prototype Stage they could be enhanced by advances in Artificial Intelligence, Bio-Electronic Medicine, Magnetorestrictive Materials, Nano-Medicine, Regenerative Medicine, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

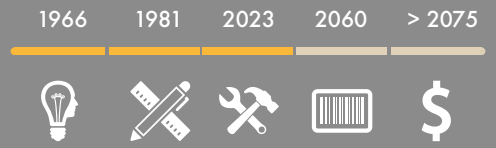
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

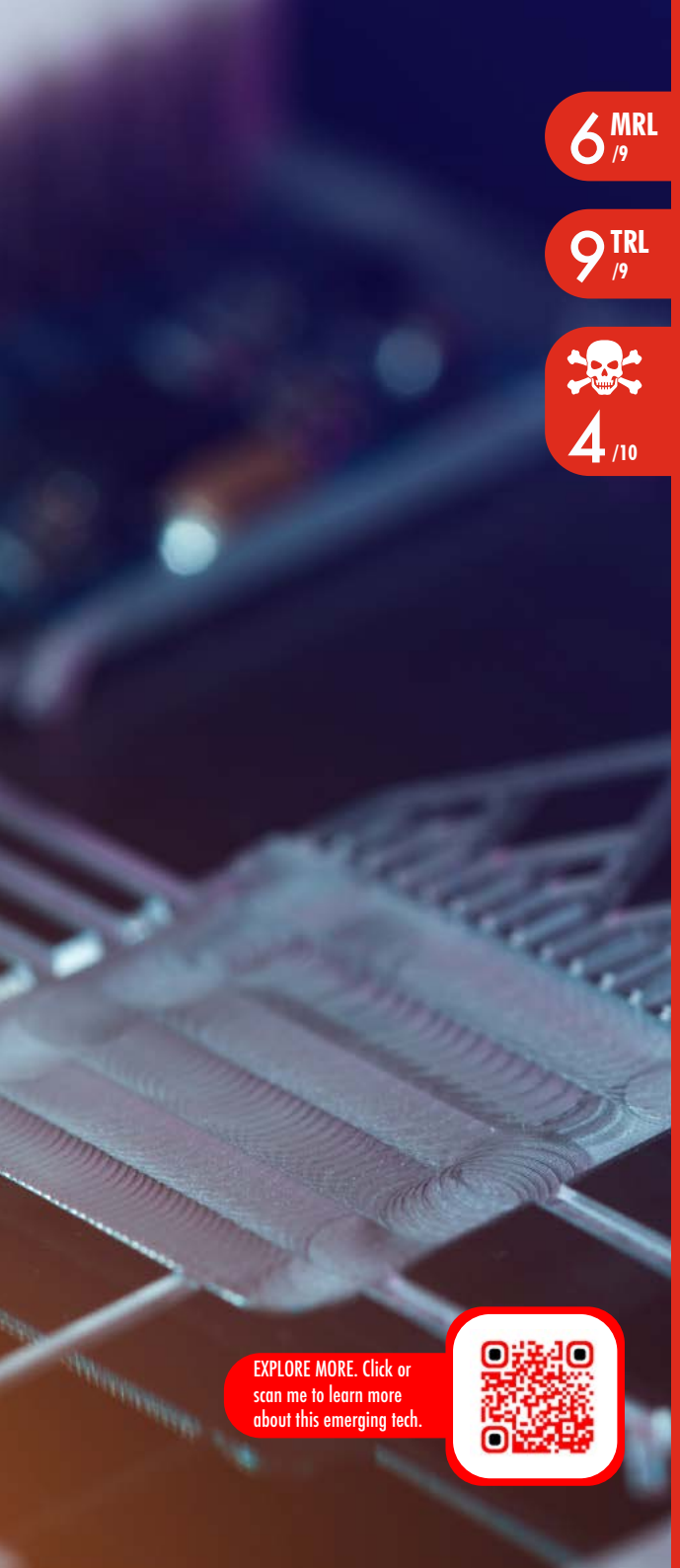
IMPACT

STATUS



Accessibility	3
Affordability	6
Competition	5
Demonstration	7
Desirability	8
Investment	3
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



6 MRL /9

9 TRL /9

4 /10

LABS ON CHIPS

LABS ON CHIPS, which is still largely in the Prototype Stage and early Productisation Stage, is the use of small 3D Printed plastic devices, or chips, that provide researchers with a way to precisely mimic the behaviours and functions of specific biological functions, and when stacked with other chips, entire biological systems. As a result they provide researchers with a fast and effective way to test the impact of drugs, environmental factors, and healthcare treatments much faster and cheaper than before. It is also possible that they could herald an end, one day, to animal testing.

DEFINITION

Labs on Chips are cheap small devices that integrate one or several laboratory functions onto a single chip.

EXAMPLE USE CASES

Today we are using Labs on Chips to test the impact of new drugs on a wide range of simulated human biological systems including on the blood-brain barrier, heart and liver tissue, as well as their potential impact on unborn children in the womb. However, as the technology matures it will also have a significant impact on a wide range of testing and monitoring fields, including, but not limited to, environmental monitoring.

FUTURE TRAJECTORY AND REPLACABILITY

Over the course of the next decade research in the field will continue to accelerate, and investment and interest will continue to grow at an accelerating rate, especially now that the US FDA has approved the use of the technology in early stage drug trials. Inevitably, in the healthcare sector, the end goal of many of the researchers in the field is to create a complete Human on a Chip system that will help to accelerate the testing and eventual approval of new drugs and treatments by orders of magnitude.

While Labs on Chips are still largely in the Prototype Stage and early Productisation Stage, over the long term the technology will be replaced by digital technologies, such as whole body Simulation Engines, but in the meantime they will be enhanced by Nano-Sensors, and Quantum Computing, which, once proved and accepted by regulators, could see the creation and assessment of new healthcare treatments closer to real time.

MATTHEW'S RECOMMENDATION

In the short to medium term, I suggest companies put the technology on their radars, explore the field, and establish a point of view.

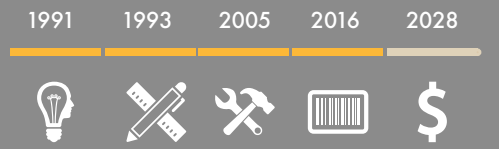
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22

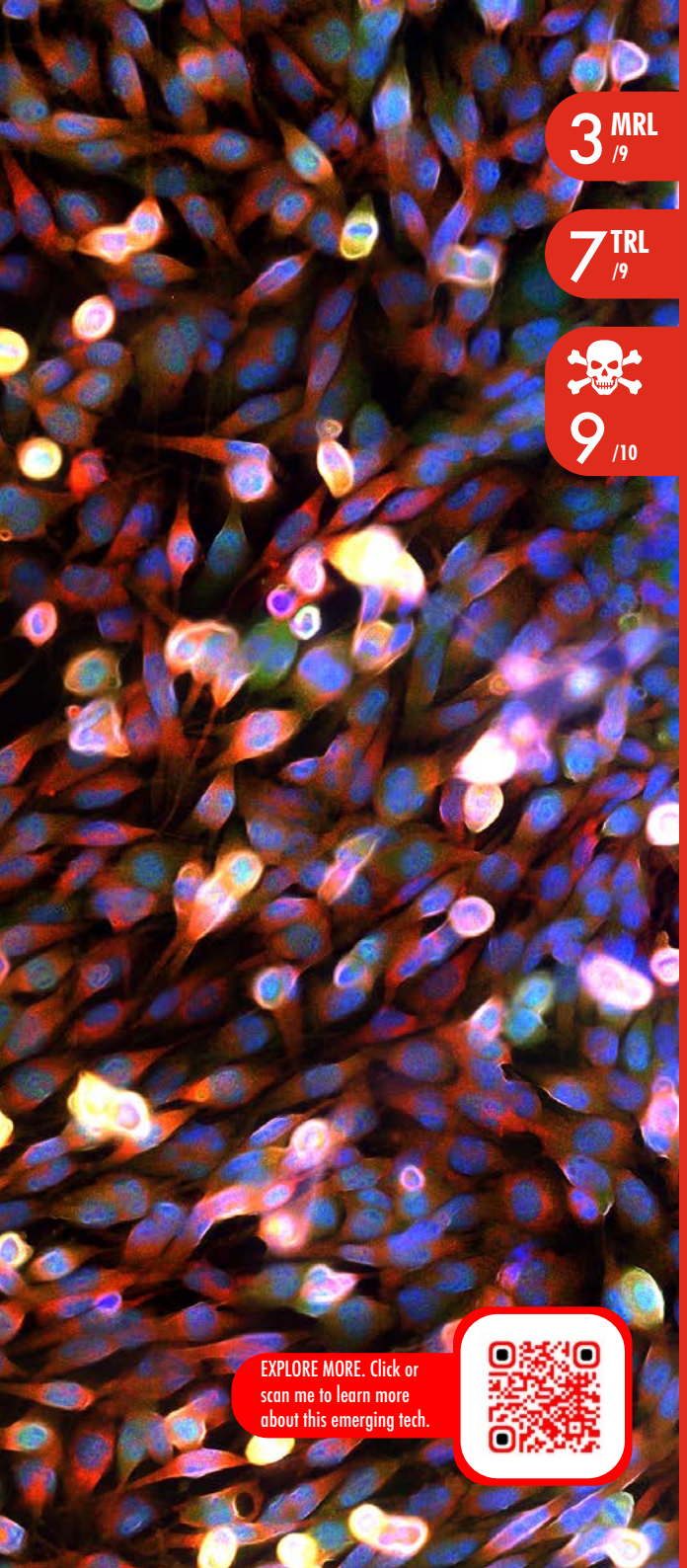
IMPACT

STATUS



Accessibility	7
Affordability	7
Competition	2
Demonstration	8
Desirability	8
Investment	7
Regulation	7
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

7 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

LIVING PHARMACIES

LIVING PHARMACIES, which are in the early Prototype Stage, is the field of research concerned with creating medicinal pharmacies within the human body that are able to detect different diseases and then produce the medicines and treatments needed to counteract them in vivo without the need for any external assessment, diagnosis, or intervention. Recent breakthroughs include the use of probiotics to create and deliver Parkinson's disease treatments within patients own bodies, and elsewhere other researchers are trying to turn humans into disease fighting supercomputers by combining together Bio-Manufacturing, Biological Computing, and Genetic Engineering technologies that can be used to create these in vivo living pharmacies, with some success.

DEFINITION

Living pharmacies are pharmacies within the human body that can identify and analyse different diseases and autonomously create and manufacture the treatments to combat them.

EXAMPLE USE CASES

Recently the development of implantable immunotherapies and probiotics have let researchers create in vivo pharmacies and treatment manufacturing centers for diseases including cancer and Parkinsons disease, in the latters case by modifying the genetic make up and behaviours of the patients gut microbiome. Over the longer term though organisations such as DARPA are developing Implantable Medical Devices (IMDs) with Bio-Engineered cells that can be used to autonomously treat everything from Diarrhoea to jet lag.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, albeit from a low base, primarily led by organisations in the Defense and Healthcare sectors, with limited support from government funding and university grants. In time we will see Living Pharmacies and the technologies used to create them mature and commercialise, but as they become more sophisticated it's highly likely their development will be slowed down by regulators trying to get their heads around the technology's implications.

While Living Pharmacies are in the early Prototype Stage, over the long term they will be enhanced by advances in Bio-Manufacturing, Biological Computing, Genetic Engineering, and others, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

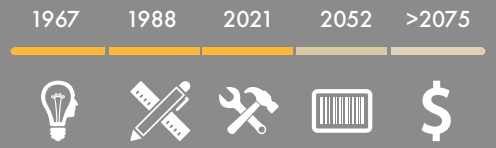
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '22, '23, '24

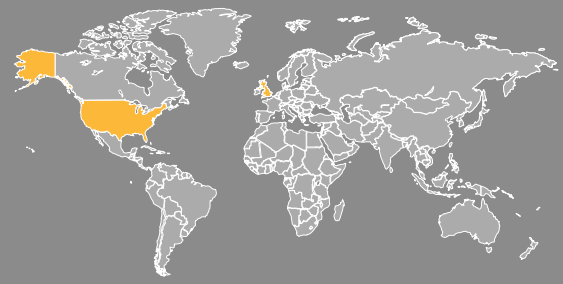
IMPACT

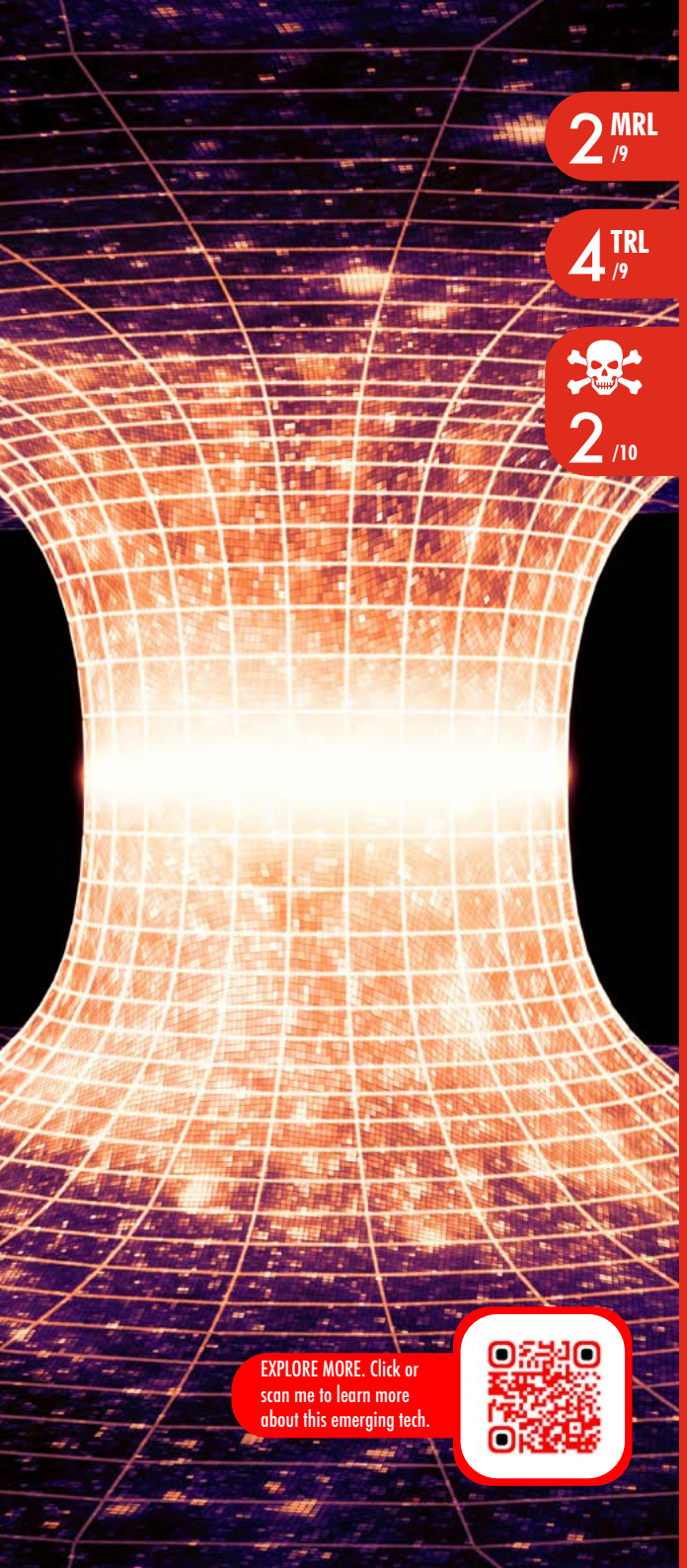
STATUS



Accessibility	2
Affordability	3
Competition	2
Demonstration	6
Desirability	9
Investment	2
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





MAGNETIC WORMHOLES

MAGNETIC WORMHOLES, which are still in the Concept Stage and very early Prototype Stage, is the use of powerful magnetic forces to create science fiction like wormhole effects where the magnetic field literally disappears, and is unmeasurable using all modern instrumentation, as it travels between two points. While the phenomenon is not understood, it has been demonstrated under lab conditions, and if it can be tamed then the phenomenon would lead to the creation of a range of new magneto products and solutions that, in short, defy today's laws of physics, and bearing in mind just how widely magnets are used, from car engines to hospital MRI machines, it could revolutionise industries.

DEFINITION

Magnetic Wormholes are magnetic fields that appear to vanish and become untraceable by any known instrumentation.

EXAMPLE USE CASES

Today there are no working products show casing the technology, but one of the first applications could be Magnetic Wormhole MRI scanners that scan individuals as they walk freely throughout a room, rather than having to lie down in the machines as they do today.

FUTURE TRAJECTORY AND REPLACABILITY

Over the course of the next decade research in the field will remain exotic and limited, with an increasing amount of interest but a limited amount of investment. As a result it is unlikely that the technology will be productised for decades, if ever.

While Magnetic Wormholes are still in the Concept Stage and very early Prototype Stage, over the long term it is not clear what technologies could replace it.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, and re-visit it every three or so years until progress in the space accelerates.

15 SECOND SUMMARY

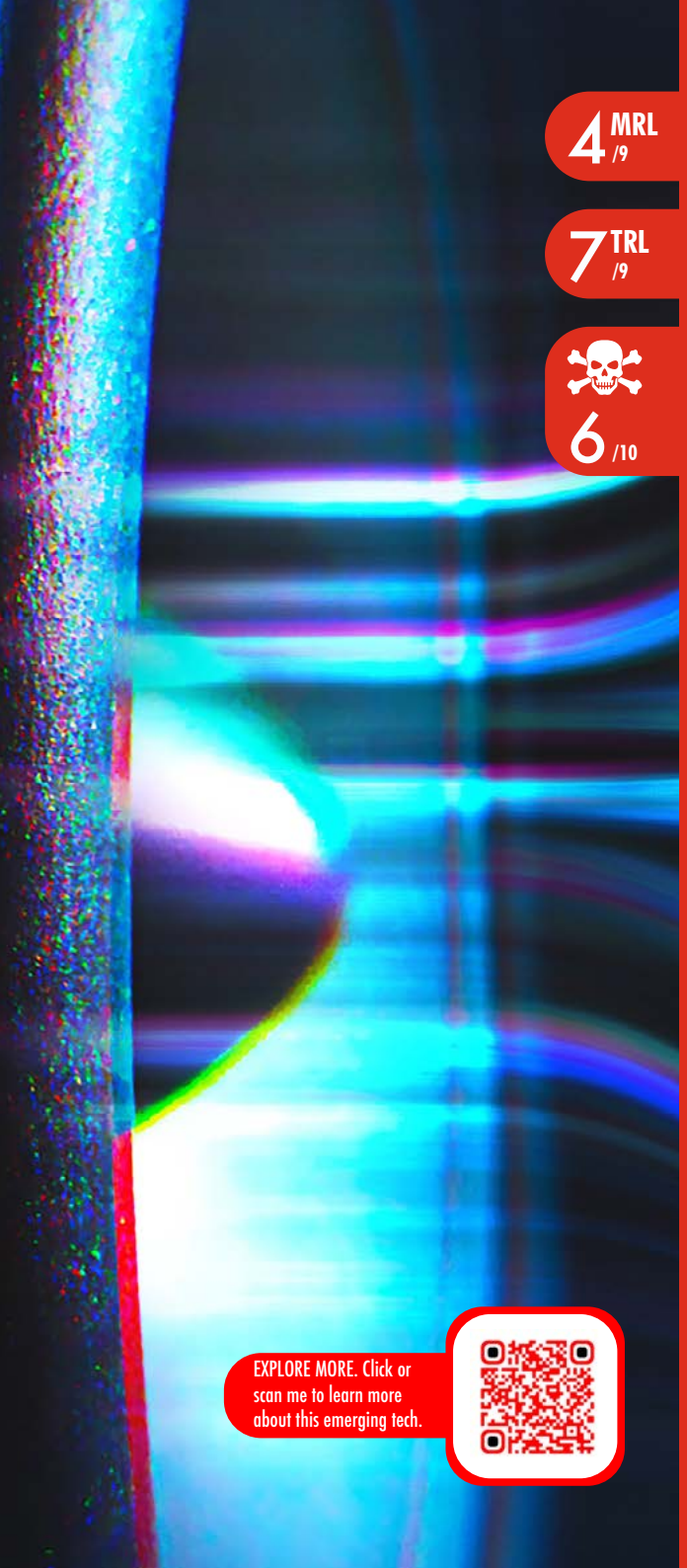
STARBURST APPEARANCES: '19

IMPACT

STATUS

Accessibility	1
Affordability	1
Competition	1
Demonstration	4
Desirability	4
Investment	1
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



4 MRL /9

7 TRL /9

6 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

MECHANO-GENETIC STIMULATION

MECHANO-GENETIC STIMULATION, which is in the Prototype Stage, is the field of research concerned with finding new ways of activating, altering, and manipulating genes and gene expression in patients using mechanical stimulation methods such as sound waves. Recently, in the first demonstration of this technology researchers enclosed insulin producing designer cells, that had been coded with specific proteins, in capsules within mice and then applied different triggers, including electricity, light, sound, and temperature, to get them to release insulin on demand thus opening the door to an entirely new kind of gene therapy which could have all kinds of untold potential for how we target and treat disease in the future and how patients administer their treatments.

DEFINITION

Mechano-Genetic Stimulation is the activation and manipulation of genes using mechanical stimulii such as sound.

EXAMPLE USE CASES

At the moment the primary use case for this technology is as a novel way to activate designer cells and get them to release drugs on demand in situ. However, when combined with Living Pharmacies and other Bio-Medicine concepts the ultimate benefit of this technology could be to eventually fully automate patients drug administration via, for example, a wearable device which could activate the automatic release of medicine within patients bodies which, in some cases could vastly improve the living standards of patients with chronic conditions or who are unable to self-medicate.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Mechano-Genetic Stimulation increase, primarily led by the Healthcare sector and university grants. While this technology is both novel and has great utility the fact of the matter remains that ultimately it can help dramatically improve the living standards of patients, and while it is certain to face ethical and regulatory challenges the upsides could be life changing and open the door to a whole new way of treating ailments and disease.

While Mechano-Genetic Stimulation is still in the Prototype Stage it could be enhanced by advances in Artificial Intelligence, CRISPR, Nano-Medicine, Nanotechnology, Synthetic Biology, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

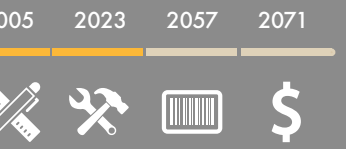
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

IMPACT

STATUS



Accessibility	3
Affordability	7
Competition	2
Demonstration	7
Desirability	6
Investment	2
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

MEDICAL TRICORDERS

MEDICAL TRICORDERS, are ironically in the early Productisation Stage, depsite the fact that today we already have many of the technologies, from Artificial Intelligence, Machine Vision, and Sensors, that we need to turn today's common-a-garden smartphones into the first generation of devices capable of accurately diagnosing everything from Depression and Skin Cancer, to Dementia and even Pancreatic Cancer. A staple of many science fiction films Medical Tricorders are positioned as the future physicians go to diagnostic tool, but their development is, arguably, being held back by the fact that researchers are focused on creating new, custom devices rather than experimenting with what we have available in our hands today, or, to use an analogy, the "supercomputer in our pockets."

DEFINITION

Medical Tricorders are hand held, non invasive devices that can detect and diagnose a range of medical conditions in real time.

EXAMPLE USE CASES

Today we are using Medical Tricorders, and by that I mean our smartphones, to diagnose dementia, depression, disease, inherited genetic disorders, rudimentary cancers, and more. all of which is just the tip of the iceberg.

FUTURE TRAJECTORY AND REPLACABILITY

Over the course of the next decade research in the field will continue to accelerate, and interest and investment in it will continue to grow, but it is also likely that researchers focused on discovering new ways to identify and diagnose diseases will be siloed and that groups will develop solutions in isolation to one another. Only when we see these individual research strands join together will we see the development and eventual regulation and commercialisation of the world's first true Medical Tricorder.

While Medical Tricorders are still in the early Productisation Stage, over the long term they could be replaced by Biological Computers and Smart Medicine that are enhanced by different collections of User Experience technologies.

MATTHEW'S RECOMMENDATION

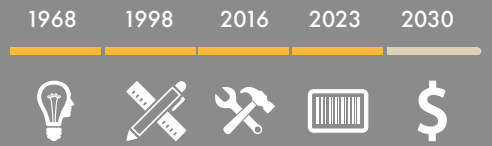
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '19

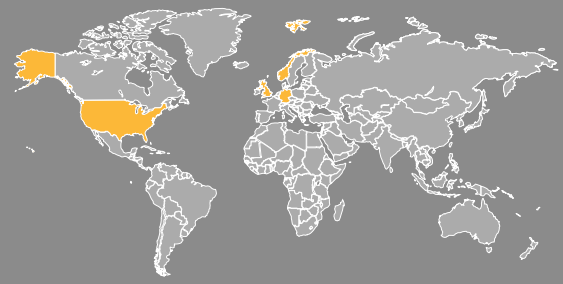
IMPACT

STATUS



Accessibility	4
Affordability	7
Competition	6
Demonstration	7
Desirability	8
Investment	6
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



4 MRL /9

4 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

MEMORY EDITING

MEMORY EDITING, which is still in the early Prototype Stage, is a science fiction like technology that is increasingly becoming real thanks to significant advances in Artificial Intelligence, Brain Machine Interfaces, Neuro-Prosthetics, and Neuroscience. Increasingly today researchers are unravelling the mysteries of the human brain, including the mechanics of how we create and retain long and short term memories. As a result researchers are increasingly able to use this information to interfere with and influence memory to the point where now we are seeing the very early stages of being able to edit memory in the same way we edit word processing documents using copy, cut and paste functionality.

DEFINITION

Memory Editing is the purposeful manipulation of the human brain using a variety of technologies to alter and edit memories.

EXAMPLE USE CASES

Today we are using Memory Editing technologies to eradicate memories associated with Addiction, and Depression, and researchers have also managed to edit memories related to behaviours and food.

FUTURE TRAJECTORY AND REPLACABILITY

Over the course of the next decade research in the field will continue to accelerate, albeit constrained to specialist research teams, and interest and investment in the space will continue to grow, again albeit at a moderate rate. Ultimately researchers want to get to the point where we are able to edit the human memory in the same way we edit word processing documents.

While Memory Editing is still in the early Prototype Stage, over the long term it is not clear what technologies could replace it. That said though there are plenty of technologies, from Brain Machine Interfaces and Biological Computers, to Neuro-Prosthetics, Smart Medicine and Virtual Reality, that can all be combined together in different ways to augment and enhance it.

MATTHEW'S RECOMMENDATION

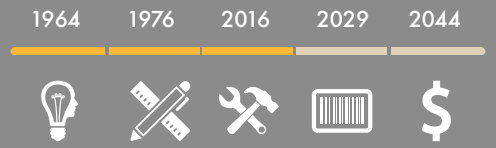
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and re-visit it every three or so years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	1
Demonstration	6
Desirability	6
Investment	4
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

5 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

NANO-MEDICINE

NANO-MEDICINE, which is still largely in the Concept Stage and early Prototype Stage, is often thought of by people in terms of the miniature Nanobots and Nano-Machines that are designed to travel throughout people's bodies seeking out disease and eliminating it. But the reality is far more entertaining and wierder. Today we are developing a range of nano-technologies, from Nanoparticles that can track and monitor diseases, such as Cancer, within the body, brain controlled Nano-Machines with enzyme engines that can detect disease and deliver drugs with nanometer scale precision if they detect the onset of a psychotic episode, such as an epileptic fit, and Nanobot GPS systems that let us keep track of them all.

DEFINITION

Nano Medicine is the application of Nanotechnology to prevent and treat disease and psychosomatic conditions.

EXAMPLE USE CASES

Today we are using Nano-Medicine, in the form of Nanoparticles, to help us locate and identify cancers so they can be more prescicely targeted and tracked, but in the future use cases will include the use of Nanobots and Nano-Machines to identify and eliminate disease, perform targeted drug delivery, and even in vivo human surgical procedures, all of which have been demonstrated but not regulated or commercialised.

FUTURE TRAJECTORY AND REPLACABILITY

Over the course of the next decade research in the field will continue to accelerate, and interest and investment will continue to grow. However, while there have already been some staggering breakthroughs in the labs the eventual productisation and commercialisation of the technology will be wholly reliant on regulators approving its use, and as the challenge of assessing the impact of such microscopic technologies on the human body continue to prove challenging this could take decades.

While Nano-Medicine is still largely in the Concept Stage and early Prototype Stage at the moment there are only a couple of technologies on the horizon that could replace it, including Biological Computing, CRISPR Gene Editing, DNA Robots and Soft Robots, and In Vivo Gene Editing.

MATTHEW'S RECOMMENDATION

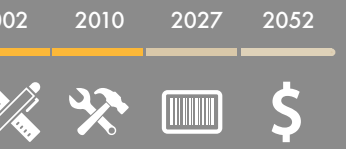
In the short to medium term, I suggest companies put the technology on their radars, explore the field, and establish a point of view.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '23, '24

IMPACT

STATUS



Accessibility	3
Affordability	2
Competition	4
Demonstration	6
Desirability	6
Investment	5
Regulation	3
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

NEURO-PROSTHETICS

NEURO-PROSTHETICS, which is now in the early Productisation Stage, is the marriage of advanced prosthetic devices with Brain Machine Interface technologies. As the technology continues to advance the field is burgeoning, with some devices being directly implanted into people's brains in order to augment, monitor and modulate people's memories and thoughts, while others are connected, directly, via direct attachment to people's peripheral nervous system, or indirectly, via wireless connections, to people's brainwave activity. The result is an increasing array of Neuro-Prosthetic devices that help people with neurdegenerative disorders regain function, and devices that help people who have lost limbs regain life like mobility by using the power of thought.

DEFINITION

Neuro-Prosthetics are mechanical devices that are directly, and indirectly, connected to an organisms Peripheral or Central Nervous System in order to enhance its cognitive, motor or sensory capabilities.

EXAMPLE USE CASES

Today we are using brain implanted Neuro-Prosthetics to help improve memory performance and memory retention in dementia patients by upto 30 percent, and helping amputees regain life like mobility again by letting them control the behaviours and motion of their prosthetic limbs using the power of thought.

FUTURE TRAJECTORY AND REPLACABILITY

Over the course of the next decade research in the field will continue to accelerate, and interest and investment will continue to grow. Similarly, the number and range of Neuro-Prosthetic products being developed and produced will continue to expand as the individual technologies and control systems supporting them continue to mature.

While Neuro-Prosthetics are still in the early Productisation Stage, in the long term the only technology on the horizon that could replace Neuro-Prosthetic limbs would be Artificial Body Parts and Regenerative Medicine, and the only technology that could replace Neuro-Prosthetic brain implants would be Artificial Body Parts and Stem Cell Technology.

MATTHEW'S RECOMMENDATION

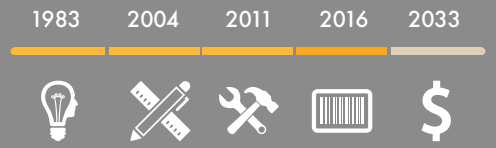
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential. implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22

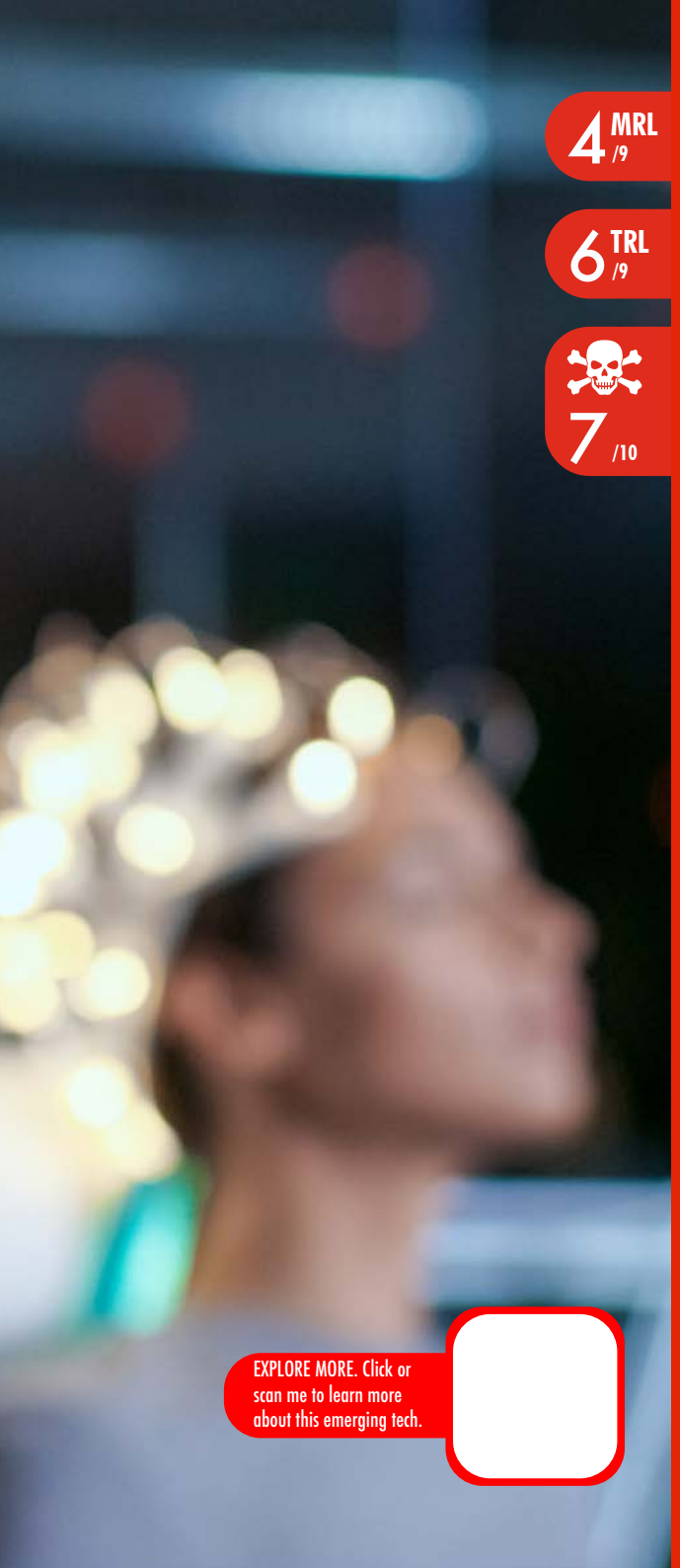
IMPACT

STATUS



Accessibility	6
Affordability	4
Competition	2
Demonstration	8
Desirability	8
Investment	6
Regulation	5
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



4 MRL /9

6 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

NEUROLOGY

NEUROLOGY, which is still in the Productisation Stage, is the field of research involved with understanding and finding treatments for ailments and diseases that affect the human brain, central nervous system, and spine. Recently there have been dramatic breakthroughs in both Neuroscience and Neurology which, when combined with other technology developments including in Brain Machine Interfaces, Carbon Nanotubes, High Resolution fMRI, Neural Interfaces, Neuro-Prosthetics, Regenerative Medicine, and Stem Cell Technology, and more, mean that the field is now starting to enter its golden age.

DEFINITION

Neurology is the branch of medicine or biology that deals with the anatomy, functions, and organic disorders of nerves and the nervous system.

EXAMPLE USE CASES

Today Neurology is being used to cure Paralysis, help people with ALS and Locked In Syndrome communicate with loved ones, live stream images, movies and thoughts in real time from people's minds, treat Addiction, Dementia and PTSD with new levels of effectivness and efficiency, turn Parkinsons Disease on and off, and more.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the space will continue to accelerate, and interest and investment will continue to grow and accelerate. The field will also get a big boost when the first Exascale Supercomputers come on line which will let researchers simulate the entire human brain, not just the 10 percent of it that they can do today. As a result we will see the number of breakthroughs in the field increase dramatically, and as research gathers momentum in the other complimentary technology fields the field will start to hit the knee of the exponential acceleration curve.

While the technology is still in the Productisation Stage, over the long term it will be enhanced by Brain Machine Interfaces, Carbon Nanotubes, Graphene, High Resolution fMRI, Neural Interfaces, Neuro-Prosthetics, Regenerative Medicine, and Stem Cell Technology. However, it is unlikely to be replaced.

MATTHEW'S RECOMMENDATION

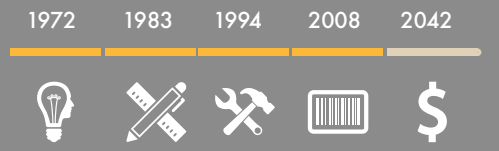
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19

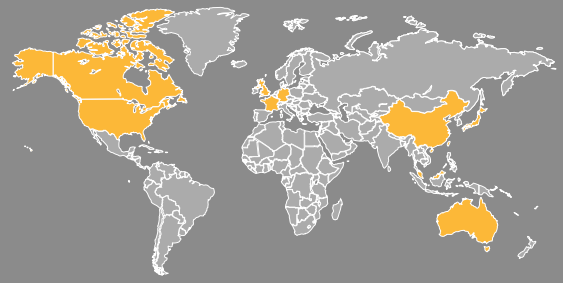
IMPACT

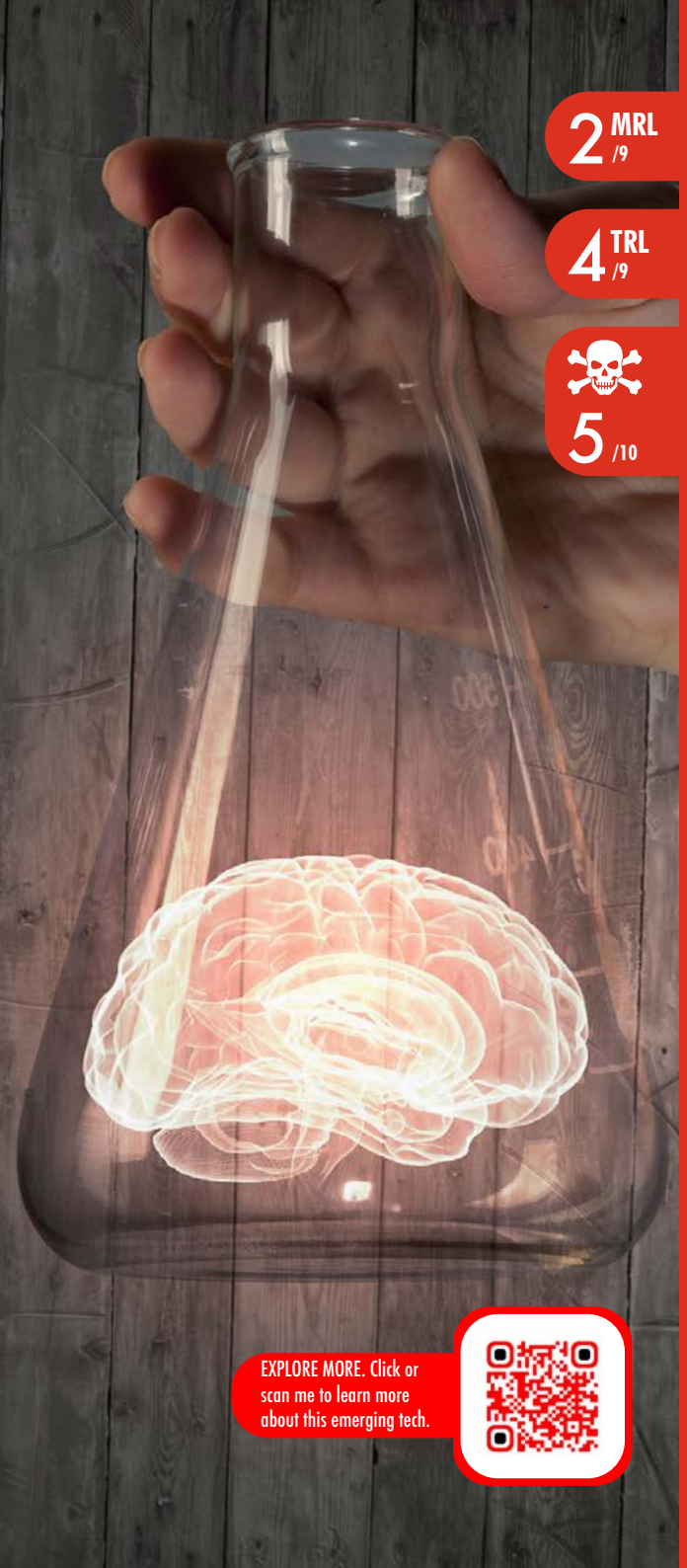
STATUS



Accessibility	8
Affordability	4
Competition	2
Demonstration	6
Desirability	8
Investment	7
Regulation	7
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





2 MRL /9

4 TRL /9

5 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ORGANOIDS

ORGANOIDS, which are in the Prototype Stage, is the field of research concerned with trying to find new ways to develop and grow human and non-human organs ex vivo. Recently there have been several breakthroughs including the development of new organoid human and mouse mini brains which have then gone on to spontaneously learn how to play games and sense images - in many cases better than machine based AI's. While unexpected these "accidents" have now given rise to a new technology field - that of Synthetic Biological Intelligence (SBI) - which could have huge implications in the future across sectors. Asides from these and other similar breakthroughs we've also seen growing of human stomachs and other mini organs in dishes which one day could be transplant worthy, and other similarly sci-fi-like breakthroughs.

DEFINITION

Organoids are artificially grown masses of cells or tissues that resemble an organ.

EXAMPLE USE CASES

While the primary use case includes their eventual use in human transplants they are also proving useful when it comes to helping researchers conduct medical research and test new drug treatments. They're also giving researchers vital insights into how organs grow and behave which, as researchers study the processes driving these, will have wide ranging medical implications. Then there's the unusual use case of growing human-like brains ex vivo which, as they acquire their own "intelligence" and "sensing abilities" that rival the abilities of machine AI could one day lead to a new ultra powerful class of AI - with all that entails.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate, albeit from a low base, predominantly led by the healthcare sector and government grants. While many people see this field as aiding medical research and solving the transplant crisis arguably it's the ability of this field to drive advances in Hybrid Human Organs as well as new classes of AI's which could turbo charge its development.

While Organoids are still in the Prototype Stage they could be enhanced by advances in 3D and 4D Bio-Printing, Bio-Hybrid Organs, Bio-Manufacturing, Cellular Recorders, CRISPR Gene Editing, Stem Cell Technology, Synthetic Biological Intelligence, Synthetic DNA, and others, however over the long term it could be replaced by 3D and 4D Bio-Printing.

MATTHEW'S RECOMMENDATION

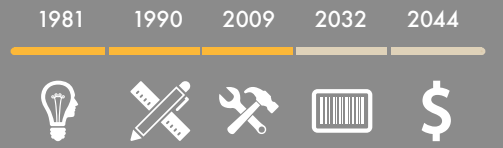
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

IMPACT

STATUS



Accessibility	4
Affordability	4
Competition	4
Demonstration	7
Desirability	7
Investment	6
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

5 MRL /9

9 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

PERSONALISED MEDICINE

PERSONALISED MEDICINE, which is still in the Concept Stage and Prototype Stage, is the promise of being able to individually tailor and personalise specific medical treatments according to the person's own genomic and proteomic information. While the field is much talked about the challenge of unravelling the mysteries of the human body at a granular enough level to create these treatments is still a very difficult and complex task, so as a consequence many personalised treatments are still expensive and used in exceptional circumstances. That said though as we unravel the mysteries of the human genome, and as new DNA sequencing and diagnostic tools become available being able to tailor treatments becomes an increasingly viable proposition. That said though the benefits of the field include faster, and more effective treatment for patients, with dramatically reduced recovery times and significantly fewer post treatment implications and complications.

DEFINITION

Personalised Medicine is the use of an individuals Genomic and Proteomic information to better diagnose, treat and prevent disease.

EXAMPLE USE CASES

Today we are using Personalised Medicine to treat a very narrow range of patients, especially those suffering from Cancer and inherited genetic conditions.

FUTURE TRAJECTORY AND REPLACABILITY

Over the course of the next decade research in the field will continue to acelerate, and interest and investment will continue to grow at accelerating rates, albeit that researchers in the field will focus on those diseases and situations where their research efforts can have the greatest impact to the most people.

While Personalised Medicine is still in the Concept Stage and Prototype Stage in the long term it is unlikely to be replaced. Instead it will be enhanced and complimented by new powerful technologies including Artificial Body Parts, CRISPR Gene Editing, In Vivo Gene Editing, Nano-Medicine, Regeneritive Medicine, Semi-Synthetic Cells, Synthetic Cells, Stem Cell Technology, and Tissue Engineering.

MATTHEW'S RECOMMENDATION

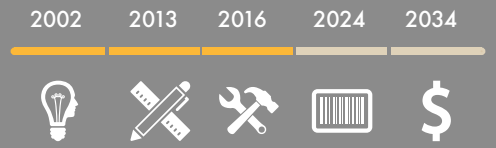
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and forecast out the potential.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '22, '23

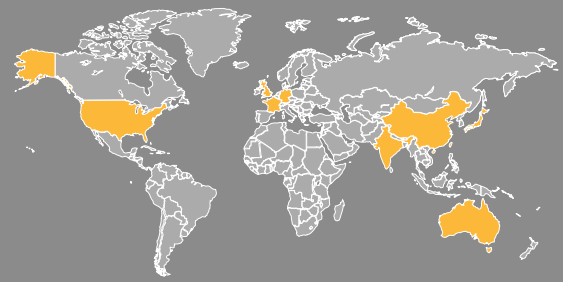
IMPACT

STATUS



Accessibility	4
Affordability	4
Competition	5
Demonstration	6
Desirability	8
Investment	7
Regulation	5
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



6 MRL /9

6 TRL /9

5 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

PHAGE THERAPY

PHAGE THERAPY, which is in the Prototype Stage, is the field of research concerned with trying to find effective alternatives to anti-biotics in this case by using bacteriophages to treat and destroy drug resistant bacterial infections. By harnessing the natural abilities of bacteriophages, or viruses which prey on bacteria, it's hoped that this technology could be a valuable weapon in the war against the trend of anti-biotic resistance. Recently there have been a number of breakthroughs in the field including the use of bacteriophages to successfully treat patients where all anti-biotic treatments had failed and who without phage therapy would have died.

DEFINITION

Phage Therapy is the therapeutic use of bacteriophages for the treatment of pathogenic bacterial infections.

EXAMPLE USE CASES

Today the primary use case for this technology is to help fight anti-biotic resistant bacterial infections and it has already been used successfully with multidrug-resistant bacterial infections who without the treatment would have otherwise died. In the longer term though it could have a significant impact on the treatment of everything from eye infections and staphylococcal lung infections, to sepsis, UTI's, wound infections, and beyond.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate, albeit from a low base, predominantly led by the healthcare sector and government grants. As the WHO continues to declare anti-biotic resistance as the next global pandemic it's difficult to see why Phage Therapy won't play a more central role in treating patients with all manner of bacterial infections, and with regulators also looking favourably on this highly adaptable technology the future for it looks promising.

While Phage Therapy is still in the Prototype Stage it could be enhanced by advances in AI, CRISPR Gene Editing, Nano-Medicine, Synthetic Biology, and other technologies, and replaced by Human Hybrid Immune Systems although perhaps not entirely.

MATTHEW'S RECOMMENDATION

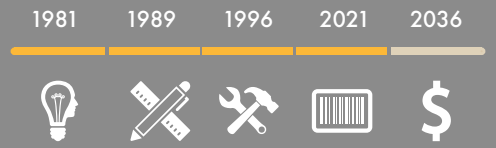
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23, '24

IMPACT

STATUS



Accessibility	3
Affordability	4
Competition	6
Demonstration	7
Desirability	8
Investment	4
Regulation	4
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

1 MRL /9

6 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

PREDICTIVE VACCINES

PREDICTIVE VACCINES, which is in the Prototype Stage, is the field of research concerned with trying to use Artificial Intelligence to predict how existing viruses could mutate in the future, which would then enable researchers to develop vaccines before those new viruses get a foothold in the wild and limit their impact. In a hat tip to research done during the COVID-19 pandemic recent breakthroughs in this field include the use of Machine Learning, combined with genetic data from the Coronavirus, to predict future mutations and their potential impacts on individual human populations. The researchers then synthesised predictive vaccines to counter and nullify the effect of those mutations and were successful in defeating the new mutated viruses in 65% of cases. While impressive the real news here is that increasingly we have a pathway to a new create a new healthcare trend that I'll refer to as Predictive Medicine.

DEFINITION

Predictive Vaccines is the use of Artificial Intelligence to predict future viral mutations that enable researchers to develop vaccines before the mutations appear in the wild and cause harm.

EXAMPLE USE CASES

Today the major use case for this technology is the ability to predict how viruses and diseases could mutate and then create antidotes and vaccines to counter the worst and most deadly viruses before they emerge in the wild and spread. Imagine, for example, contracting the latest Ebola strain and already being vaccinated against it - and other less deadly diseases.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Predictive Vaccines increase, primarily led by university grants and the Healthcare sector. While we are all aware of Predictive Health - the use of AI and other technologies to predict that you might get ill - this is the first example of Predictive Medicine and hopefully I don't have to spell this one out to you as to why the combination of the two - which have broad applicability - could transform global healthcare and help increase human longevity.

While Predictive Vaccines are still in the Prototype Stage they could be enhanced by advances in Artificial Intelligence, Quantum Computing, Synthetic Biology, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

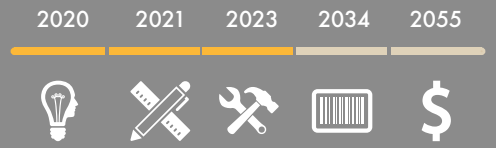
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

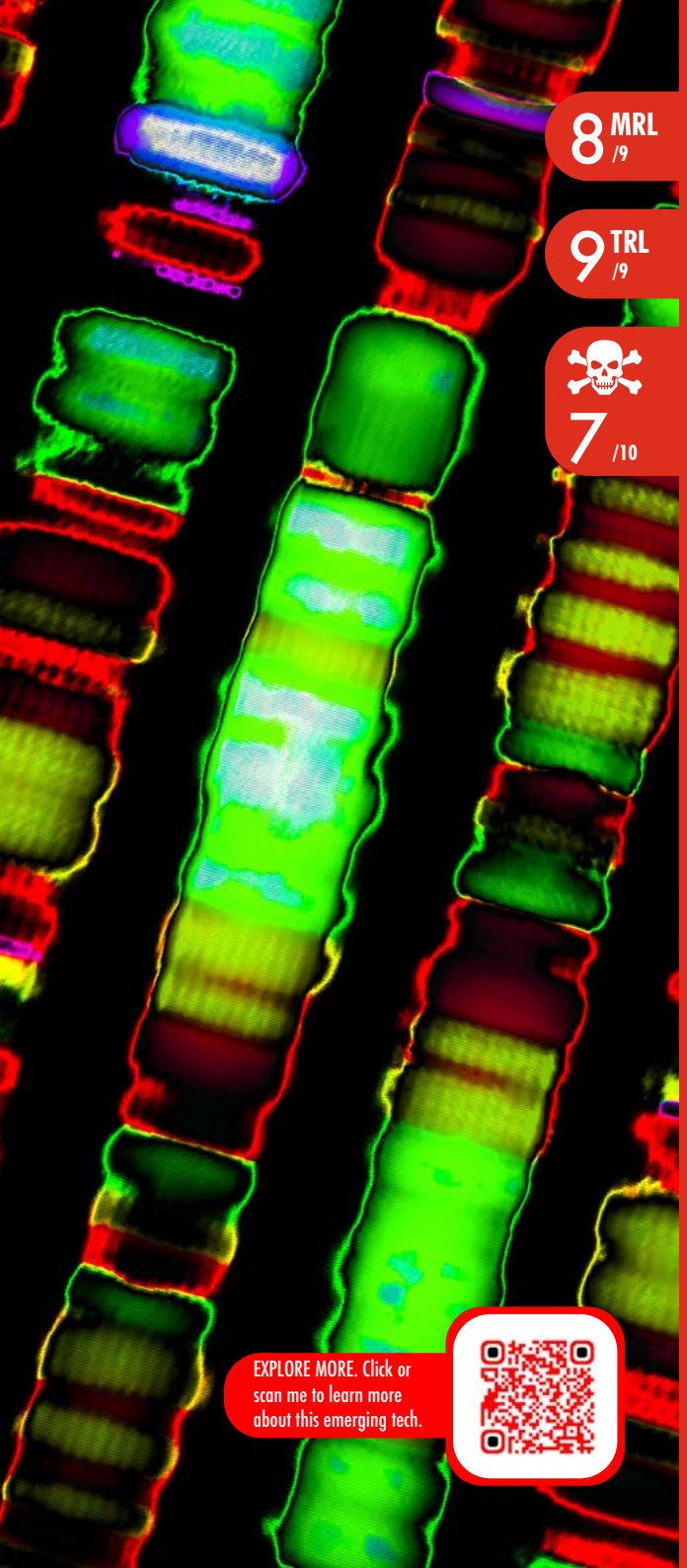
IMPACT

STATUS



Accessibility	4
Affordability	5
Competition	3
Demonstration	8
Desirability	9
Investment	3
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



8 MRL /9

9 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

RAPID GENE SEQUENCING

RAPID GENE SEQUENCING, which is in the early Commercialisation Stage, is the field of research concerned with trying to develop the technology needed to sequence human and non-human genomes in near real time for almost no cost. Recently we saw the most significant breakthough ever in this field after scientists managed to sequence the complete genomes of human patients in less than five hours for less than $100 - an initiative that is now starting to put the trend of truly personalised healthcare within arms reach and make it possible to develop truly personalised and tailored patient treatments that could help defeat deadly diseases, such as Cancer with sci-fi like ability.

DEFINITION

Rapid Gene Sequencing is the high-speed process of determining the order of nucleotides in a DNA molecule.

EXAMPLE USE CASES

The ability to do real time or near real time genome sequencing means that it's increasingly easy to analyse the genetic make up of both humans and the diseases that affect us, with an example of this being the benefit of this technology to create highly personalised and highly targeted Cancer treatments which, in the Personalised Healthcare space we've already seen be 100% effective in killing certain types of Cancer. Putting this mildly, when combined with other enabling technologies in some cases this technology is the literal Silver Bullet that doctors have been waiting for to help patients survive some of the worst and most deadly diseases known to man.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Rapid Gene Sequencing increase, primarily led by the Healthcare and Technology sectors. Over the longer term the ability to create highly effective, highly targeted medical treatments for patients at increasingly low cost, will open the door to yet another healthcare revolution which will help extend human longevity, and when combined with AI analysis and other complimentary technologies, many people see this technology as the Holy Grail of medicine.

While Rapid Gene Sequencing is still in the early Commercialisation Stage it could be enhanced by advances in Artificial Intelligence, CRISPR, Quantum Computing, Materials, Synthetic Biology, Sensors, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view.

15 SECOND SUMMARY

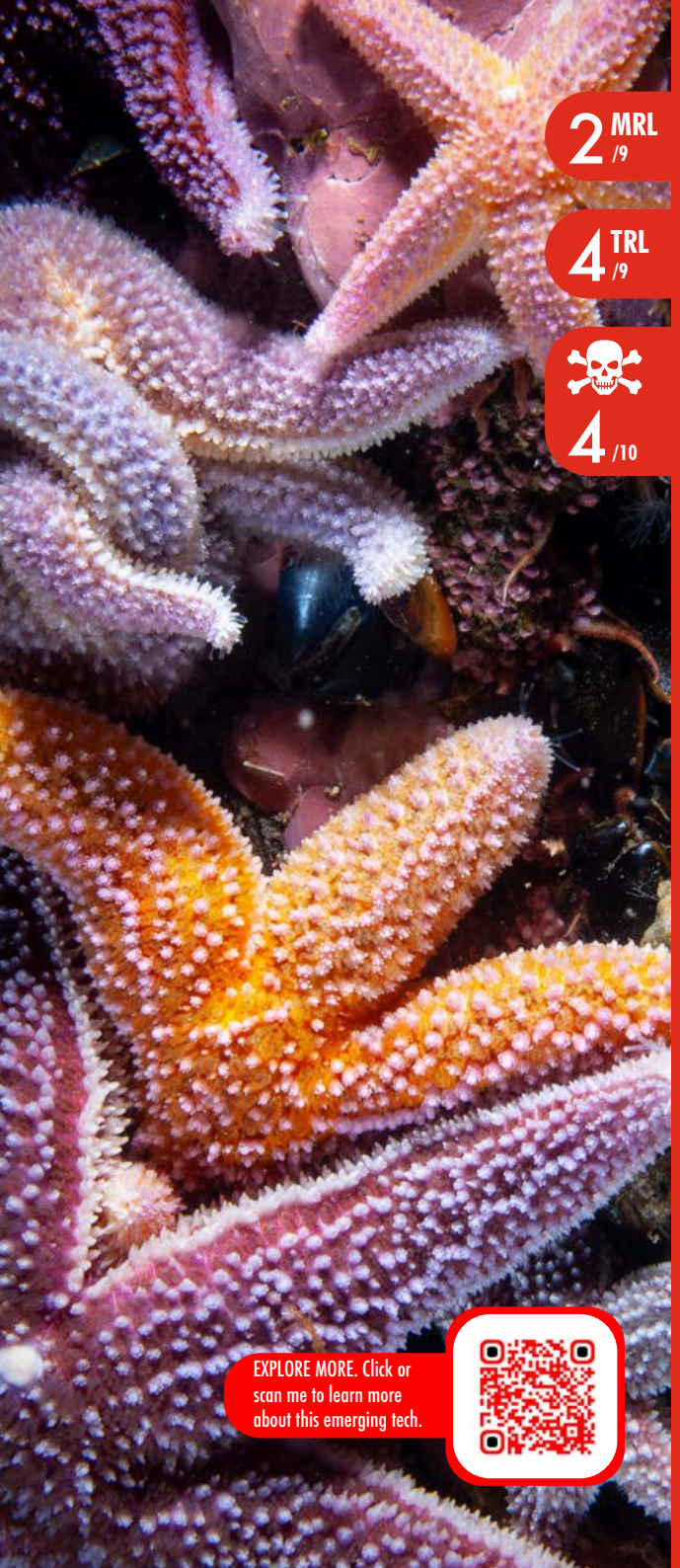
STARBURST APPEARANCES: '24

IMPACT

STATUS

Accessibility	6
Affordability	4
Competition	5
Demonstration	8
Desirability	9
Investment	3
Regulation	2
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



2 MRL /9

4 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

REGENERATIVE MEDICINE

REGENERITIVE MEDICINE, which is still in the Prototype Stage and very early Productised Stage, is the mystical ability to re-grow different body parts on demand, as old ones are damaged or lost. While there are many animals who have this ability, ranging from Starfish and Salamanders to Zebra Fish, which is the result of their genomic make up, it is thought that the genes needed to re-grow and re-generate human organs and limbs have become dormant over time. As a result researchers are trying to identify the genes responsible for regeneration, understand the mechanisms, and re-activate them in other animals and humans, and so far they have had a number of successes that include identifying the genes needed for whole body re-generation in Three Banded Tiger Worms, and being able to re-grow severed frogs legs and rat's toes using silk Bioreactors and exotic Progesterone cocktails.

DEFINITION

Regenerative Medicine refers to a group of biomedical approaches that have the potential to fully heal and re-grow damaged tissues and organs.

EXAMPLE USE CASES

Today Regeneritive Medicine in humans is limited to using bandages laced with exotic cocktails that accelerate wound healing, but so far the ability to perform more complex regeneration is elluding researchers, within humans at least.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the space will continue to accelerate, and interest and investment in the sector will continue to grow. However, the field is a very complex one, with multiple genes and biological mechanisms controlling and directing regeneration, and understanding, and then being able to replicate them, even to a modest extent is incredibly complex. Similarly when the technology does develop sufficiently enough to be used on humans there will be serious ethical and regulatory hurdles to overcome.

While Regenerative Medicine is still in the Prototype Stage and very early Productised Stage, over the long term it could be enhanced by Bioreactors, Brain Machine Interfaces, and Neuro-Prosthetics, and replaced by CRISPR Gene Editing, and Stem Cell Technology.

MATTHEW'S RECOMMENDATION

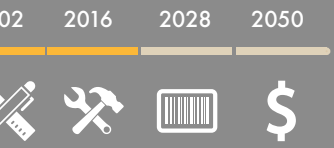
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	3
Demonstration	4
Desirability	9
Investment	5
Regulation	4
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

1 MRL /9

2 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

RESURRECTION

RESURRECTION, which is in the Concept Stage, is the field of research concerned with bringing people back from the dead, ideally in their original physical form with their original experiences and memories intact. Recently researchers have made several advances in the field across a range of technology disciplines which include being able to bring people out of comas using light, being able to genetically reconstruct the genomes of people who died centuries ago which could then be cloned to create Artificial Humans and be imbued with downloaded, edited, and manipulated human memories, creating life-like digital clones of dead people complete with realistic behaviours and responses, cryogenics, and the suspended animation of entire biological entities and individual human organs. Suffice to say though there is still alot of work to be done.

DEFINITION

Resurrection is the concept of bringing people back from the dead in one form or another.

EXAMPLE USE CASES

Today the vast majority of people want to live forever and in order to do so they will need to rely on Exponential Healthcare technologies and Anti Ageing or Longevity technologies. However, in the event that a person does die the development of these technologies will allow them to be "re-born" in digital, hybrid, and or physical form. Although, that said, there will be obvious ethical, societal, and religious implications to deal with.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Healthcare and Technology sectors, with tacit support from governments. In time we will see the technology to enable resurrection, in a variety of both digital, hybrid, and physical forms mature at which point it will cause a societal paradigm shift.

While Resurrection is in the Concept Stage, over the long term it will be enhanced by advances in Anti Ageing, Artificial Humans, Artificial Body Parts and Wombs, Cryogenics, Designer Humans, Digital Humans, Genetic Engineering, Memory downloading, editing, manipulation, and transfer, Neuro-Prosthetics, Stem Cells, Suspended Animation, and Synthetic Biology, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

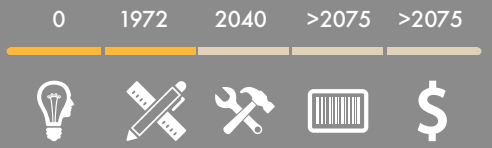
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '21, '22

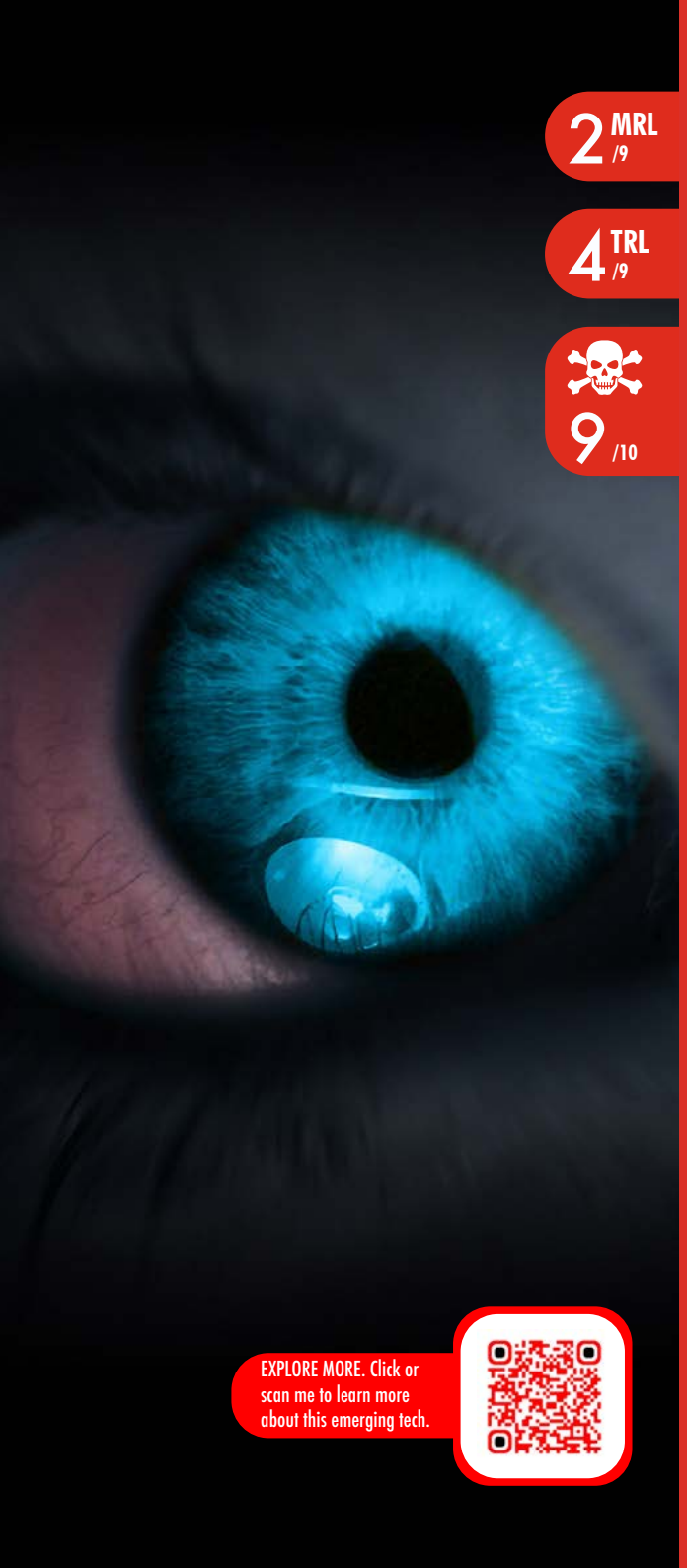
IMPACT

STATUS



Accessibility	1
Affordability	1
Competition	1
Demonstration	2
Desirability	9
Investment	1
Regulation	1
Viability	5

PRIMARY GLOBAL DEVELOPMENT AREAS



2 MRL /9

4 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SELF-DELETING GENES

SELF-DELETING GENES, which is in the Concept and Early Prototype Stage, is the field of research dedicated to finding new ways to genetically engineer and manipulate organisms and then be able to undo those changes, as well as undo all transgene creations, when they have fulfilled their function. Recently there have been a number of breakthroughs in the field including the development of a new process that allows researchers to store an organisms original genetic sequence, in a system of record within the organism itself - a back up of sorts. This then allows the researchers to make the necessary changes to the organisms genetic makeup using gene editing tools, such as CAST and CRISPR, and then, when the features those new edits enable are no longer needed, the organisms genes can be rolled back to their original versions.

DEFINITION

Self-Deleting Genes is a technology that allows people to delete and roll back the modifications made to genetically engineered genes or genomes.

EXAMPLE USE CASES

Today we are using Gene Editing and Genetic Engineering to create all manner of Genetically Modified Organisms, and there is also the fear that new human Aerosol and In Vivo Gene Editing technologies will be used to genetically alter humans, for better and worse. All this makes it vitally important that we have a way to undo and roll back harmful changes to DNA, genes, and genomes. This technology also allows researchers to implement genetic modifications that have an expiry date, and enable them to create GMO's with temporary, not permanent, genetic characteristics.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Healthcare sector, with support from government funding and university grants. In time we will see the technology mature to a point where it is ready to be deployed, at which time the ethics boards and regulators will step in to establish a way forwards.

While Self-Deleting Genes is in the concept and Early Prototype Stage, over the long term they will be enhanced by advances in CAST and CRISPR, and Gene Drives, as well as Genetic Engineering, and Synthetic DNA, but at this point in time it is not clear what they will be replaced by.

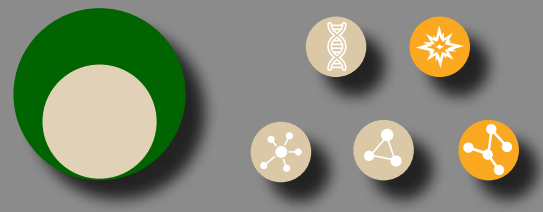
MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '22

IMPACT



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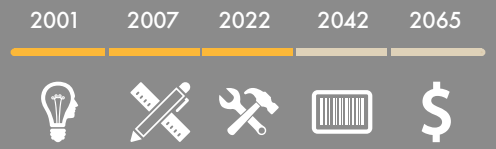


Accessibility	1
Affordability	1
Competition	1
Demonstration	3
Desirability	9
Investment	2
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

SEMI-SYNTHETIC CELLS

SEMI-SYNTHETIC CELLS, which are still in the Concept Stage and early Prototype Stage, is the fusion of both inorganic and organic compounds within biologically active, living cells to create hybrid cells that have unique properties that have a range of new, and unique properties. These Semi-Synthetic cells could be used to aid and enhance drug delivery within the human body, create new semi-synthetic organisms and sensors, and accelerate and enhance the development of cell based Bio-Manufacturing technologies.

DEFINITION

Semi-Synthetic Cells are artificially manufactured or modified cells that are made up from a mixture of different inorganic, organic and synthetic components and materials.

EXAMPLE USE CASES

Today we have created Semi-Synthetic Cells with artificial membranes and cell walls that can withstand highly toxic conditions that would kill ordinary biological cells.

FUTURE TRAJECTORY AND REPLACABILITY

Over the course of the next decade research in the space will accelerate, and interest and investment will grow. However, given the sheer complexity of the field, and our current lack of understanding of the mechanics that control and drive cell behaviours, let alone what impact introducing foreign components into that mix will have, it is fair to say that progress in the field will remain constant for some time, and then accelerate dramatically as more of the mysteries of cells are unravelled.

While Semi-Synthetic Cells are still in the Concept Stage and early Prototype Stage, over the long term the technology will be enhanced by advances in 3D Bio-Printing, 3D Printing, Bio-Manufacturing, CRISPR Gene Editing, In Vivo Gene Therapy, Molecular Assemblers, Stem Cell Technology, and Synthetic Cells, but not replaced.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19

IMPACT

STATUS

Accessibility	3
Affordability	2
Competition	2
Demonstration	4
Desirability	5
Investment	4
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

7 MRL /9

9 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SMART DRUGS

SMART DRUGS, which are in the Productisation Stage, is the field of research concerned with developing new ways to enhance and improve human memory and memory retention, and concentration. Recent breakthroughs in the field include the development of new drug compounds which boost human cognitive ability by a factor of 30 percent.

DEFINITION

Smart Drugs are a group of pharmaceuticals that improve mental functions such as concentration, intelligence and memory beyond average Human levels.

EXAMPLE USE CASES

Today we are using Smart Drugs to help people with severe concentration and memory issues regain some level of normality. In the future the primary use case of this technology will be to continue to help people improve their concentration and memory capabilities but the use of these products will be much more widely spread.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by organisations in the Healthcare sector, with support from univesity grants. In time we will see the technology mature to the point where it will be commercialised and sold as off the shelf products, however, before that happens there will be significant regulatory hurdles to overcome which will slow down the adoption and rate of development of the technology.

While Smart Drugs are in the Productised Stage, over the long term they will be enhanced by advances in Brain Machine Interfaces, Gene Editing, and Neuro-Prosthetics, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

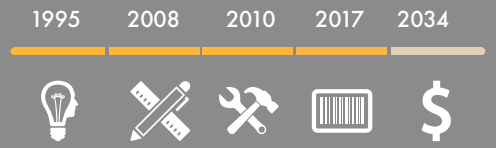
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22

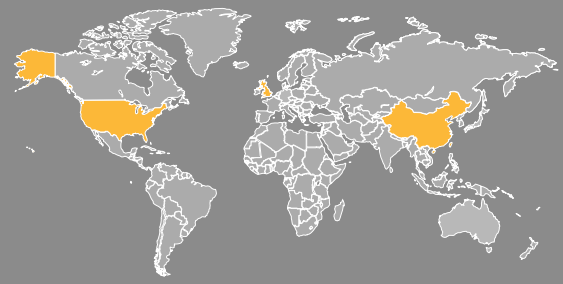
IMPACT

STATUS



Accessibility	6
Affordability	6
Competition	4
Demonstration	6
Desirability	8
Investment	2
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



5 MRL /9

8 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SMART MEDICINE

SMART MEDICINE, which is still in the Prototype Stage and early Productisation Stage, is the field of medicine involved with producing Smart Drugs, that enhance people's mental performance, as well as the use of different technologies, that engender drugs, pills, and other medical treatments with intelligence that allows doctors to precisely control and monitor their behaviours. As a field Smart Medicine holds a lot of promise, primarily because today most drug delivery systems and treatments, for example Chemotherapy, indescriminately flood the body with drugs rather than delivering them precisely to where they're needed where they can have the greatest effect with the smallest doses. The field is also broad, ranging from sensor equipped Smart Pills that release drugs at precise times and locations, all the way through to Nano-Medicine technologies, and even the use of Biological Computers that turn living cells into sentinels within the body capable of identifying diseases and manufacturing the drugs needed to eliminate them on demand and in vivo.

DEFINITION

Smart Medicines are a group of delivery systems, medicines, and treatments that are infused or combined with smart technologies that help boost their efficacy and effectivness.

EXAMPLE USE CASES

Today we are using Smart Medicine to create sensor laden Smart Pills that release specific quantities of drugs, to precise locations within the human body, in response to specific stimulii.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the field will continue to accelerate, and interest and investment will continue to grow. There is currently a lot of buzz about the potential of Smart Medicine, which not only plays into the popularity around Personalised Medicine, but also into the buzz around Quantified Self, all with the added benefit of being able to precisely control and monitor the behaviours of individual treatments.

While Smart Medicine is still in the Prototype Stage and early Productisation Stage, over the long term it is unlikely to be replaced, instead it will be enhanced by other technologies including CRISPR Gene Editing, In Vivo Gene Editing, Nano-Medicine, Semi-Synthetic Cells, and Synthetic Cells.

MATTHEW'S RECOMMENDATION

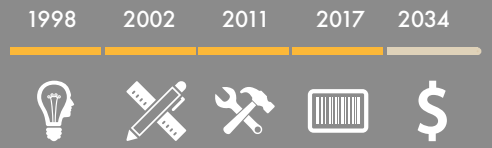
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19

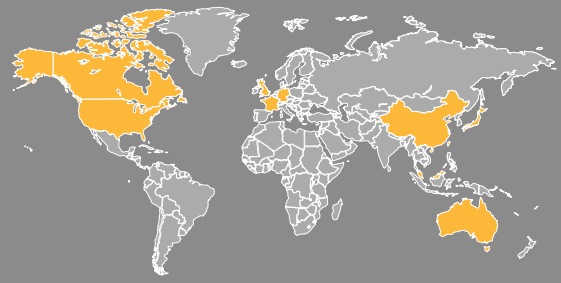
IMPACT

STATUS



Accessibility	4
Affordability	4
Competition	5
Demonstration	5
Desirability	8
Investment	6
Regulation	6
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



6 MRL /9

9 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

STEM CELL TECHNOLOGY

STEM CELL TECHNOLOGY, which is still in the Prototype Stage and Productisation Stage, is the use Stem Cells, the fundamental building blocks of all life on Earth, to create new treatments that improve patient longevity and survivability. While the technology first came to fame in the 1980's it has seen a dramatic renaissance over the past few years with a multitude of breakthroughs, including the creation of the world's first generic, synthetic stem cells, that have helped researchers unravel the mysteries and mechanics of how Stem Cells turn into different differentiated cells which can be used to create basic replica organs and tissues that can then be used in medical treatments. Additionally, however, while researchers are using stem cells to grow replacement organs and tissues, as well as edible meat known as Clean Meat, the advent of 3D Bio-Printing now means researchers can now print organs and tissues, made from stem cells, on demand, and this will accelerate the development and adoption of the technology.

DEFINITION

Stem Cell Technology is the use of stem cells to treat or prevent a disease or condition.

EXAMPLE USE CASES

Today Stem Cell Technology is being used to create everything from replacement bones, which have been transplanted into patients who have suffered bone loss as a result of Cancer, replacement Heart tissue, which has been used to replace dead and scarred heart tissue after heart attacks, and replacement teeth. Furthermore, in other areas researchers have been using the technology to grow Clean Meat, meat without the animal, in Bioreactors, and as a result, the potential of the technology is almost unlimited.

FUTURE TRAJECTORY AND REPLACABILITY

Over the course of the next decade research in the space will continue to accelerate, and interest and investment will continue to grow, all of which will be accelerated by dramatic developments in the complimentary 3D Bio-Printing field.

While Stem Cell Technology is still in the Prototype Stage and Productisation Stage, over the long term it will be enhanced by CRISPR Gene Editing, Semi-Synthetic Cells, and Synthetic Cells, but it is unlikely to be replaced.

MATTHEW'S RECOMMENDATION

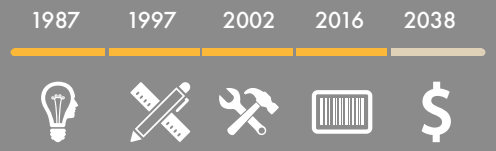
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '23

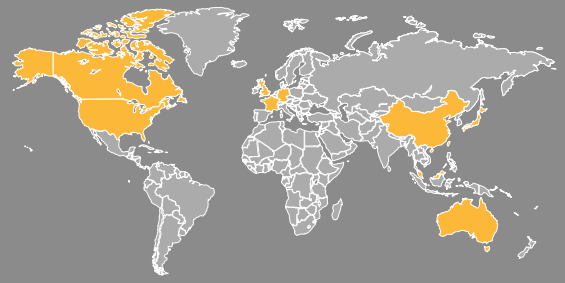
IMPACT

STATUS



Accessibility	7
Affordability	4
Competition	3
Demonstration	7
Desirability	9
Investment	7
Regulation	7
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



4 MRL /9

7 TRL /9

6 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SYNTHETIC BLOOD

SYNTHETIC BLOOD, which is in the Prototype Stage, is the field of research concerned with finding new ways to replace the blood in our body with alternatives that have the same utlity of real blood, but that can be created and or made available on demand without the need for human blood banks or transfusions. Recently there have been a spate of breakthroughs in this field, including powdered blood, and the development of lab grown blood cells from Stem Cells which then went on to be successfully trialled in human patients in the UK.

DEFINITION

Synthetic Blood is a lab made substance that mimics and fulfils the functions of biological blood.

EXAMPLE USE CASES

Every year people die because they can't get the blood transfusions that they need but increasingly the ability to produce blood on demand in a lab, or elsewhere, means that hospitals and patients everywhere will one day be able to get a constant cheap supply of whatever blood groups they need, which is not only revolutionary but is also life changing and saving.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Synthetic Blood increase, albeit from a low base, primarily led by organisations in the Defense and Healthcare sectors. Being able to create human blood on demand has been a long held dream for many doctors and researchers and now that we can this technology is nothing short of revolutionary. Furthermore, as we get better at creating designer blood, which could have applications in the Human Hybrid Immune System field, there is also the likelihood that this same technology could be applied to produce designer blood that helps combat different ailments and diseases in new ways, so one giant leap could lead to many more.

While Synthetic Blood is still in the Prototype Stage it could be enhanced by advances in Artificial Intelligence, CRISPR, Hybrid Human Immune Systems, Materials, Synthetic Biology, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

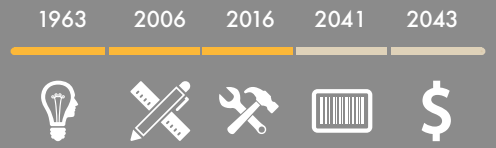
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24, '24

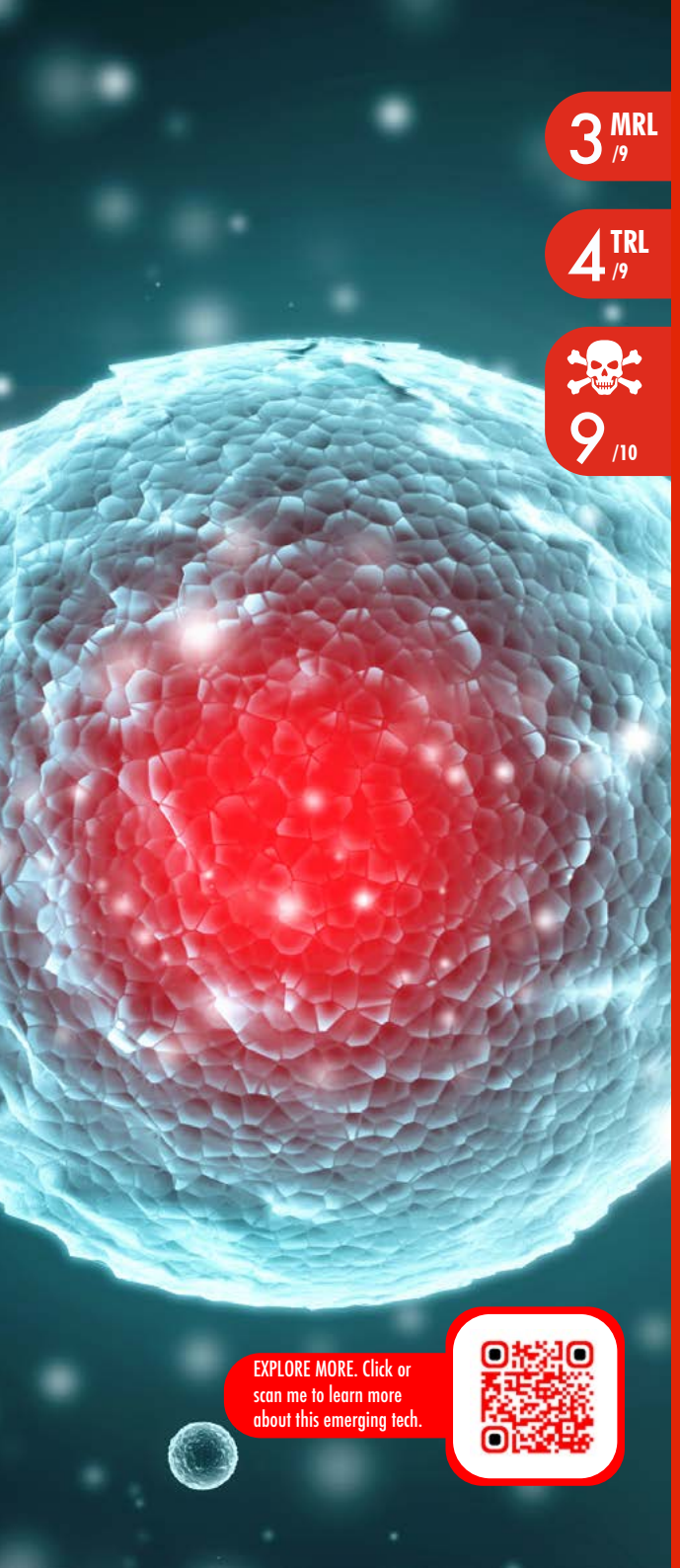
IMPACT

STATUS



Accessibility	3
Affordability	4
Competition	2
Demonstration	6
Desirability	9
Investment	4
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

4 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SYNTHETIC CELLS

SYNTHETIC CELLS, which are still in the Concept Stage and early Prototype Stage, are fully artificial cells that are not found anywhere in nature. While the creation of fully artificial cells, whatever their abilities or properties, is still beyond our grasp, the use cases for the technology would be unlimited, impacting every sector, and potentially every product category, from batteries and energy production, to drugs, materials, and even sensors.

DEFINITION

Synthetic Cells are cells that are wholly artificially manufactured using a variety of different technologies and techniques.

EXAMPLE USE CASES

Today we have created Synthetic Cells with artificial membranes and cell walls that can withstand highly toxic conditions that would kill ordinary biological cells

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the space will continue to accelerate, and interest and investment in will grow, albeit at a slow to moderate rate. Given the sheer complexity of the field, and our current lack of understanding of the mechanics that control and drive cell behaviours, let alone navigating the ethical and regulatory questions surrounding the technology, it is highly likely that the pace of progress in the field will be slow, and then accelerate exponentially over the coming decades. That said though it is also inevitable that there will be breakthroughs along the way and that work in the field will find itself being gradually productised.

While Synthetic Cells are still in the Concept Stage and early Prototype Stage, over the long term the technology will be enhanced by advances in 3D Bio-Printing, 3D Printing, Bio-Manufacturing, CRISPR Gene Editing, In Vivo Gene Therapy, Stem Cell Technology, Molecular Assemblers, and Synthetic Cells, but not replaced.

MATTHEW'S RECOMMENDATION

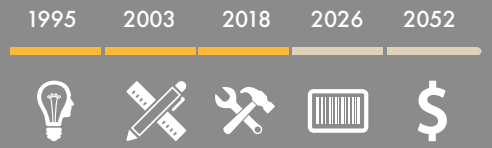
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22

IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	1
Demonstration	3
Desirability	6
Investment	2
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

5 MRL /9

5 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SYNTHETIC DNA

SYNTHETIC DNA, which is in the early Prototype Stage, is the field of research concerned with developing new ways to create artificial or synthetic DNA that are unlike anything found in nature. Recent breakthroughs in the space include the development of new 6 and 8 base pair DNA which has no natural equal and whose impact, to create everything from new biological products and even alien lifeforms with almost unimaginable new capabilities and traits, such as being immune to all known pathogens, is unlimited.

DEFINITION

Synthetic DNA is an unatural and artificial form of DNA that has no equal or equivalent in nature that is made up of either six or eight DNA base pairs rather than the usual four.

EXAMPLE USE CASES

Today we are using Synthetic DNA to create new alien life forms, such as bacteria, that are immune to every known pathogen on Earth, and needless to say the ability to create biological products and lifeforms with 6 and 8 base pair DNA opens up a true Pandora's Box of infinite potential. In the future this technology will be used in any product or sector that has a genetic component, whether it is in the creation of designer humans, Biological Computing and Biological Electronics, or Bio-Manufacturing and Synthetic Biology, to name but a few.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Healthcare sector, with support from univesity grants. In time we will see the technology mature to the point where it creates a new era of evolution and infinite opportunity, however, it will likely face some of the strictest regulatory scrutiny we have ever seen which will delay its adoption and development.

While Synthetic DNA is in the early Prototype Stage, over the long term it will be enhanced by advances in 3D Bio-Printing, 4D-Bio-Printing, Bio-Manufacturing, Biological Computing, DNA Computing, CAST, CRISPR, Gene Drives, Molecular Assemblers, Semi-Synthetic Cells, Synthetic Biology, and Synthetic Cells, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

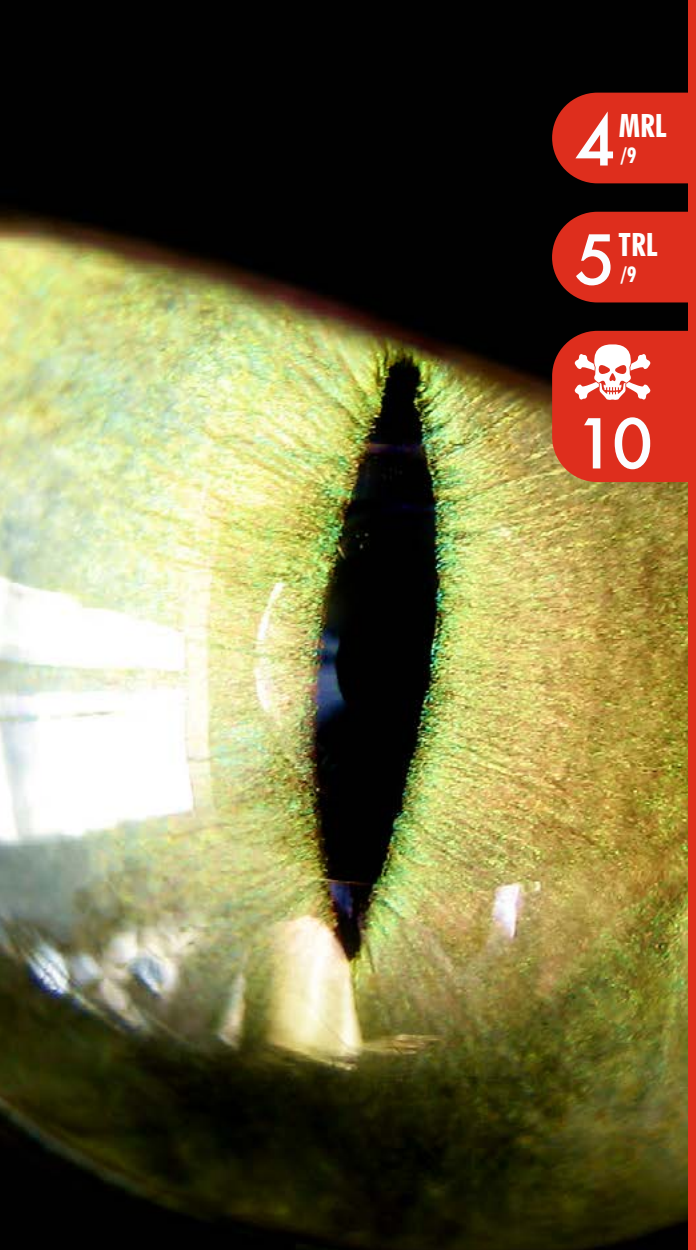
STARBURST APPEARANCES: '20, '21, '22, '23

IMPACT

STATUS

Accessibility	2
Affordability	4
Competition	2
Demonstration	7
Desirability	9
Investment	1
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



4 MRL /9

5 TRL /9

10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SYNTHETIC LIFEFORMS

SYNTHETIC LIFEFORMS, which is in the Prototype Stage and early Commercialisation Stage, is the field of research concerned with developing living, and in some cases replicating, synthetic lifeforms that are man made and therefore unnatural. As we see big strides being made in Synthetic Biology it's becoming increasingly feasible for researchers to create new kinds of life forms with novel properties that would never have existed in nature. At the moment most Synthetic Lifeforms are part natural and part synthetic, however in time there's little doubt we'll see the creation of fully synthetic lifeforms, including synthetic Humans. Recent breakthroughs in this field include the development of the first Yeast cell that was 50% artificial and 50% natural which was a giant leap from previous iterations.

DEFINITION

Synthetic Lifeforms are engineered living organisms created using Synthetic Biology that have distinct functions or properties.

EXAMPLE USE CASES

The primary use case for this technology is to create bio-engineered life forms, such as bacteria, that can then be used in Bio-Manufacturing to make new drugs, enzymes, materials, and other valuable products. Other use cases include creating lifeforms that can clear up toxic chemicals and spills, for example in mining operations, industrial bio-technology and bioinformatics applications, as well as new kinds of biological and living sensors, and many other use cases.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Synthetic Lifeforms increase, primarily led by the Healthcare and Manufacturing sectors and university grants. While this technology refers to any organism whose genetic makeup has been in part or in whole synthesised in a lab, rather than through natural selection or selective breeding, its potential use cases are almost limitless - as is often the way with "nature." But there are huge ethical and regulatory hurdles to overcome before it goes mainstream.

While Synthetic Lifeforms are still in the Prototype and early Commercialisation Stage it could be enhanced by advances in Artificial Intelligence, Biological AI and Computing, CRISPR, Quantum Computing, Synthetic Biology, Synthetic DNA, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

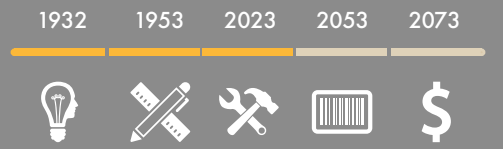
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

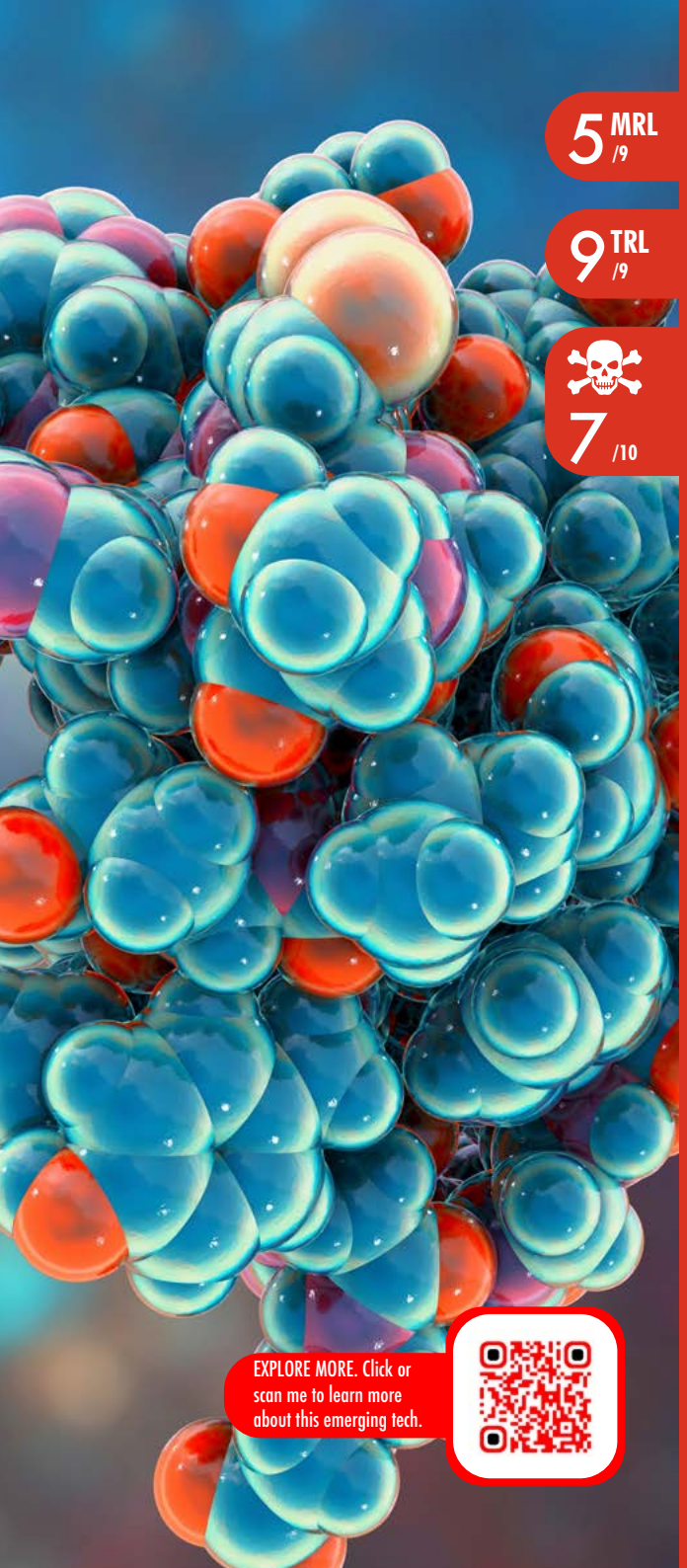
IMPACT

STATUS



Accessibility	3
Affordability	6
Competition	5
Demonstration	8
Desirability	8
Investment	5
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



5 MRL /9

9 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SYNTHETIC PROTEINS

SYNTHETIC PROTEINS, which are in the early Productisation Stage, is the field of research concerned with trying to develop new proteins with new capabilities and functionalities that don't exist in nature. Recently there have been major breakthroughs in the field, and with literally everything to play for the upsides of getting this technology right could be world changing. These breakthroughs include the development of an AI that can model and simulate any protein - natural or unnatural - and which broke biology's "50 year Grand Challenge," and the development of new complex and large synthetic proteins with tens of thousands of amino acids and millions of atoms.

DEFINITION

Synthetic Proteins are proteins that have been synthesised.

EXAMPLE USE CASES

The applications of Synthetic Proteins is vast, from transforming human healthcare and accelerating the development of Cellular Recorders, as well as new drugs and even lifeforms, through to their roles in the development of new Bio-Active Materials, Bio-Manufacturing processes and products, biochemicals, biofuels and new energy alternatives, drug manufacturing, electronic interfaces, foods, molecular machines and nanomachines, sensors, therapeutics, wonder materials, and much more.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate dramatically, predominantly led by the Healthcare sector, and supported with government grants. With new developments in many complimentary technology areas interest in this field has increased significantly with increasingly giant teams of researchers on the front line now focused on productising the technology. While the exact date of when certain product categories will emerge is fuzzy there is no doubt that this technology will play a significant role in the future of humanity.

While Synthetic Proteins are still in the early Productisation Stage they could be enhanced by advances in AI, Biological Computing, Cellular Recorders, Living Pharmacies and Living Materials, Quantum Computing, Synthetic Biology, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

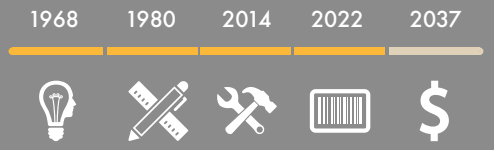
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23, '24

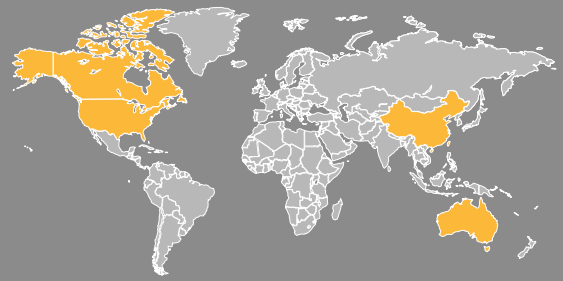
IMPACT

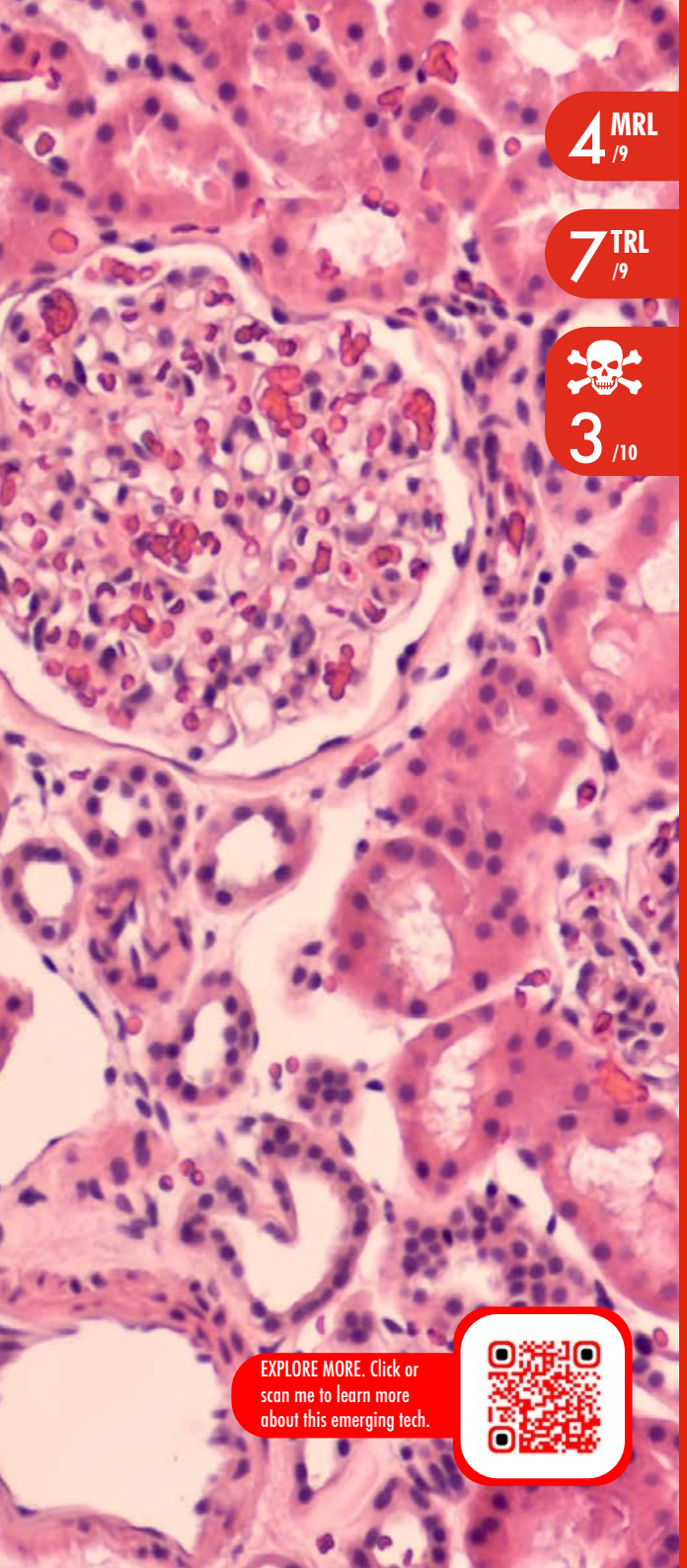
STATUS



Accessibility	4
Affordability	4
Competition	3
Demonstration	7
Desirability	9
Investment	4
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





4 MRL /9

7 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

TISSUE ENGINEERING

TISSUE ENGINEERING, which is still in the Prototype Stage and early Productisation Stage, is a relatively old field that has seen a dramatic uptick in interest in recent years. This is partly fuelled by the up surge of interest in other complimentary technology fields, such as 3D Bio-Printing, Regenerative Medicine, Nanotransfection, and Stem Cell Technology, where there are research overlaps. Tissue Engineeering, which can at a crude level be thought of construction for organs, plays a vital role in helping researchers create viable, replacement organs and tissues that can be used in medical treatments. In order to achieve this researchers have to figure out the right way to combine different biological materials, and scaffolds and growth factors, that help those organs grow in the right shape with the right biological and mechanical properties.

DEFINITION

Tissue Engineering is the use of a combination of cells, materials and suitable biochemical and physiochemical factors to improve or replace biological functions.

EXAMPLE USE CASES

Today we are using Tissue Engineering to create viable, replacement Arteries, Bladders, Cartilage, Skin Grafts, and Trachea, which have already been implanted into patients.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the space will continue to accelerate, and interest and investment will continue to grow. Furthermore the inter-dependencies between all of the aforementioned technologies means that Tissue Engineering will get a bump and play an increasingly vital role in helping us realise our eventual goals of creating replacement organs and tissues.

While Tissue Engineering is still in the Prototype Stage and early Productisation Stage, over the long term purely biological products will eventually be enhanced by other technologies such as Flexible Electronics, Semi-Synthetic Cells, Sensors, and Synthetic cells, to create hybrid organs and tissues with new and enhanced capabilities.

MATTHEW'S RECOMMENDATION

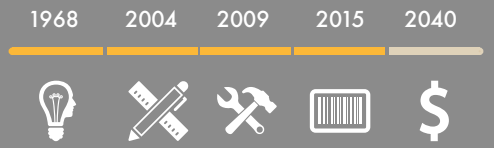
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19

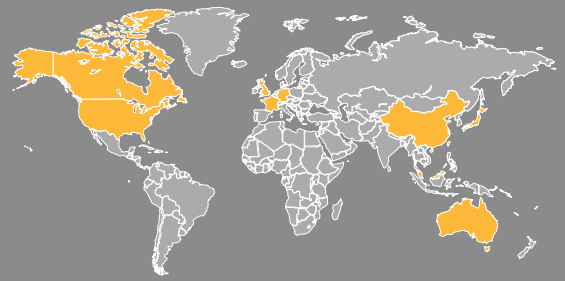
IMPACT

STATUS



Accessibility	8
Affordability	5
Competition	6
Demonstration	7
Desirability	8
Investment	7
Regulation	6
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



5 MRL /9

9 TRL /9

6 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

TISSUE NANOTRANSFECTION

TISSUE NANOTRANSFECTION, which is in the Prototype Stage, is the field of research concerned with finding new ways to transform skin and other human tissues into other tissue types which can then be used in therapies and transplants on demand. Recently there have been multiple breakthroughs in the field across different tissue types including the development of a Nanochip that gives tissues a mild electric shock in order to reprogram them at the genetic level and transform them into other kinds of human tissues which can then be used to treat everything from muscle loss to nerve damage.

DEFINITION

Tissue Nanotransfection is the use of non-invasive technologies to reprogram the body's biological tissues and functions.

EXAMPLE USE CASES

Today Tissue Nanotransfection is being used to transform skin tissue into all manner of other useful tissue types including blood vessels, muscle tissue, and nerve tissues which can then be transplanted into patients to treat different chronic conditions. There have also been examples of it being used to achieve cell-specific gene editing of skin tissue to accelerate and improve wound healing in burns and diabetic patients. Looking ahead this technology will also have significant implications for the field of Regeneritive Medicine.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in Tissue Nanotransfection accelerate, albeit from a low base, predominantly led by the healthcare sector and government and military grants. The ability to transform a patients own tissues into other kinds of usable tissues gives doctors access to a valuable literal on demand "tissue library" which can be used in all kinds of treatments, and with signs that regulators are willing to authorise treatments, the future for this technology, provided it can receive the funding and support it needs looks promising.

While Tissue Nanotransfection is still in the Prototype Stage it could be enhanced by advances in AI, 3D and 4D Bio-Printing, Bio-Electronic Medicine, Regenerative Medicine, Synthetic Biology, and other technologies, however over the long term it could be replaced by Organ Printing.

MATTHEW'S RECOMMENDATION

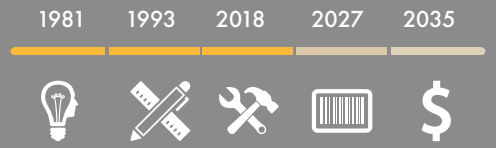
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

IMPACT

STATUS



Accessibility	4
Affordability	4
Competition	4
Demonstration	7
Desirability	8
Investment	5
Regulation	7
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

6 MRL /9

8 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

XENOTRANSPLANTATION

XENOTRANSPLANTATION, which is in the Prototype Stage, is the field of research concerned with trying to find new ways to transplant the organs of Chimeric Organisms into human patients who for whatever reason have no alternative transplant options. While there have been limited breakthroughs in the field our ability to create Chimeric organs for transplant is improving as too are the techniques to transplant those organis into human patients. However, so far while there have been several transplants the results have not been as good as people hoped with some patients unexpectedly dying from hitherto undetermined complications. Despite this though researchers in the field have hope for the future.

DEFINITION

Xenotransplantation is the process of grafting or transplanting organs or tissues between members of different species.

EXAMPLE USE CASES

Today the primary use case for this technology, and arguably the only one at the moment, is to help solve the human organ transplant problem where today a severe lack of viable human organs for transplant patients means that many of them either live severely limited lives or die before suitable organs become available.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in the field accelerate, albeit from a low base, predominantly led by the healthcare sector. However, as we continue to see the rise of alternative organ therapies, such as Universal Organs and 3D and 4D Bio-Printed organs, the future for this particular research thread is uncertain. That said though given the fact that the supply of human organs for transplant remains restricted regulators have been keen to engage so while the time window for success is narrowing it's not time to count this technology out quite yet.

While Xenotransplantation is still in the Prototype Stage it could be enhanced by advances in Chimeras, Organ Printing, Universal Organs, and other technologies, however over the long term it is likely to be replaced by Organ Printing and Regenerative Medicine.

MATTHEW'S RECOMMENDATION

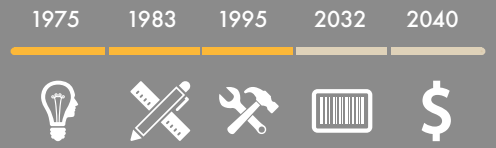
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23

IMPACT

STATUS



Accessibility	5
Affordability	6
Competition	5
Demonstration	8
Desirability	7
Investment	6
Regulation	8
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

COMPUTE

TODAY WE think of computing in much the same way we have for the last number of decades - in digital bits and bytes running on silicon. But tomorrow's computing platforms will instead harness the power of biology, chemistry and physics, to create new formats and platforms that are capable of packing all of today's computing power into nothing more than the size of a test tube, and which far exceed the power and potential of even the most powerful systems we have today.

In this section you will find details of the emerging technologies that made it into this years Griffin Emerging Technology Starburst along with details of other impactful emerging technologies:

1. Analogue Computing
2. Biological Computing
3. Blockchain
4. Chemical Computing
5. Distributed Computing
6. DNA Computing
7. Earable Computing
8. Edge Computing
9. Exascale Computing
10. Federated Supercomputing
11. Intelligence Processing Units
12. Ionic Computing
13. Liquid Computing
14. Meta Computing
15. Micromotes
16. Minerless Blockchains
17. Molecular Computing
18. Nano Magnetic Computing
19. Nanoscale Computing
20. Neuromorphic Computing
21. Organic Computing
22. Photonic Computing
23. Pneumatic Computers
24. Quantum Computing
25. Substrate Computing
26. Terahertz Computer Chips
27. UHD Rendering Engines
28. Wave Computing

In addition to these emerging technologies there are many others that have yet to get an entry in this codex. These include, but are not limited to:

29. 3D Chips
30. Bio-Molecular Software
31. Bio-Photonics
32. Carbon Nanotube Transistors
33. Chiplets
34. Cloud Based Rendering Engines
35. Codeless Computing
36. Computational Semantics
37. Containerisation
38. Decentralised Applications
39. DNA Storage
40. Fiber Computing
41. Gate All Around Transistors
42. Graphic Processor Units
43. Intercloud Computing
44. Memristors
45. Memtransistors
46. Neural Processing Units
47. Neurosynaptic Chips
48. Neurotransistors
49. Polymer Storage Technology
50. Probablistic Computing
51. Progressive Web Applications
52. Quantum Simulators
53. Serverless Computing
54. Silicon Photonics
55. Spatial Computing
56. Storage Crystals
57. Virtualisation

4 MRL /9

6 TRL /9

3 /10

ANALOGUE COMPUTING

ANALOGUE COMPUTING, which is in the early Commercialisation Stage, is the field of research concerned with trying to develop a new kind of ultra low power computing platform that has special utility, especially when it comes to being able to run large scale Analogue Artificial Intelligence models. Recent breakthroughs include the development of increasingly powerful and commercially viable analogue computing chips by major US technology companies which could in time form the foundation of a new range of cloud computing and edge computing platforms.

DEFINITION

Analogue Computing systems use the continuous variation of analogue signals to model and solve problems.

EXAMPLE USE CASES

Today Analogue Computing platforms are fairly limited in their utility, however given their unique characteristics they excel at the simulation of physical streams and can solve differential equations in real time, making them valuable for engineers and scientists who want to analyse system behaviours and optimise designs. Other use cases also include the ability to efficiently optimise different dynamic systems that have continuous inputs and outputs, as well as their use in electronic warfare applications, flight simulation, missile guidance, navigation, and even spectrum analysis.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Analogue Computing increase, primarily led by the Aerospace and Technology sectors. Today it's all too easy to think we live in a digital only world but there are still a huge number of applications and data sets that are analogue in nature which makes this computing platform, albeit niche by comparison to some others, vitally important, therefore this is a technology that still has a long life ahead of it.

While Analogue Computing is still in the early Commercialisation Stage it could be enhanced by advances in Analogue Artificial Intelligence, Materials, Quantum Computing, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

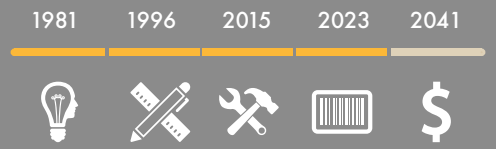
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

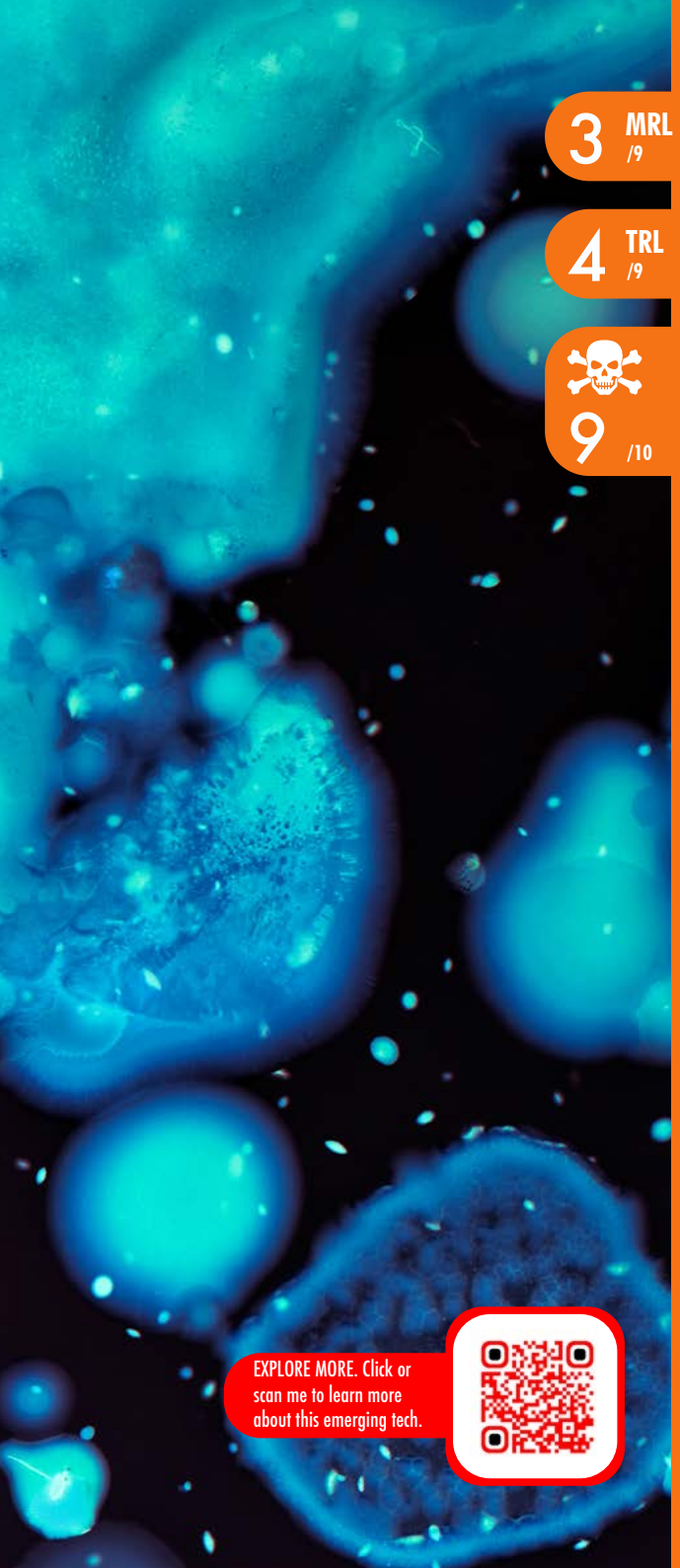
IMPACT

STATUS



Accessibility	4
Affordability	6
Competition	3
Demonstration	7
Desirability	8
Investment	5
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

4 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

BIOLOGICAL COMPUTING

BIOLOGICAL COMPUTING, a GENERAL PURPOSE TECHNOLOGY, which is still in the Concept Stage and Prototype Stage, is the field of computing concerned with turning biological systems, from the most basic forms of bacteria to humans, into computing and storage platforms. Closely coupled with DNA Computing, and made possible by advances in CRISPR Gene Editing, ultimately these will quickly become the most powerful and complex computing platforms ever created, capable of packing all of today's computing power into something no larger than a test tube, and potentially far exceeding the performance of Quantum Computers. Similarly, as the rise of Bio based products and industries continue to emerge these platforms could, over time, become the planets main de facto computing standard.

DEFINITION

Biological Computers use systems of biologically derived molecules, such as DNA and proteins, capable of performing computational calculations that involve the storing, retrieving, and processing data.

EXAMPLE USE CASES

Today we have created Biological Computers, in the form of bacteria and human Liver cells, capable of computing and storing data, and re-playing videos. We have also demonstrated in the lab that we can turn human as well as mammalian cells into powerful Biological Computers capable of turning the human body into a disease fighting supercomputer capable of identifying disease and then manufacturing the drugs needed to eliminate them.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the area will continue to accelerate, and while interest and investment in the space is growing it is growing from a very low, specialist base. As a result it is likely that the bulk of the work will be restricted to the labs. However, as our understanding of genetics, and as our Gene Editing tools improve, this rate of acceleration will increase, but it is also highly likely that the Productisation of the technology will be heavily impacted and slowed down by the regulators.

While Biological Computing is still in the Prototype Stage and Concept Stage, over the long term it will be enhanced by new advances in 3D Bio-Printing, CRISPR Gene Editing, DNA Computing, Molecular Computing, Molecular Assemblers, Nanotechnology, and Quantum Computing, but not replaced.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

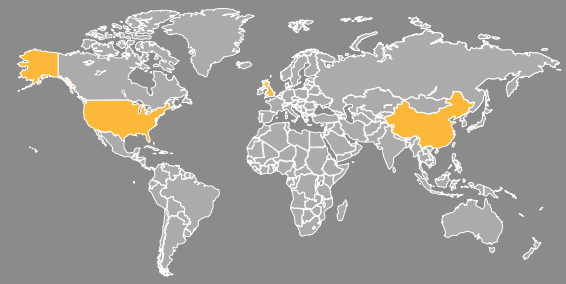
STARBURST APPEARANCES: '19, '20, '21, '22, '23, '24

IMPACT

STATUS

Accessibility	2
Affordability	3
Competition	7
Demonstration	7
Desirability	9
Investment	2
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



9 MRL /9

9 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

BLOCKCHAIN

BLOCKCHAIN, a GENERAL PURPOSE TECHNOLOGY, which is in the Prototype Stage and Productisation Stage, is a technology revolutionising the way decentralised and disparate third party organisations and systems, across all sectors and types, communicate and interact with one another. While the technology has seen its share of hype, which was initially responsible for its fast rise to fame, the technology is slowly coming into its own, and in the minds of many people, including governments and regulators, is finally starting to loose its Bitcoin stigma which was arguably holding it back. As the technology shows the early signs of maturing we now look forwards to seeing it roll into the mainstream.

DEFINITION

Blockchain is a tamper proof, verified, decentralised public ledger of digital events. It's data can never be erased and new data can only be added to it once the consensus of a majority of the Miners in the system is reached.

EXAMPLE USE CASES

Today there are thousands of use cases already being productised, from the creation of national cryptocurrencies, and new global banking, identity, logistics and supply chain solutions, to the creation of new cyber-security, internet and RegTech services. There is arguably no limit to the number of use cases the technology can be applied to.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the area will continue to accelerate, and interest and investment will continue to grow, albeit in a slightly cyclical manner as the technology will likely still experience sudden surges in popularity.

While Blockchain is still in the Prototype Stage and Productisation Stage, over the long term it will be enhanced by Artificial Intelligence, and Quantum Safe Blockchains, and potentially replaced by new forms of Minerless Blockchains.

MATTHEW'S RECOMMENDATION

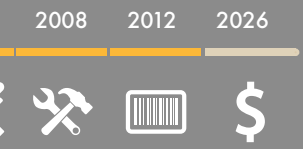
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

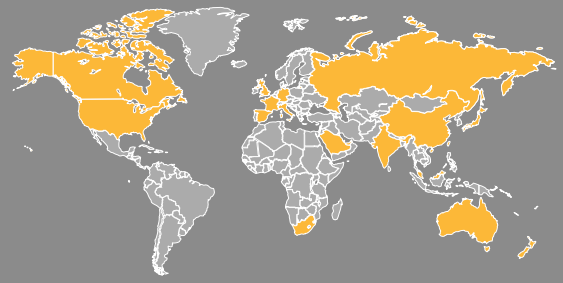
IMPACT

STATUS



Accessibility	9
Affordability	7
Competition	4
Demonstration	9
Desirability	9
Investment	8
Regulation	5
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



CHEMICAL COMPUTING

CHEMICAL COMPUTING, a GENERAL PURPOSE TECHNOLOGY, which is stil in the Concept Stage and early Prototype Stage, is a form of computing that uses chemicals to process and store information in Chits, which are the Chemical Computing equivalent of Binary units. Unlike their silicon based equivalents Chemical Computers have the advantage that they can take many forms, both liquid and semi-liquid, and as a result they will be able to be incorporated into many different products, as well as environments and living organisms, including humans.

DEFINITION

Chemical Computers use varying concentrations of different chemicals, and Acid-Base reactions, to store and process information contained in Chemical Bits.

EXAMPLE USE CASES

Today we are using basic Chemical Computers to send text messages and perform basic calculations, but over the longer term possible use cases could also include environmental monitoring, manufacturing and more.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the space will continue to accelerate, and interest and investment will continue to grow, albeit from a low base.

While Chemical Computers are still in the Concept Stage and early Prototype Stage, over the long term they will be enhanced by Molecular Assemblers, Molecular Robotics, Nano-Manufacturing, and Nano-Robotics, and eventually it is highly likely that the category will merge with the Molecular Computing category.

MATTHEW'S RECOMMENDATION

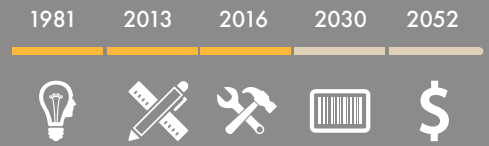
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

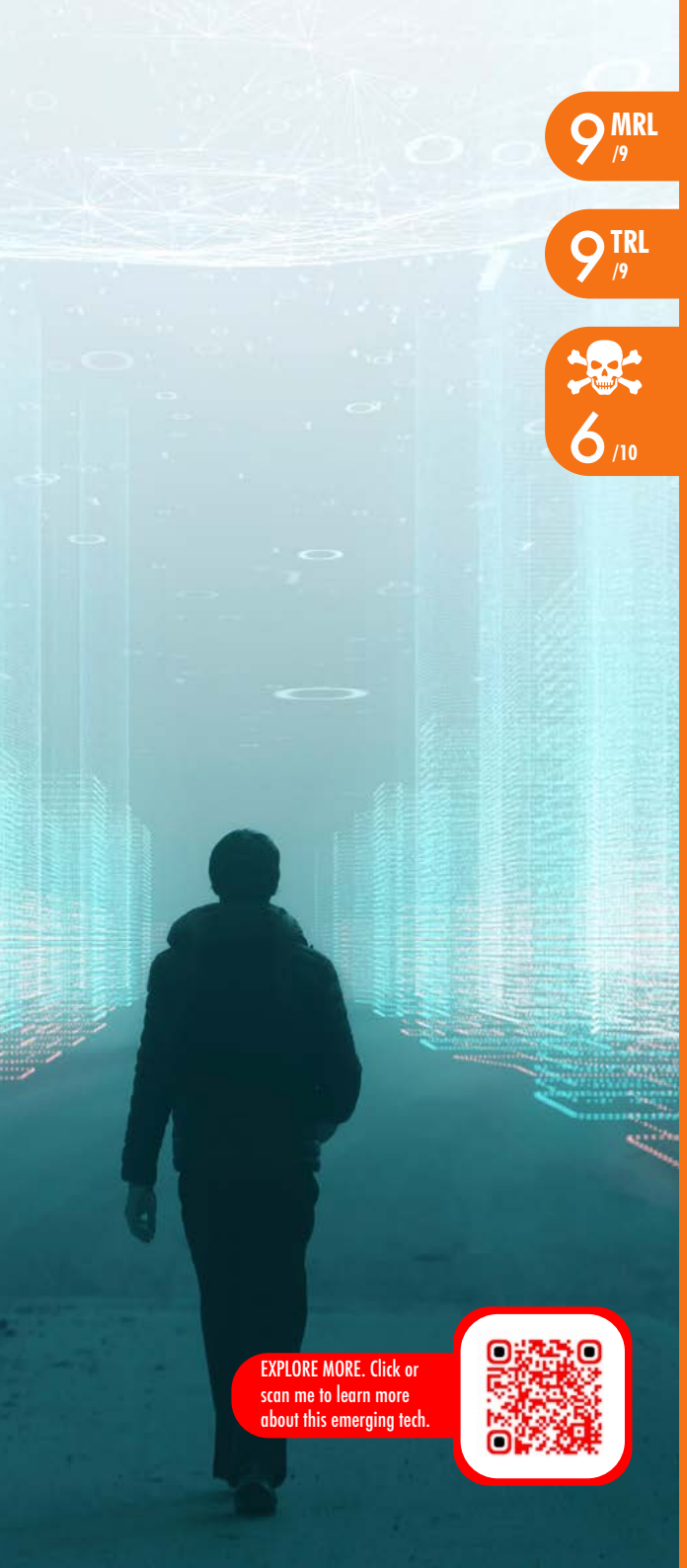
IMPACT

STATUS



Accessibility	2
Affordability	3
Competition	4
Demonstration	5
Desirability	7
Investment	2
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



9 MRL /9

9 TRL /9

6 /10

DISTRIBUTED COMPUTING

DISTRIBUTED COMPUTING, which is in the Productisation Stage, is a relatively generic computing term that in my opinion, today, should also include the Edge Computing and Fog Computing categories. It is often thought that the computing industry moves in cycles, with computing first being centralised, and then eventually becoming decentralised again over time before it consolidates again, but as computing platforms continue to shrink in size, while at the same time increasing in power, we are increasingly able to embed computing capabilities, that can be directed and managed by Blockchain networks, into devices of all shapes and sizes, from gadgets, materials, and sensors, to one day organisms and even humans.

DEFINITION

Distributed Computing, which also encapsulates Edge and Fog Computing, is where data is ingested, processed, stored and transmitted from a wide variety of devices and locations.

EXAMPLE USE CASES

Today we are using Distributed Computing to embed intelligence into everything from Autonomous Vehicles and Internet of Things products, through to all of our devices and gadgets, but over the longer term we will be able to embed compute capabilities into everything everywhere, from marine organisms, which is already on the US Military's roadmap thanks to the advent of Biological Computing, to space colonies, and everything in between.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the space will continue to accelerate, and interest and investment will continue to grow, and over time everything everywhere will be embedded with computing and intelligence.

While Distributed Computing is still in the Productisation Stage, over the long term it will be enhanced by Biological Computing, Blockchain, Chemical Computing, DNA Computing, Liquid Computing, Micromotes, Minerless Blockchains, Molecular Computing, Neuromorphic computing, photonic Computing, and potentially replaced by the advent of 5G and 6G.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

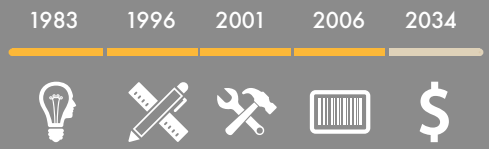
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17

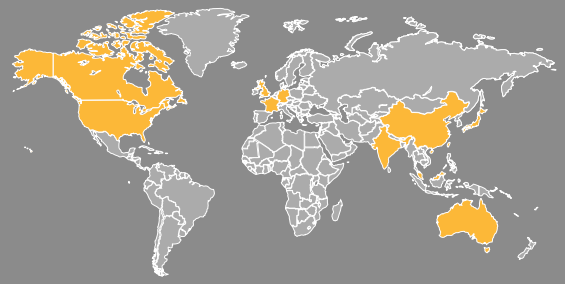
IMPACT

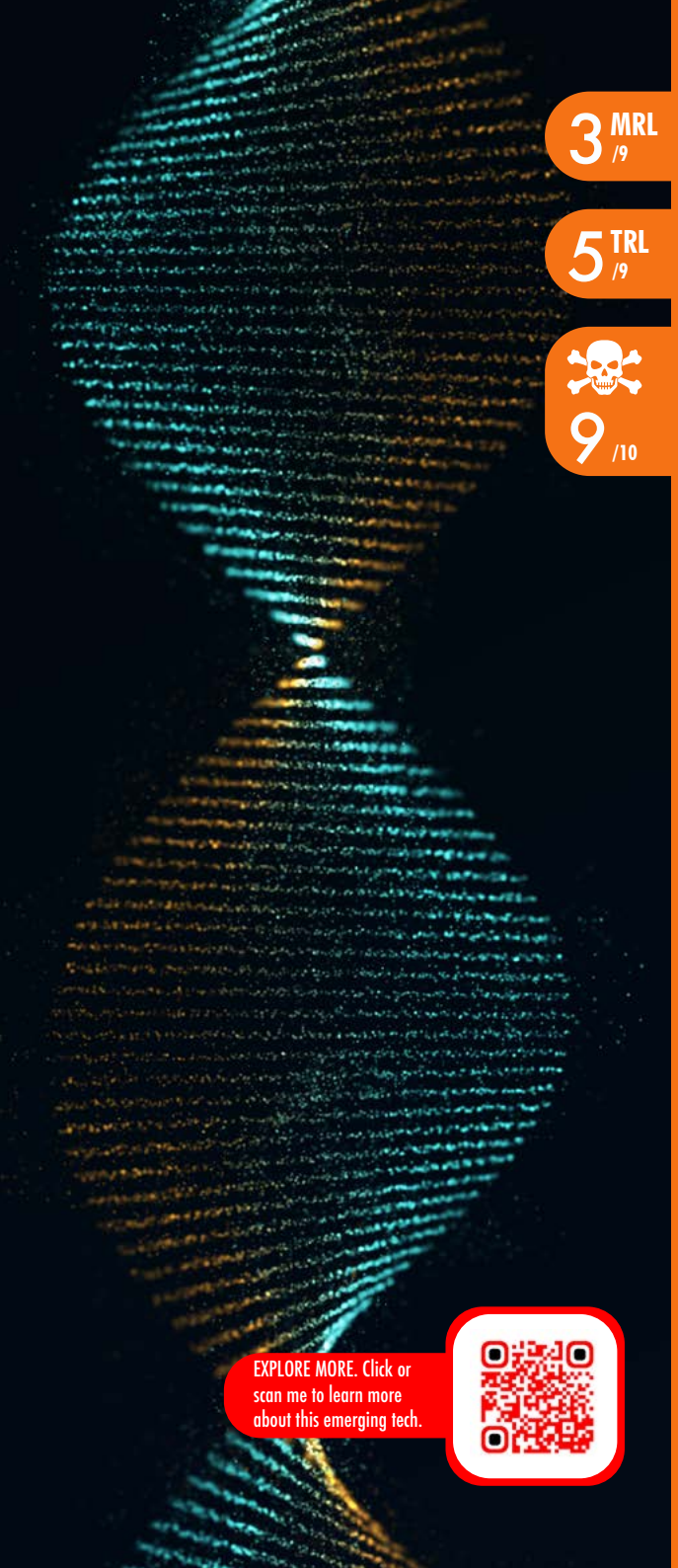
STATUS



Accessibility	6
Affordability	7
Competition	5
Demonstration	7
Desirability	8
Investment	5
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





3 MRL /9

5 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

DNA COMPUTING

DNA COMPUTING, a GENERAL PURPOSE TECHNOLOGY, which is still in the Concept Stage and early Prototype Stage, will potentially be one of, if not the most powerful, type of computing platforms on the planet, making even ultra-powerful and performant Quantum Computers, that can operate at over 100 million times faster than today's logic based computer platforms, look slow thanks to the fact that DNA Computers will be able to process everything from complex single workloads to trillions of workloads in parrallel by simply replicating themselves up, before collapsing back down again, and all within the confines of a space no larger than a small test tube.

DEFINITION

DNA Computing uses Biochemistry, DNA, and Molecular Biology hardware, instead of the traditional silicon based computer technologies to process and store information.

EXAMPLE USE CASES

Today we are using DNA Computers to create the world's first DNA Storage services in the cloud, and to turn ordinary human cells in the labs into powerful disease fighting supercomputers capable of identifying and then eliminating by disease by controlling the cells DNA machinery and getting it to manufacture the necessary drugs.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the space will continue to accelerate, albeit from a low base, and interest and investment will continue to grow. As researchers continue to unlock and unravel the mysteries of DNA and genetics, and become increasingly competent at hijacking natures own machinery for their own benefits, it is inevitable that one day DNA computers will become productised.

While DNA Computing is still in the Concept Stage and early Prototype Stage, over the long term it will be enhanced by Biological Computing, and CRISPR Gene Editing, however, while the category may merge with Biological Computing, at the moment it is highly unlikely it will be replaced.

MATTHEW'S RECOMMENDATION

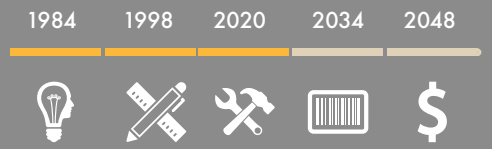
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23

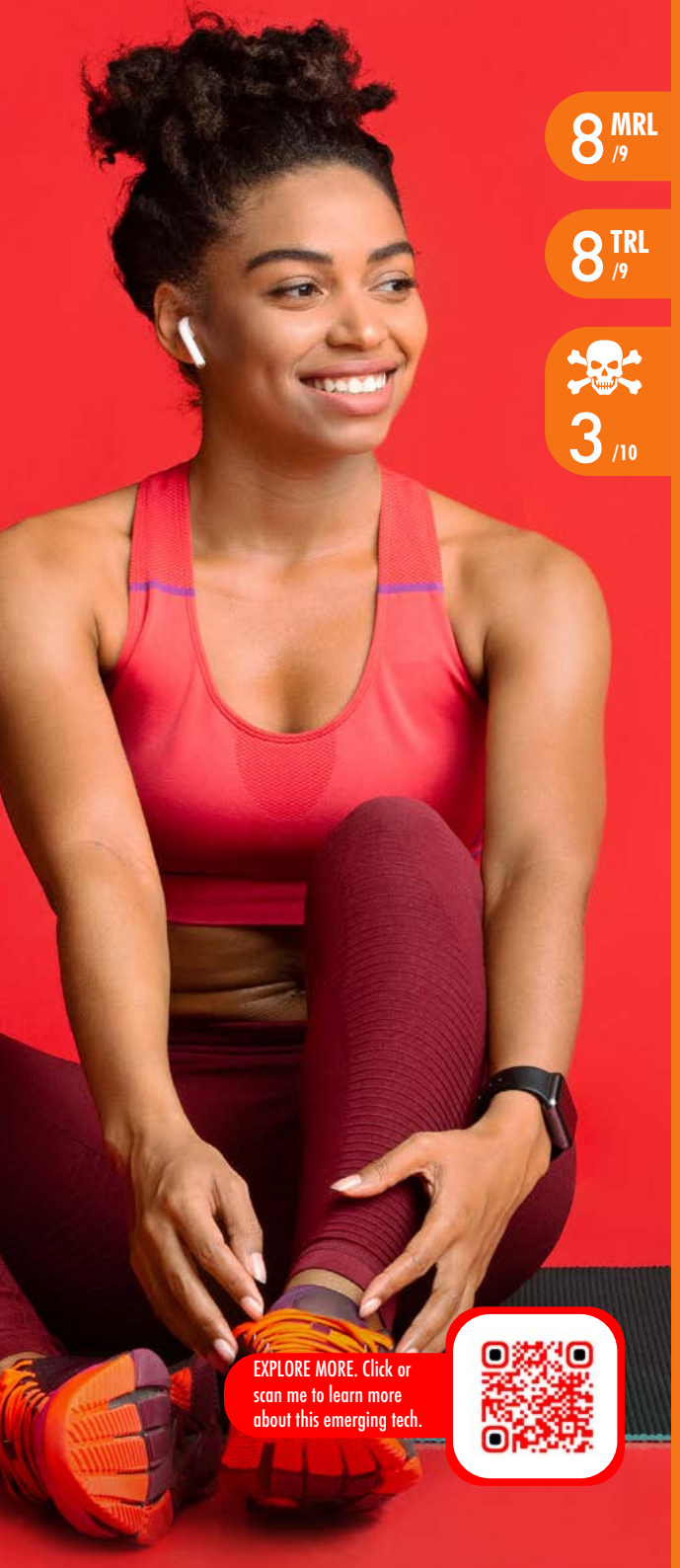
IMPACT

STATUS



Accessibility	4
Affordability	3
Competition	2
Demonstration	8
Desirability	9
Investment	2
Regulation	3
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



8 MRL /9

8 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

EARABLE COMPUTING

EARABLE COMPUTING, which is in the Prototype Stage, is the field of research concerned with developing new types of computing and electronics platforms that fit inside, or rest alongside, the human ear. Recently there have been a number of developments in the field which include the development of new healthcare focused in the ear wearables, as well as Neuro-Modulating earbuds which let people learn new skills in new ways. Also, as technology continues to miniaturise and improve in capability and performance Earable Computing could become an increasingly interesting field especially when you realise that as wireless Non-Invasive Brain Machine Interfaces (NIBMI), which will soon allow people to communicate telepathically with one another as well as enable people to "telepathically" beam images directly to peoples brains, thus bypassing the eyes, continues to miniaturise this could make the ideal platform to replace the ubiquitous smartphone whose only issue leaping to "what comes next" is the display.

DEFINITION

Earable Computing is an ear worn technology that includes a variety of compute and compute-like components.

EXAMPLE USE CASES

Today we have Neuro-Modulating earbuds that can be used to accelerate Neuro-Training. We also have earbuds that can sense their heartbeats from the blood vessels in the ear, and we have NIBMI which can be embedded into Smart Tattoos and Smart Glasses to enable wireless Brain to Brain and Brain to Machine communication as well as eventually AI Symbiosis. By combining these tecnologies together, which would let machines send imagery and information telepathically to peoples brains, thus bypassing the eyes, in the long term the technology has a shot being the next Smartphone format.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, primarily led by organisations in the Consumer Electronics and Technology sector, with support from university grants. In time we will see the technology mature to the point where we are able to realise new opportunities.

While Earable Computing is in the prototype Stage, over the long term it will be enhanced by advances in Brain Machine Interfaces, as well as Compute, Electronics, and Sensor technologies, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

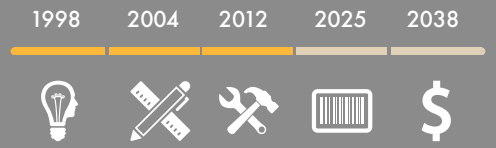
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '21

IMPACT

STATUS



Accessibility	5
Affordability	6
Competition	7
Demonstration	6
Desirability	5
Investment	3
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

9 MRL /9

9 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

EDGE COMPUTING

EDGE COMPUTING, which is in the Productisation Stage, is the field of research concerned with finding new ways to bring compute, intelligence, and storage, closer to data sources at the edges of the network so that they can be analysed and actioned without first having to be sent back to central datacenters to be processed. While this technology goes hand in hand, somewhat, with the Internet of Things trend as well as other technologies and trends, today the continued miniaturisation of AI neural networks, compute components, and their associated dramatic increases in performance mean that this technology is becoming increasingly powerful and impactful.

DEFINITION

Edge Computing is the practise of capturing, storing, and analysing data near where the data is generated.

EXAMPLE USE CASES

While many people might think small when they think of this technology, such as the use of edge computing and sensor fusion technologies to create more intelligent Internet of Things networks and systems, such as those used in Precision Agriculture, Smart Cities, Smart Grids, or Smart Homes, today Autonomous Vehicles are also another good example of this technology in action, and so too is Predictive Maintenance and wearable technology's quantified self use case. And there are many other examples.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the technology sector. In time we will see Edge Computing become ubiquitous and be the defacto way that rapid decision making at the edge is done.

While Edge Computing is in the Productisation Stage, over the long term it will be enhanced by advances in Artificial Intelligence, Communications, Computing, and many other complimentary technology fields, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

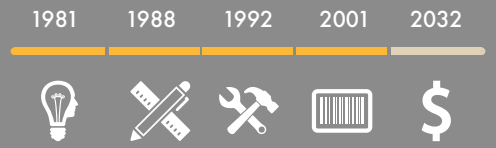
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

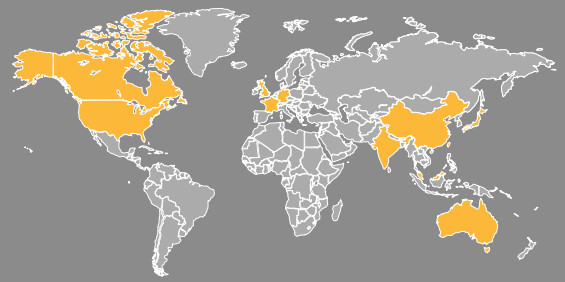
IMPACT

STATUS



Accessibility	7
Affordability	7
Competition	5
Demonstration	9
Desirability	9
Investment	7
Regulation	4
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



EXASCALE COMPUTING

EXASCALE COMPUTING, a GENERAL PURPOSE TECHNOLOGY, which is still in the Prototype Stage and early Productisation Stage, is an increasingly important computing category as sovereign governments see the power of these computing platforms as a competitive national advantage when it comes to the ability to innovate new breakthrough products and solutions in just fractions of the time it would take a traditional large scale computing platform. Exascale Computers are computing platforms packed with state of the art inerconnects, GPU's and silicon based chips that are capable of performing a Quintillion calculations per second, and they will become increasingly important as governments and organisations want to run increasingly complex experiments and simulations.

DEFINITION

Exascale Computing refers to computing systems capable of at least one Exaflop, or a Quintillion, calculations per second.

EXAMPLE USE CASES

When the first Exascale Computing platforms arrive we will be using them to model the whole human brain, not just the 10 percent that we do today, create better climate models and discover new drugs and materials, and much more.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the space will continue to accelerate, and interest and investment will continue to grow, especially when we begin to see the first platforms coming online.

While Exascale computing is still in the Prototype Stage and early Productisation Stage, over the long term, and once we have the new programming languages and tools established, they will at first be enhanced by Photonic Computing and Quantum Computing, and eventually replaced by new exotic forms of computing including Biological Computing, Chemical Computing, Molecular Computing, Neuromorphic Computing and, again, Quantum Computing.

MATTHEW'S RECOMMENDATION

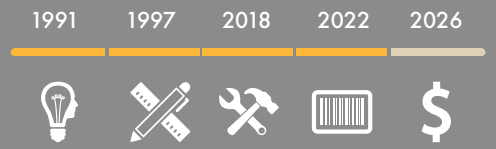
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '23, '24

IMPACT

STATUS



Accessibility	6
Affordability	4
Competition	5
Demonstration	9
Desirability	9
Investment	7
Regulation	6
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

6 MRL /9

9 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

FEDERATED SUPERCOMPUTING

FEDERATED SUPERCOMPUTING, a General Purpose Technology, which is in the early Productisation Stage, is the field of research dedicated to building the computer architectures needed to allow geographically distrubuted computing clusters and platforms to pool their compute, storage, and network resources in order to emulate and exceed the performance and capabilities of traditional supercomputers. Recently there have been several breakthroughs with expanded containerisation options, as well as the deployment of several small scale supercomputing instances which have been combined together to create Federated Supercomputing-as-a-Service (FSaaS). And we are also seeing the first stages of Federated Quantum Computing-as-a-Service (FQCaaS) which could be game changing.

DEFINITION

Federated Supercomputing is the pooling together of logically distributed computing nodes to create a massive single supercomputing instances.

EXAMPLE USE CASES

While the largest FS and FQCaaS services don't yet exceed the capabilities of the world's largest Exascale supercomputers there is a major overlap between the two when it comes to use cases especially in the fields of AI development, data mining, materials and medical research, supply chains and logistics, and many more.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate, predominantly led by the technology sector and government and military grants. In time this approach could become the dominant deployment model for the supercomputing industry especially as it offers several commercial and sustainability advantages over the mega installations we see with traditional supercompute and Exascale Computing deployments. While it's unlikely that major compute heavy organisations will ditch their large supercomputer investments though in time this model will be a force to be reckoned with especially when it comes to serving alternative clients who don't have the capital clout or need to buy dedicated supercompute infrastructure.

While Federated Supercomputing is in the early Productisation Stage it could be enhanced by advances in AI, and other technologies, however over the long term it's unclear what it could be replaced by.

MATTHEW'S RECOMMENDATION

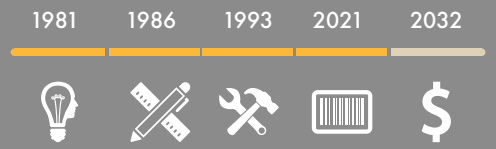
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23

IMPACT

STATUS



Accessibility	8
Affordability	7
Competition	5
Demonstration	9
Desirability	9
Investment	5
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

2 MRL /9

2 TRL /9

6 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

IONIC COMPUTING

IONIC COMPUTING, a General Purpose Technology, which is in the very early Prototype Stage, is the field of research concerned with trying to use ionic fluids to create a new brain-like class of liquid or aqueous computers. While ions in water move slower than electrons in semiconductors, scientists think the diversity of ionic species with different physical and chemical properties could be harnessed for richer and more diverse information processing, and while there have been limited breakthroughs in the field recently researchers developed one of the world's first complete ionic curcuits recently complete with hundreds of ionic transistors.

DEFINITION

Ionic Computing is the manipulation of ionic fluids to create liquid computing platforms.

EXAMPLE USE CASES

While the obvious sweet spot for this technology will be any use case where liquid environments and computing needs to overlap it will also open up the possibility of creating liquid computing platforms that can occupy any shape or space. Furthermore, given the technology's properties it could have interesting implications for the future of computing and datacenter cooling. Primary use cases could include the development of so called "Wet AI" and having a liquid computing platform could also open up interesting biotech and health-tech use cases.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate, albeit from a very low base, predominantly led by government grants. Given the current slow speeds of the technology it will likely take decades before it emerges as a commercially viable technology, but in the shorter term it might be able to find some interesting niche use cases where it excels which would help to fuel its future development.

While Ionic Computing is still in the early Prototype Stage it could be enhanced by advances in AI, Quantum Computing, Synthetic Chemistry, Synthetic Molecules, and other technologies, however over the long term it could be superceeded by Biological, Chemical, Liquid, and Molecular Computing platforms.

MATTHEW'S RECOMMENDATION

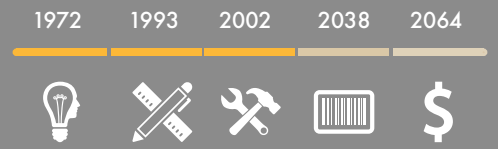
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23, '24

IMPACT

STATUS



Accessibility	3
Affordability	3
Competition	7
Demonstration	7
Desirability	7
Investment	3
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

INTELLIGENCE PROCESSING UNITS

INTELLIGENCE PROCESSING UNITS, which are still in the early Productisation Stage, are a revolutionary form of Artificial Intelligence computing chip that can handle advanced AI algorithms hundreds of times faster than today's state of the art CPU and GPU technologies. Unlike these current technologies, that solve problems by collecting blocks of data and then running algorithms and logic operations on it in sequence across banks of parallel processors, IPU's contain thousands of individual processors that share the processing workloads by leveraging graph computing with a low-precision floating-point computing model that dramatically accelerates the processing of complex machine learning models.

DEFINITION

Intelligence Processing Units combine graph computing with massively parallel, low-precision floating-point computing to boost workload processing performance by multiples.

EXAMPLE USE CASES

Today we are using Intelligence Processing Units to speed up Artificial Intelligence training by up to 100 fold.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the space will continue to accelerate, and interest and investment will accelerate at an increasingly rapid rate as the technology becomes productised and accepted by the markets.

While Intelligence Processing Units are still in the early Productisation Stage, over the long term they will be enhanced by new Artificial Intelligence training methodologies. However, while it is certain that they will one day be replaced, at this moment in time, other than the advent of Artificial Intelligence Zero-Day Learning, it is unclear what they will be replaced by.

MATTHEW'S RECOMMENDATION

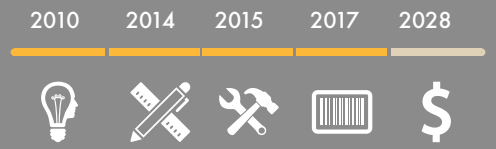
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20

IMPACT

STATUS



Accessibility	7
Affordability	5
Competition	2
Demonstration	9
Desirability	8
Investment	6
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

2 MRL /9

4 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

LIQUID COMPUTING

LIQUID COMPUTING, a GENERAL PURPOSE TECHNOLOGY, which is still in the Concept Stage and early Prototype Stage, is the creation of new liquid computing platforms that use liquids and 2D materials to process and store information. Today we have already created the world's first liquid computer chips, logic gates and transistors - all the essential primary components of a traditional computing platform. While there is still a long way to go before we see a fully assembled and fully functional Liquid Computer we are on our way to creating all of the individual components we need to build one, and needless to say when we finally crack the code it means that tomorrow's computers will look completely alien to us.

DEFINITION

Liquid Computing uses liquid transistors and other fluidic components to carry out computer-like processing and storage functions.

EXAMPLE USE CASES

Today the first Liquid Computer prototypes have been used to test the theory that liquids and 2D materials can be combined together to process and store information. Needless to say though the future use cases for the technology are almost limitless.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the field will continue, albeit be constrained to narrow, specialist labs, and interest and investment will grow, again, albeit at a very slow rate at first, with principal funding rounds coming in by way of government and university grants.

While Liquid computing is still in the Concept Stage and early Prototype Stage, over the long term it is likely it could be enhanced by Biological Computing, Chemical Computing, and DNA Computing. However, at this moment in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '19, '20, '21, '22, '23, '24

IMPACT

STATUS

Accessibility	2
Affordability	1
Competition	4
Demonstration	3
Desirability	8
Investment	2
Regulation	1
Viability	6

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

7 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

META COMPUTING

META COMPUTING, which is in the early Prototype Stage, is the field of research concerned with using virtual gaming and simulation engines to create virtual "Meta" computers within virtual worlds that are capable of independently running their own code and programs independent of those world's underlying hardware. These computers are literal virtual computers in the truest sense of the word, with only passing resemblances to their real world counterparts, and only exist in virtual worlds completely unconstrained by physical or natural laws. Recent breakthroughs include the development of an 80 storey tall 8-Bit 1Hz meta computer called Chungus in Minecraft made out of Redstone Blocks which is capable of running programs and games. In time these platforms will be capable of continuous self-improvement and could lead to the development of true "Multi-Dimensional" computing systems.

DEFINITION

Meta Computing is the development of virtual reality like computer systems within virtual worlds.

EXAMPLE USE CASES

We have all seen the modern world benefit of virtualised computers such as those developed by VMWare, but meta computers which are different, have the potential to change the computing world again. In time, by drawing on Distributed, Edge, and other underlying global computer resources, these systems could have almost infinite amounts of compute running within virtual environments and worlds that are all abstracted away from hardware - the use cases for which are limitless.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, albeit from a very low base, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Meta Computing sector. In time we will see Meta Computing become increasingly popular within virtual environments such as the Metaverse where they will be used for both consumer and enterprise, as well as other Machine 2 Machine (M2M) applications.

While Meta Computing is in the early Prototype Stage, over the long term it will be enhanced by advances in Artificial Intelligence, Distributed Computing, Edge Computing, Simulation Engines, and other fields, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

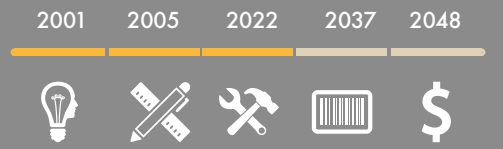
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and re-visit it every few years until progress in this space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23, '24

IMPACT

STATUS



Accessibility	3
Affordability	6
Competition	3
Demonstration	7
Desirability	9
Investment	2
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

8 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

University of Michigan

MICROMOTES

MICROMOTES, which are in the early Productisation Stage, and which some people are trying to rename, incorrectly in my view for now at least, as Smart Dust, is the name given to the range of increasingly tiny fully autonomous computers, packed with sensors, that today are already thousands times smaller than a single grain of rice. As computers and computer components continue to shrink in size it is clear that even these miniature computing platforms, by future standards, will be gigantic, dwarfing their molecular sized future counterparts.

DEFINITION

Micromotes are the world's smallest complete computing platforms and are smaller than a grain of rice.

EXAMPLE USE CASES

Today we are using Micromotes to help us track and cryptographically secure global supply chains, and embed compute and intelligence natively into Internet of Things solutions where Micromotes ability to process information in situ at the edge means we no longer have to send as much information back to bloated datacenters.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the area will continue to accelerate, and interest and investment in the space will grow. As the individual compute components used to make Micromotes continues to shrink inevitably these tiny computing platforms will first become microscopic, and then molecular in size, with the next generation of Micromotes likely to include the ability to run basic Neural Networks which will allow them to process information at the networks edge and allow the objects they are embedded into behave and react to information and stimuli in new "intelligent" ways.

While Micromotes are still in the early Productisation Stage, over the long term they will be enhanced by Biological Computing, Chemical Computing, DNA Computing, Flexible Electronics, Smart Materials, and Quantum Sensors, and it is likely that they will be replaced by Molecular Computing.

MATTHEW'S RECOMMENDATION

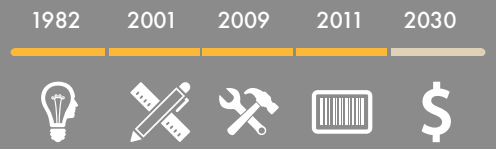
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22

IMPACT

STATUS



Accessibility	7
Affordability	7
Competition	6
Demonstration	8
Desirability	8
Investment	5
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

7 MRL /9

9 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

MINERLESS BLOCKCHAINS

MINERLESS BLOCKCHAINS, a GENERAL PURPOSE TECHNOLOGY, are still in the Prototype Stage and early Productisation Stage, and are sometimes referred to as Blockchain 3.0. One of the biggest problems highlighted by users and critics alike of traditional Blockchain technology, sometimes referred to as Blockchain 1.0 and 2.0, is its reliance on Blockchain Miners who are responsible for adding transaction records to Blockchain public ledgers, a process that is complicated, expensive, slow, and, more worryingly for many, incredibly energy hungry. Putting this latter point into perspective, if traditional Blockchain technology represented a county it would have the sixth highest energy consumption in the world. As a result a number of suggestions have been put forwards to remedy this problem including verifying transactions by using Proof of Work, and Proof of Stake, but in order to create truly Minerless Blockchains another way of processing transactions, Proof of Authority, has now been developed.

DEFINITION

Minerless Blockchains use a variety of different mathematical concepts, rather than Blockchain Miners, to validate and process blockchain transactions.

EXAMPLE USE CASES

Today we are using Minerless Blockchains to create decentralised payment networks, and Stable Coins whose values, unlike traditional cryptocurrencies like Bitcoin, are tied to fiat currencies, and process decentralised payments. Over the longer term it looks like the use cases that are ripe pickings for Blockchain 1.0 and 2.0 technology will also be applicable to Minerless Blockchains.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the space will continue to accelerate, and interest and investment will continue to grow at an accelerating rate as the technology moves from the early Prototype Stage and into the Production Stage, and throughout that period it is highly likely that the vast majority of Blockchain developments will be iterative, rather than revolutionary.

While Minerless Blockchains are in the Prototype Stage and early Productisation Stage, over the longer term it is likely that they will be enhanced by Artificial Intelligence, but not replaced.

MATTHEW'S RECOMMENDATION

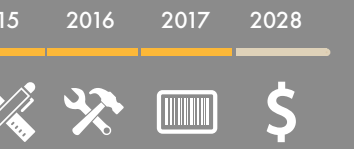
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '19, '20, '21

IMPACT

STATUS



Accessibility	7
Affordability	7
Competition	4
Demonstration	8
Desirability	8
Investment	5
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

2 MRL /9

3 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

MOLECULAR COMPUTING

MOLECULAR COMPUTING, a GENERAL PURPOSE TECHNOLOGY, which is still in the Concept Stage and early Prototype Stage, is the use of molecules and polymers to create a revolutionary new form of compact and powerful computing platforms that can store and process all of the data and workloads managed by today's exascale and hyperscale datacenters into a form factor no larger than a standard office desk. While there are many approaches being investigated and developed the ones that show the most promise include varying the composition, spin and colour combinations of discrete polymer chains and molecules in order to get the best results.

DEFINITION

Molecular Computing uses molecules and polymers instead of the traditional silicon based computer to process and store information.

EXAMPLE USE CASES

Today the first Molecular Computing prototypes are being used to test the theory that we can process and store information in molecules, and use different lightwave diffraction patterns to store exascale volumes of information in polymer chains.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the space will continue to accelerate, and interest and investment will continue to grow, albeit that the majority of it will stem from government institutions and large invested technology companies.

While Molecular Computing is still in the Concept Stage and early Prototype Stage, over the longer term it is likely that it will be enhanced by other Biological Computing, Chemical Computing, DNA Computing and Liquid Computing, it is unclear what technology will replace it.

MATTHEW'S RECOMMENDATION

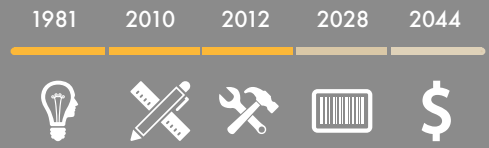
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '19, '20, '21, '22, '24

IMPACT

STATUS



Accessibility	3
Affordability	1
Competition	4
Demonstration	3
Desirability	9
Investment	4
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

NANO MAGNETIC COMPUTING

NANO MAGNETIC COMPUTING, a General Purpose Technology, which is in the early Prototype Stage, is the field of research concerned with developing a new class of computing platform that doesn't need or rely on electricity - or electrons - to perform compute functions instead relying on magnetism at the nanoscale. Unlike traditional computers they only use the absolute bare amount of energy to perform calculations when it's needed and, asides from theoretically being the most energy efficient computers possible given today's laws of physics, it's been calculated that if they used any less energy they would break the second law of Thermodynamics.

DEFINITION

Nano Magnetic Computing is the use of magnetic fields to carry out computational tasks rather than using electricity.

EXAMPLE USE CASES

Today use cases for these kinds of computers is largely theoretical, however given their ultra low power consumption they could be suited to the development of ultra low power AI's, and could be used anywhere where power availability is either at a premium or almost abscent including in the deep sea and space based applications.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate, albeit from a very low base, predominantly led by the technology sector and government grants. Needless to say the allure of a computer platform that's so energy efficient that it's close to breaking the sacrasanct laws of physics is great, especially in today's times, but despite this killer USP it's likley that it's still decades away from being commercialised.

While Nano Magnetic Computing is still in the Prototype Stage over the long term it could be enhanced by advances in AI, Materials, Nanotechnology, Quantum Computing, and other technologies, however one day it be superceeded by Biological, Chemical, Liquid, or even Molecular Computing, among others.

MATTHEW'S RECOMMENDATION

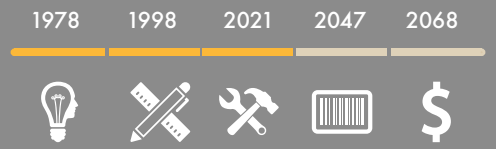
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

IMPACT

STATUS



Accessibility	3
Affordability	3
Competition	7
Demonstration	5
Desirability	6
Investment	2
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

NANOSCALE COMPUTING

NANOSCALE COMPUTING, which is in the early Prototype Stage, is the field of research concerned with trying to develop nanoscale computing systems that are either biological, non-biological, or hybrid in nature, and while this is still seen as a niche technology the long term potential to embed compute into everything at the nanoscale would change the world as we know it. Recently there have been a number of breakthroughs in the field including the development of the first nanoscale cellular computer which was able to analyse the biological information coming out of cells and then respond to it by turning gene expression within the cell on and off, as well as the development of the first virus sized computer blueprint architecture.

DEFINITION

Nanoscale Computing is the use of biological and non-biological nanoscale devices to perform computing tasks.

EXAMPLE USE CASES

Today the development of Nanoscale Computing, where the computers are in some cases smaller than a virus, means that we stand on the cusp of being able to embed compute and intelligence into all manner of biological and non-biological systems which could, in the former case, then be used to help turn the human body into a Living Pharmacy that is capable of identifying disease in vivo then making the treatments in vivo using Bio-Manufacturing. Meanwhile, other applications include the ability to monitor and analyse the behaviours of systems at the nanoscale and perform actions in response to certain behaviours or stimuli.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Nanoscale Computing increase, albeit from a very low base, primarily led by university grants. Over the long term this could be a technology to be reckoned with, especially if the nanoscale computing platforms we are developing are capable of self-improvement and replication as we see with other similar systems such as Living Robots. A truly futuristic computing platform its potential is huge.

While Nanoscale Computing is still in the early Prototype Stage it could be enhanced by advances in Biological AI and Compute, Cellular Recorders, Materials Nano-Manufacturing, Synthetic Biology, Nano-Sensors, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

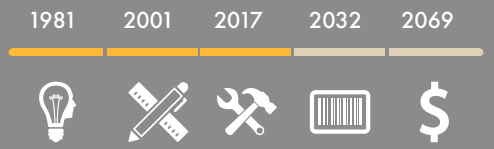
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

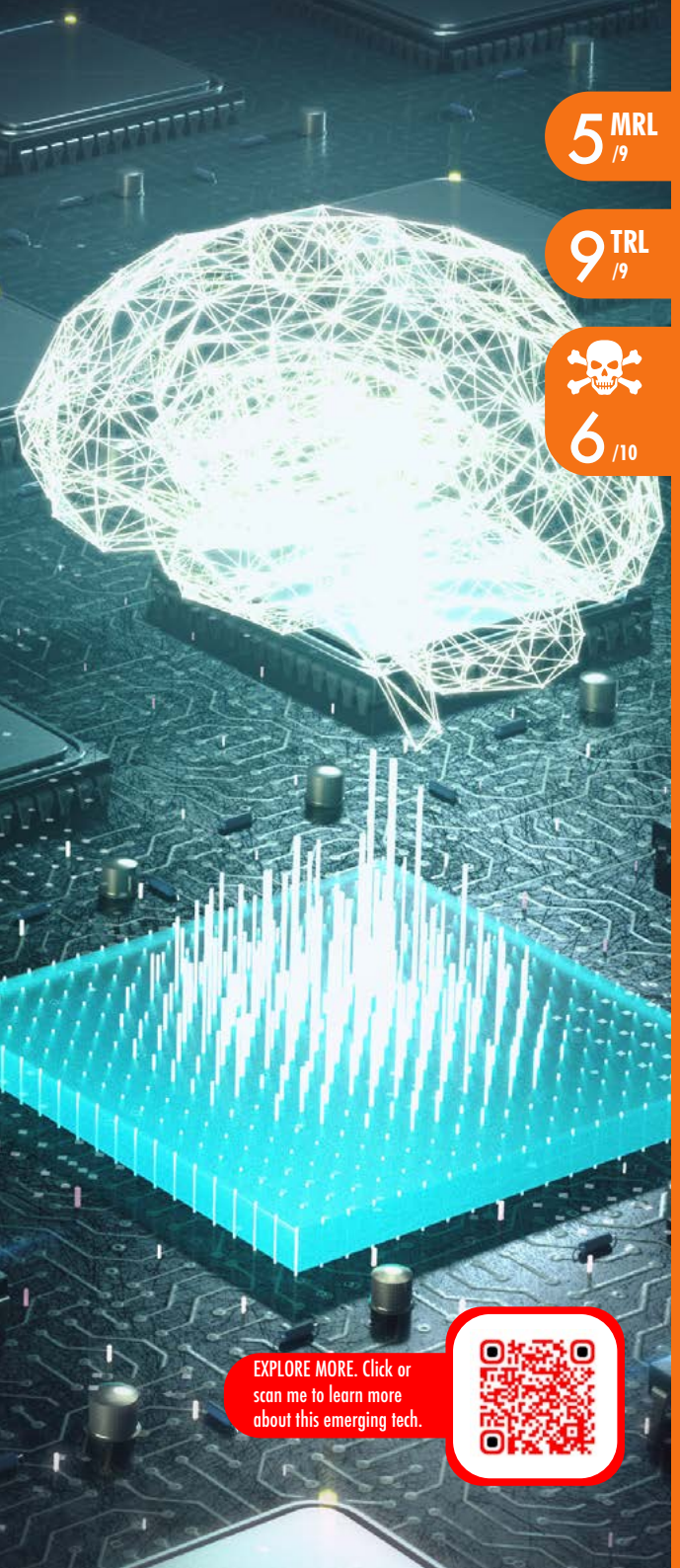
IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	2
Demonstration	7
Desirability	8
Investment	2
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



NEUROMORPHIC COMPUTING

NEUROMORPHIC COMPUTING, a GENERAL PURPOSE TECHNOLOGY, which is in the early Productisation Stage, is a new form of ultra-powerful computing platform, whose architecture and design is modelled on the human brain, capable of compacting the performance found in today's top of the line supercomputers into a package the size of a fingernail that runs on mere watts of power, not Megawatts or Gigawatts like today's traditional top of the line platforms. While we now have million core neuromorphic computing platforms in operation overall development in the field is being held back by the lack of a comprehensive software ecosystem which means that building a full, programmable and functional software stack remains a top priority for researchers in the field, something that is being addressed by the award of new grants, and several government led programs.

DEFINITION

Neuromorphic Computing uses electronic circuits that mimic the Neuro-Biological architectures of the human nervous system to process information.

EXAMPLE USE CASES

Today we are using Neuromorphic Computing and it's massively parallel, low power computer architecture to build human like machine brains that learn in a similar way to humans, and create more complex biological brain simulations. In the future the primary applications of the technology will include building self-learning machines that revolutionise computing.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the space will continue to accelerate, and interest and investment will continue to grow at an increasingly accelerated rate as the field becomes one of the next hot computing battlegrounds.

While Neuromorphic Computing is in the early Productisation Stage, over the longer term it could be replaced by a variety of different technologies including Biological Computing, Chemical Computing, DNA Computing, and Molecular Computing, however that future is still a way off.

MATTHEW'S RECOMMENDATION

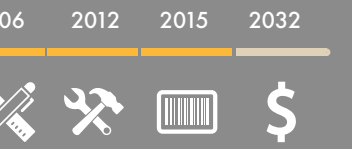
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	5
Affordability	4
Competition	4
Demonstration	8
Desirability	7
Investment	4
Regulation	4
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

2 MRL /9

3 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ORGANIC COMPUTING

ORGANIC COMPUTING, which is in the Concept Stage and early Prototype Stage, is the field of research concerned with developing new ways to bind the biological computing capability of individual organisms together to form complex and connected collaborative organic computing platforms. Recent breakthroughs in the space include the development of the first human telepathic network and mammalian inter-continental Hive Mind networks which are the first steps to creating the first viable Organic Computer platforms.

DEFINITION

Organic Computing is a computing platform where the computing nodes doing the processing are collections of living organisms and not computers or machines.

EXAMPLE USE CASES

Today Organic Computing platforms are still very experimental and in some respect theoretical. In the future the primary use of this technology will be to turn organisms into collective computing nodes that are capable of computing and processing information and computer workloads.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Healthcare sector, with support from univesity grants. In time we will see the technology mature to the point where researchers are able to connect together living organisms and harness their collective computing power, but there will likely be significant cultural and regulatory hurdles to be overcome before the technology can be productised.

While Organic Computing is in the Concept Stage and early Prototype Stage, over the long term it will be enhanced by advances in Brain Machine Interfaces, Hive Minds, Memristors, Neuromorphic Computing, and Neuro-Prosthetics, and in the long term it could be replaced by more traditional and less contraversial Biological, Chemical, DNA, Liquid, Molecular, and Neuromorphic Computing platforms.

MATTHEW'S RECOMMENDATION

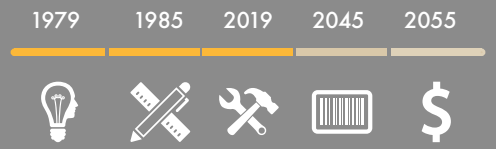
In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '23

IMPACT

STATUS



Accessibility	1
Affordability	2
Competition	2
Demonstration	3
Desirability	6
Investment	1
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

5 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

PHOTONIC COMPUTING

PHOTONIC COMPUTING, a GENERAL PURPOSE TECHNOLOGY, which is still in the Prototype Stage, is the use of light, rather than the electrons used by today's computing platforms, to move and process data thousands of times faster than we do today. However, while the field has always shown great promise realising those promises and productising the technology has been difficult as researchers struggle to get the right heat, power and size ratios for their components, and harness the most useful form of light, infrared, whose wavelength size is not readily compatible with today's electronics or silicon. While there have been advances in lithography which goes some way to addressing the latter issue many researchers are now focusing their attention on finding new ways to manipulate light, such as bending and spinning it, and breakthroughs in these areas are now becoming more frequent.

DEFINITION

Photonic Computing is a form of ultra fast computing technology that uses photons produced by lasers or diodes to perform computing tasks.

EXAMPLE USE CASES

Today the first Photonic Computing prototypes are being used to test the theory that we can move and process information at light speed, and researchers are focused on developing the photonic chips, circuitry, and memory components.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the space will continue to accelerate, and interest and investment will continue to grow, however, as the number of competing computing technologies continues to increase if the field doesn't get a breakthrough soon then it might be at risk of being sidelined in favour of other more promising technologies. That said though, with significant advances in Lasers, Nano-Manufacturing, Nanotechnology, Nano-Photonics and Optics, those breakthroughs could be closer than we think.

While Photonic Computing is still in the Prototype Stage, over the longer term it could be replaced by new advances in Biological Computing, Chemical Computing, DNA Computing, Liquid Computing, Molecular Computing and Quantum Computing. However, despite this it is still highly likely that future traditional computer architectures will move away from electron based platforms to photonic ones, and that Photonic Computing will find its own niche in the new line-up.

MATTHEW'S RECOMMENDATION

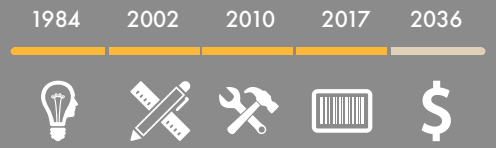
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '23, '24

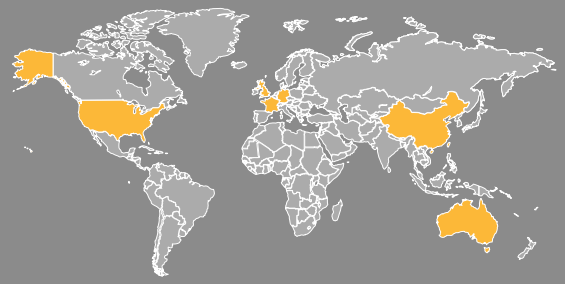
IMPACT

STATUS



Accessibility	3
Affordability	4
Competition	6
Demonstration	7
Desirability	8
Investment	4
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



X MRL /9

X TRL /9

X /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

PNEUMATIC COMPUTING

PNEUMATIC COMPUTING, which is in the early Prototype Stage, is the field of research concerned with developing computing platforms that use pressure to perform computing tasks rather than electricity which is the standard for most other computing platforms. While this is a niche emerging technology recent breakthroughs include the development of the first complete pneumatic computing platform made of glass and silicone that was able to use pressure to encode information, instead of electricity, and then process it in a lab to aid technicians in their Biotech work.

DEFINITION

Pneumatic Computing systems use air pressure to perform computing tasks.

EXAMPLE USE CASES

Today this technology is being lined up to eliminate up to 99% of the cost of building and running micro-fluidic instruments, as well as to control miniaturised biomedical laboratories that are undertaking analysis and sample monitoring activities. Meanwhile other applications could include the technology being used to act as the brains of soft robots which, in some cases already use air pressure to help them move, and which could soon use that same pressure to help them make specific decisions in response to different stimuli. Additionally, it could also find itself being used as what's known as an Off-Chip solution to augment regular computing devices.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see investment and interest in Pneumatic Computing increase, albeit from a very low base, led primarily by university grants. While this is a niche technology and will remain so it opens the door to a new way of embedding compute and rudimentary intelligence into different devices and environments where it might not otherwise be practical, plus its incredibly low power consumption, which is practically zero will also make it attractive in certain applications such as IOT or Smart City applications.

While Pneumatic Computing is still in the early Prototype Stage it could be enhanced by advances in Artificial Intelligence, Materials, Sensors, and other technologies, however over the long term it could be replaced by Shallow Neural Networks combined with Backscatter Energy Systems, and alternative sensing systems.

MATTHEW'S RECOMMENDATION

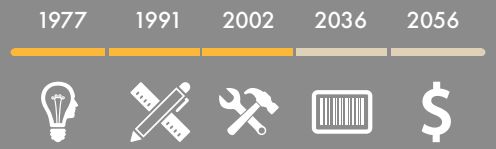
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

IMPACT

STATUS



Accessibility	3
Affordability	3
Competition	6
Demonstration	7
Desirability	6
Investment	2
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

6 MRL /9

9 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

QUANTUM COMPUTING

QUANTUM COMPUTING, a GENERAL PURPOSE TECHNOLOGY, which is in the Prototype Stage and early Productisation Stage, is the creation of a new ultra-powerful computing platform where researchers harness the properties of quantum mechanics and quantum theory to build machines that are, under the right conditions, operate hundreds of millions of times faster than today's logic based computer platforms. Recently there has been a dramatic acceleration on the development of the technology with both proprietary and universal machines emerging from the labs, as well as the public unveiling of the first limited use cloud based Quantum Computing as a Service (QCaaS) platforms and simulators. However, as research in the field hots up there is an increasing battle between those companies focusing on increasing Qubit counts, at the expense of computing accuracy, and those focusing on computing accuracy, at the expense of Qubit counts.

DEFINITION

Quantum Computing is the area of study focused on developing computer technology based on the principles of Quantum Theory.

EXAMPLE USE CASES

Today we are using the first QCaaS platforms and simulators to process complex climate change, drug, energy, machine learning, material, and traffic optimisation models, however, as the platforms evolve it is fair to say that the number of potential use cases will very quickly grow into the millions.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the space will continue to accelerate at an increasingly rapid pace, and interest and investment in the space will also grow at an accelerating rate, which, in part, is led by the fact that the field has become politicised, with China, Europe and the US vying for supremacy in the field, and the fact that the first companies able to commercialise the technology and bring it to the masses will be at the forefront of one of the most significant computing revolutions since the invention of the first PC.

While Quantum Computing is in the Prototype Stage and early Productisation Stage, over the long term it could be replaced by Biological Computing, and DNA Computing.

MATTHEW'S RECOMMENDATION

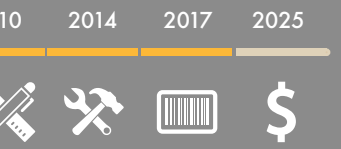
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

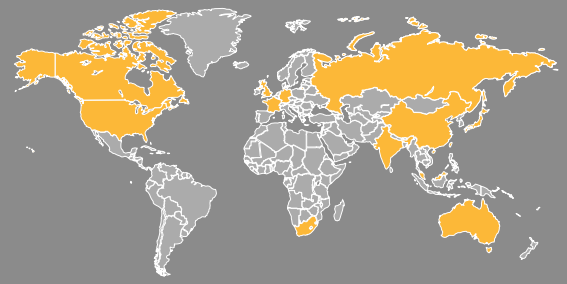
IMPACT

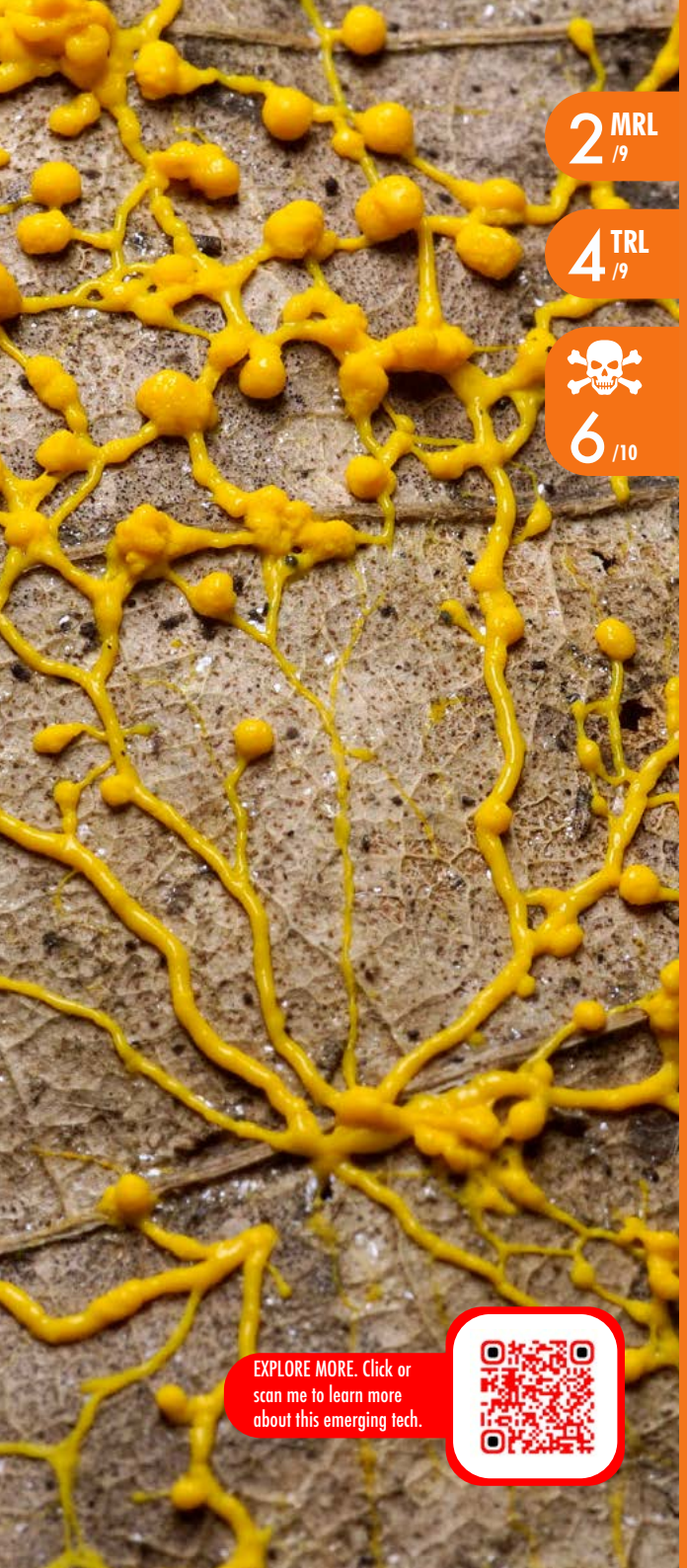
STATUS



Accessibility	7
Affordability	6
Competition	6
Demonstration	9
Desirability	9
Investment	7
Regulation	4
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





SUBSTRATE COMPUTING

SUBSTRATE COMPUTING, which is in the early Prototype Stage, is te field of research concerned with trying to use different substrates such as fungi and mold to solve computing based optimisation problems in non-traditional ways. While this technology might sound odd, and it is, recently there have been a number of breakthrough including the development of computing-like slime molds that are able to control robots, optimise traffic flows, by solving the so called Travelling Salesman problem, and solve mazes.

DEFINITION

Substrate Computing is the use of different substrates to tackle and solve traditional and non-traditional computing problems .

EXAMPLE USE CASES

While this field is still nascent there is enough evidence to suggest that there's something in this technology, if you want to call it that to warrant further investigation which is why the EU is now increasing its spending on the field. Example use cases include building cellular machines as well as new logic gate designs and hybrid electronic circuitry, designing highway and rail networks, elucidating the dark matter structure of the universe, and even predicting certain events.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, albeit from a very low base, primarily led by organisations in the technology sector, with limited support from government funding and university grants. In time we will see Substrate Computing gain momentum but it's highly likely that it will be limited to niche and specialist applications, and that it will remain a fringe tecnology for decades to come.

While Substrate Computing is in the early Prototype Stage, over the long term it will be enhanced by advances in Biological and DNA Comptuing, DNA Neural Networks, Living Sensors, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

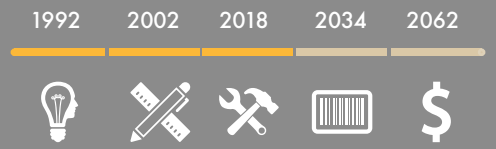
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and re-visit it every few years until progress in this space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '22

IMPACT

STATUS



Accessibility	2
Affordability	4
Competition	2
Demonstration	5
Desirability	5
Investment	1
Regulation	1
Viability	6

PRIMARY GLOBAL DEVELOPMENT AREAS

2 MRL /9

4 TRL /9

6 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

TERAHERTZ COMPUTER CHIPS

TERAHERTZ COMPUTER CHIPS, which are still in the Concept Stage and early Prototype Stage, are computer chips that operate multiples times faster than today's computer chips, operating in the Terahertz performance range, not the Gigahertz performance range. Recently there have been a number of advances in this space thanks to new breakthroughs in material science, especially in the field of Liquid Computing and Liquid Electronics where new kinds of water based transistors which can switch at the picospeed have been developed and tested, as well as 2D Graphene, which many experts see as the successor to traditional silicon, and frequency multiplication, which has allowed researchers to generate electronic signals in the Terahertz range with remarkable efficiency.

DEFINITION

Terahertz Computer Chips have clock speeds of one Terahertz, which is equal to 1,000 GigaHertz (GHz), or more.

EXAMPLE USE CASES

Today the first Terahertz Computer Chips prototypes are very basic with researchers using these products to test the viability of the technology.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the field will accelerate, and interest and investment will grow at an accelerating rate, however a lot of that investment will likely be in the form of university grants, and as a result the technology will likely take a long time to be productised.

While Terahertz Computer Chips are still in the Concept Stage and early Prototype Stage, they could be enhanced by developments in Graphene, Laser technology, Liquid Computing and Electronics, Semiconductors, and others, but over the long term it is unclear what technology could replace them.

MATTHEW'S RECOMMENDATION

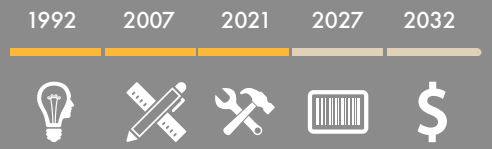
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19

IMPACT

STATUS



Accessibility	1
Affordability	1
Competition	6
Demonstration	2
Desirability	7
Investment	2
Regulation	1
Viability	6

PRIMARY GLOBAL DEVELOPMENT AREAS

5 MRL /9

9 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

UHD RENDERING ENGINES

UHD RENDERING ENGINES, which are in the Prototype Stage and Productisation Stage, are powerful compute enabled simulation engines capable of rendering ultra high definition dynamic video and stills of objects, places and people, at high speed that can be used in a variety of applications, from the creation of Synthetic Content to the creation of immersive, simulated environments and worlds. Recently significant advances in Artificial Intelligence, computing power, and GPU's have meant that researchers have now crossed the point known as Uncanny Valley, which now means that these engines are now capable of producing content capable of fooling most humans.

DEFINITION

Ultra High Definition Rendering Engines create and render dynamic video and stills at a resolution that is indistinguishable from the real thing.

EXAMPLE USE CASES

Today we are using UHD rendering Engines to create content that is indistinguishable from the real thing that is being used to create an increasingly wide variety of content, from Fake News, capable of undermining democracy, to adverts, gaming environments, and even short movies.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate. However, as the capabilities of the technology continue to grow, and as we blow past Uncanny Valley, it is highly likely that the technology will need to become increasingly controlled and regulated.

While UHD Rendering Engines are still in the Prototype Stage and Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Creative Machines, and Simulation Engines, but it is unlikely that it will be replaced.

MATTHEW'S RECOMMENDATION

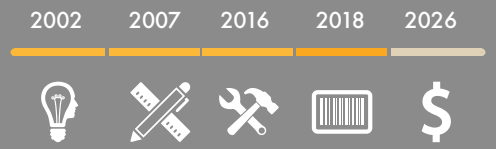
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19

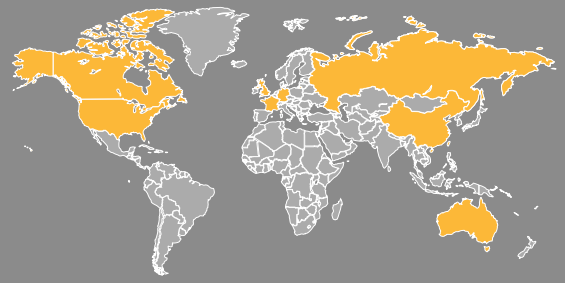
IMPACT

STATUS



Accessibility	8
Affordability	8
Competition	5
Demonstration	9
Desirability	9
Investment	5
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



1 MRL /9

3 TRL /9

5 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

WAVE COMPUTING

WAVE COMPUTING, which is in the Concept Stage and early Prototype Stage, is the field of research concerned with developing new forms of computing platforms and electronic devices that work and perform their respective tasks using magnetism and not electricity. As a result these systems, which are underpinned by the principles of Spintronics, are the first such systes that work without the need to use electricity or electrons. recent breakthroughs in the field include the development of the first Wave Computing platform that was able to process information and perform calculations without using any electrons or electrical power.

DEFINITION

Wave Computing platforms are computing platforms that work and perform calculations by using magnetism rather than electricity or electrons.

EXAMPLE USE CASES

Today the early prototypes of the technology are being used to test the theory and refine the technology. In the future the primary use case of this technology could be to create new classes of completely passive computing and electronic platforms that could be used to either compliment or replace today's traditional platforms.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by univesity grants. While the technology concept is incredibly interesting at this point in time it is difficult to ascertain whether or not it will achieve critical mass and continue to be developed, or reach a dead end and be superceeded, as a result it is one to watch but from a distance.

While Wave Computing is in the Concept Stage and early Prototype Stage, over the long term it will be enhanced by advances in Backscatter Energy Systems, Quantum Computing, and Spintronics, and potentially replaced by more traditional Biological, Chemical, DNA, Liquid, Molecular, and Neuromorphic Computing platforms.

MATTHEW'S RECOMMENDATION

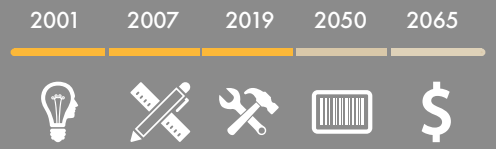
In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20

IMPACT

STATUS



Accessibility	1
Affordability	2
Competition	7
Demonstration	4
Desirability	4
Investment	1
Regulation	1
Viability	5

PRIMARY GLOBAL DEVELOPMENT AREAS

CONNECTIVITY

IT IS all very well spending time and energy embedding intelligence into everything, whether we are talking about biological systems, devices or even humans, but in order to get the most out of these things they have to be connected, and when it comes to the future of connectivity we are only just getting started. As we continue to see more people and devices become connected, and be embedded with connectivity, we can increasingly see a future where everyone, and everything is connected to one another, and where today's traditional electromagnetic communications systems are augmented with new atomic, light based, and even zeno wave nil communications systems.

In this section you will find details of the emerging technologies that made it into this years Griffin Emerging Technology Starburst along with details of other impactful emerging technologies:

1. 5G
2. 6G
3. Acoustic Signalling
4. Atomic Communications
5. Bacterial Nano-Networks
6. Bio-Molecular Communications
7. Body Area Networks
8. Cognitive Radio
9. Delay Tolerant Networks
10. Low Earth Orbit Platforms
11. Low Power Wide Area Networks
12. Molecular Communications
13. Nil Communication
14. Organic Networks
15. Petabit Networks
16. Pseudo Satellites
17. Quantum Internet
18. Ultra Low Frequency Communications
19. USB 4
20. Visible Light Communications
21. WiFi 7
22. WiGig
23. X-Ray Communications

In addition to these emerging technologies there are many others that have yet to get an entry in this codex. These include, but are not limited to:

24. 2D Antennae
25. 7G
26. Biological Networks
27. Body Area Networks
28. Drone Access Points
29. High Altitude Platforms
30. HiperLAN
31. Hollow Core Fiber
32. LiFi
33. Mesh Networks
34. MulteFire
35. Nano-Satellites
36. No Power WiFi
37. Rectifying Antennae
38. Self Healing Networks
39. Small Cell Networks
40. Terabit Networks
41. WiFi 6
42. Wireless Personal Area Networks

5G

5G, a GENERAL PURPOSE TECHNOLOGY, which is in the Mass Adoption Stage, is the next generation of mobile wireless communications technology and delivers data download and upload speeds upto 10 to 20 times faster in places than today's 4G networks, wider coverage and more stable, lower latency connections. As a consequence 5G will have a revolutionary impact on how and where businesses and consumers leverage wireless network technology. However, as the race to be the first to roll out 5G services intensifies some operators are rolling out 600MHz 5G services, which operate at lower speeds but can penetrate into buildings further, while others are rolling out more traditional 5G services that operate in the 700 MHz, 800 MHz, 900 MHz, 1.5 GHz, 2.1 GHz, 2.3 GHz and 2.6 GHz range that have higher speeds but need more base stations within buildings in order to provide good enough coverage.

DEFINITION

5G, the successor to 4G is a low latency, hyper connected multi Gigabit mobile wireless communications standard.

EXAMPLE USE CASES

Today we are using 5G networks to perform over the air robotic surgeries on animals and humans, and stream 4K and 8K video, Augmented Reality, gaming and Virtual Reality experiences direct to people's devices. In the future the primary use cases for the technology will include disintermediating fixed line telco's by using a combination of 5G, WiGig and new network backhaul platforms to deliver ultra-fast, wireless broadband services directly to businesses and homes, and accelerating the roll out of autonomous vehicles and smart transportation networks, smart healthcare platforms, the Internet of Things, and supporting the control of critical infrastructure and remote devices, among millions of other use cases.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the space will continue to accelerate dramatically, and interest and investment will grow at an accelerating rate. As the first commercial networks start being rolled out, in China and the West, the number of devices supporting 5G will continue to expand and the major task of rolling out the new technology, which requires new towers and base stations, will begin in earnest.

While 5G is still in the Mass Adoption Stage over the long term it will be replaced by 6G.

MATTHEW'S RECOMMENDATION

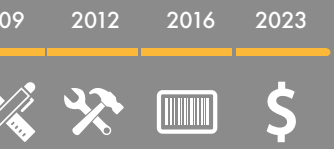
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '19, '20, '21, '22, '23, '24

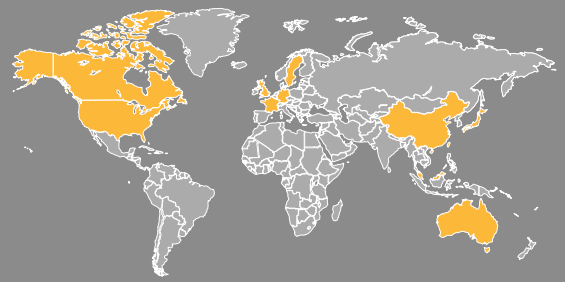
IMPACT

STATUS



Accessibility	8
Affordability	9
Competition	5
Demonstration	9
Desirability	9
Investment	8
Regulation	6
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



4 MRL /9

5 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

6G

6G, a GENERAL PURPOSE TECHNOLOGY, which is still in the Concept Stage, is the field of research concerned with trying to, one day, build the next generation of wireless mobile communications networks that operate at Terabit speeds, which will be hundreds of times faster than 4G technology, and tens of times faster, if not more, than 5G. While, by today's standards, 5G looks revolutionary, as data volumes and the number of connected devices and things in the world continue to increase at an exponential rate, researchers believe 6G will be the answer, and as a result they are investigating using the 100GHz to Terahertz (THz) bands, combined with Artificial Intelligence and Quantum Theory, to push wireless speed to a range where they say the eventual speeds will be unlimited.

DEFINITION

6G, the successor to 5G, is a multi Terabit software defined mobile communications standard that uses Artificial Intelligence to create adaptable, intelligent, self-aware networks.

EXAMPLE USE CASES

Today there are no 6G prototypes, but researchers believe 6G's primary use cases will include applications that require a "Superfast Edge" and zero network latency, "Super IOT applications" where massive IOT networks need to communicate and collaborate together, "Smart Analytics" that enable smart operations and allow networks to analyse and process data in a situational context, including for health and Quantified self applications, Smart Buildings and Cities, Smart Materials applications, and much more.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in 6G technology will continue to accelerate, and interest and investment in the field will continue to grow, primarily led by government funding, university grants, and industry consortiums.

While 6G is still in the Concept Stage, over the long term it will be enhanced by advances in Artificial Intelligence, Cognitice Radio, Low Earth Orbit Platforms, Psuedo Satellites, Quantum Internet, and Quantum Sensors. However, with the emergence of a wide variety of complimentary powerful communications technologies it is also possible that it will not be replaced, and that 7G will never arrive, or at least in the way that we expect it.

MATTHEW'S RECOMMENDATION

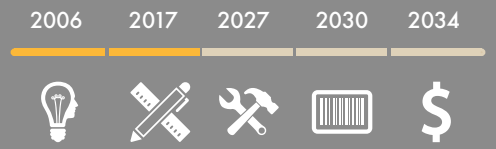
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	1
Affordability	1
Competition	2
Demonstration	1
Desirability	8
Investment	2
Regulation	2
Viability	1

PRIMARY GLOBAL DEVELOPMENT AREAS

7 MRL /9

9 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ACOUSTIC SIGNALLING

ACOUSTIC SIGNALLING, which is in the Prototype Stage, is the field of research concerned with developing communication technologies that predominantly work in aqueous or water based environments where communication so far has been difficult and slow to achieve. Recently there was a noteable breakthrough in the field that allowed divers to communicate with one another underwater using nothing more than standard smartphones and SMS which, even though to many people that might sound basic, was a game changer.

DEFINITION

Acoustic Signalling is a coded sound signal which is released and transmitted by a device to enable communication.

EXAMPLE USE CASES

Today there are many examples of uses cases where being able to communicate underwater would be advantageous, including in the military field whether it's submarines or new classes of Autonomous Underwater Vehicles (AUV), environmental and situational awareness monitoring systems, or recreational divers.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate, albeit from a very low base, primarily led by government and military grants.

While Acoustic Signalling is still in the Prototype Stage over the long term it could be enhanced by advances in AI, Materials, Ultra Low Frequency Comms, and other technologies, however one day it could be superceeded by the Quantum Internet.

MATTHEW'S RECOMMENDATION

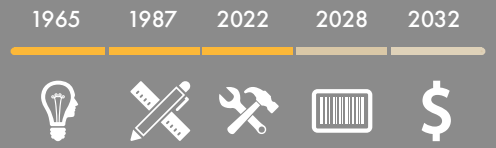
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

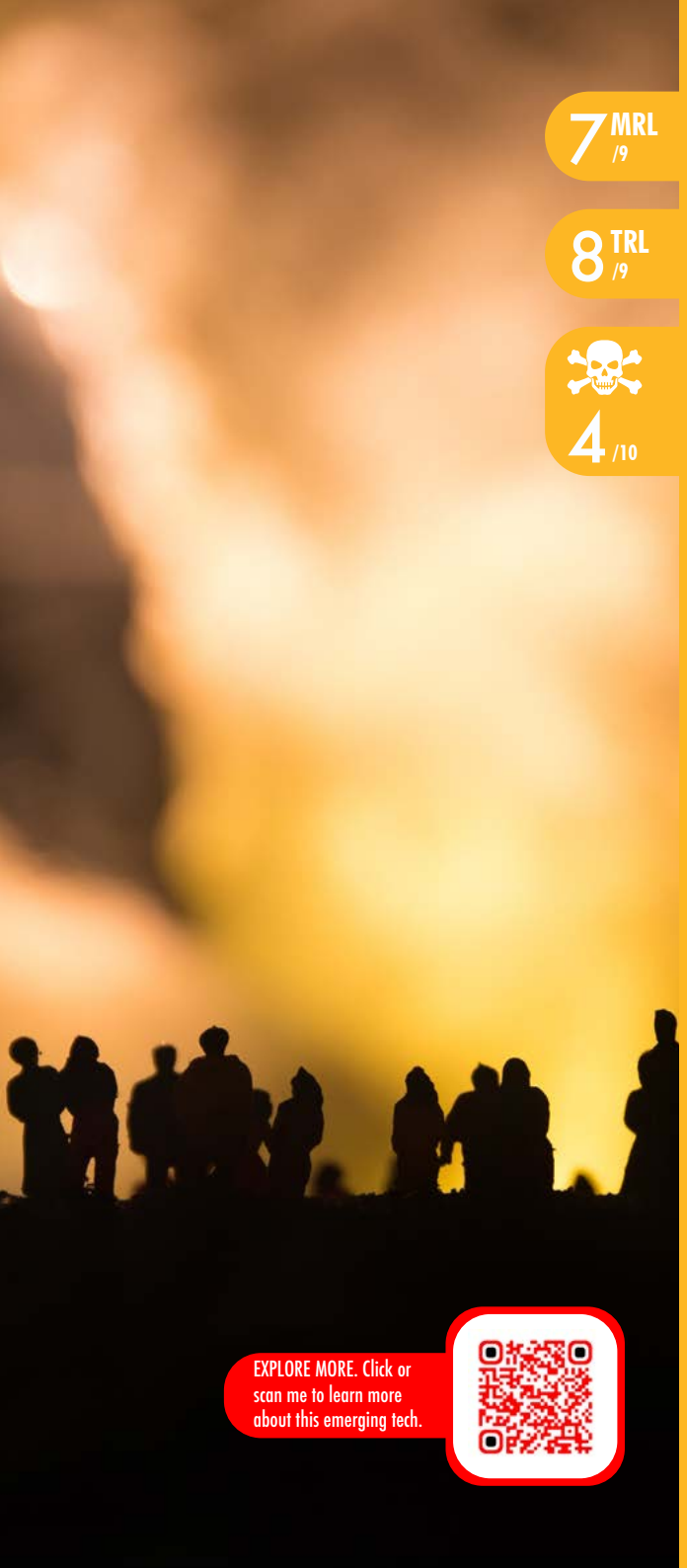
IMPACT

STATUS



Accessibility	3
Affordability	4
Competition	4
Demonstration	7
Desirability	6
Investment	2
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



7 MRL /9

8 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ATOMIC COMMUNICATIONS

ATOMIC COMMUNICATIONS, which is in the Prototype Stage, is the field of research concerned with using highly sensitive atom-based sensors, such as Rydberg sensors, to develop wireless "noise-less" communications systems that are capable of working in even the noisiest of environments. As such they not only have many advantages over their traditional peers, such as 5G and other RF communications systems, especially in disaster zones and war zones, but when used in tandem with these systems they can be used to augment them and boost their power and range, depending on the situations, hundreds fold. Recent breakthroughs include the development of "Quantum Radios" which are being used to boost the energy efficiency and range of 5G networks.

DEFINITION

Atomic Communications systems use atom-based sensor systems to determine the direction of incoming radio signals and eliminate noise.

EXAMPLE USE CASES

The incredible electromagnetic sensitivity of this technology means that today its primary use cases involve its use in helping improve the range and energy efficiency of existing communications networks, such as 5G. Not only will this have implications for IOT use cases as diverse as Precision Agriculture and Smart Cities but, because these systems can also act as passive optical receivers in hard-to-reach locations, they could play a vital role in helping mobile network operators achieve 100% coverage. They will also likely play a vital role in the future of electronic warfare.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in Atomic Communications accelerate, predominantly led by the Communications and Defence industries. The hyper sensitivity of these systems means they are very attractive to both commercial and military network operators who will use them to boost the energy efficiency, integrity, and range of their communications platforms.

While Atomic Communications are still in the Prototype Stage they could be enhanced by advances in AI, Quantum Materials, Quantum technologies, Sensors, and other technologies, however over the long term it's unclear what they could be superseded by.

MATTHEW'S RECOMMENDATION

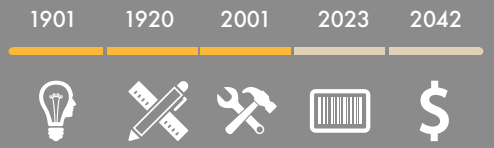
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

IMPACT

STATUS



Accessibility	3
Affordability	5
Competition	2
Demonstration	7
Desirability	8
Investment	5
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

2 MRL /9

4 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

BACTERIAL NANO-NETWORKS

BACTERIAL NANO-NETWORKS, which are in the Concept Stage and early Prototype Stage, is the field of research concerned with developing new ways to transmit information and signals within fluidic environments at the cellular, genetic, and nano scale. Recent breakthroughs in the field include the development of the first Bacterial Nano-Networks that were used to shuttle DNA based information between different targets so that the information could be stored and retrieved from new DNA Computing and Storage platforms.

DEFINITION

Bacterial Nano-Networks are nanoscale biological communications networks that use DNA and chemicals to transmit information between different entities and network nodes.

EXAMPLE USE CASES

Today we are using Bacterial Nano-Networks to move DNA based information packets between different DNA Computing and Storage platforms in an effort to improve their efficiency and speed. In the future the primary use of this technology will be to support and improve the efficiency of future Biological and DNA computing platforms, among others, and to improve the efficiency and speed of information and signal transfer between different liquid based hybrid, organic, and semi-organic entities, products, and systems.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Healthcare and Technology sectors, with support from univesity grants. In time we will see the technology mature to the point where it becomes the defacto technology that underpins future computing and electronics platforms.

While Bacterial Nano-Networks are in the Concept Stage and early Prototype Stage, over the long term they will be enhanced by advances in Biological Computing, CAST, Chemical Computing, CRISPR, DNA Computing, Liquid Computing, Semi-Synthetic Cells, Synthetic Cells, Synthetic Biology, and Synthetic DNA, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

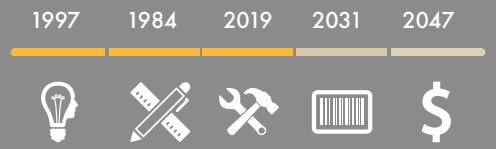
In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21

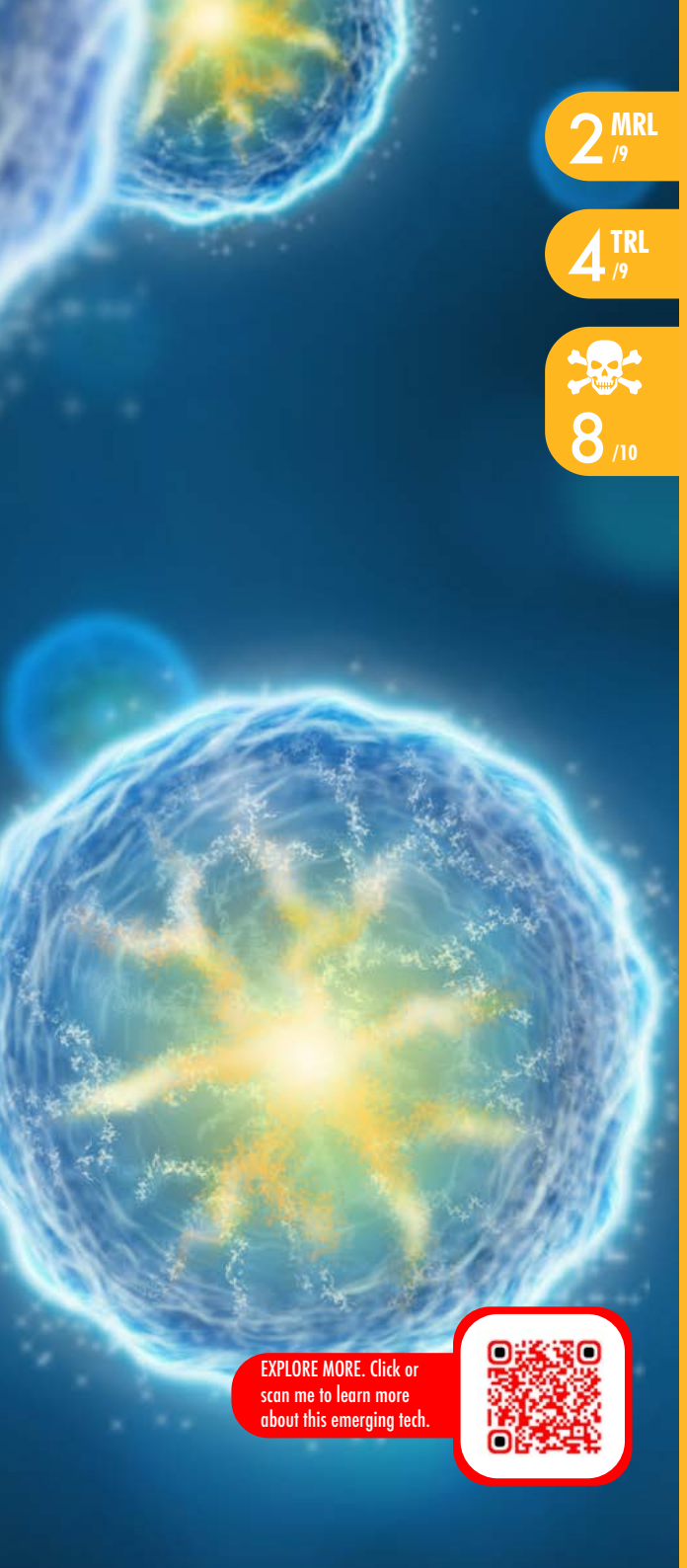
IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	2
Demonstration	5
Desirability	8
Investment	1
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



2 MRL /9

4 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

BIO-MOLECULAR COMMUNICATIONS

BIO-MOLECULAR COMMUNICATIONS, which are in the Prototype Stage, is the field of research concerned with trying to find new ways to enable bio-molecular and molecular level communications within various mediums and substrates in a way that is efficient, functional, and useful. Recently there have been a number of breakthroughs in this space including the development of new sensors and Molecular Electronics products that have allowed researchers to develop next generation systems and blueprints which will be used to underpin future research efforts.

DEFINITION

Bio-Molecular Communications is the measurable information exchange process between networked artificial or biological entities.

EXAMPLE USE CASES

The use cases for this technology are still emerging but so far the majority of examples include using this technology to increase computer storage density by a hundred fold, create new forms of molecular electronic systems, and enable Exascale Computing. However, other use cases will likely include healthcare applications as well as a broader range of computing applications especially as we head into an ear of computing that is dominated by non-traditional forms of compute including Biological, Chemical, DNA, Liquid, Molecular, and others.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, albeit from a very low base, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the healthcare and technology sectors, with support from government funding and university grants. In time we will see Bio-Molecular Communications become much more commonplace but given the nature of the field it's likely that it will be many decades before it commercialises.

While Bio-Molecular Communications are in the Prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Bio-Manufacturing, Computing, Electronics, Molecular Communications, and Nano-Manufacturing, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

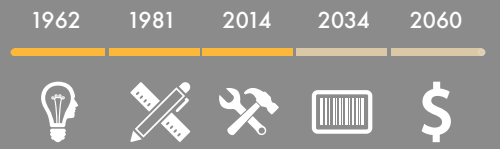
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and re-visit it every few years until progress in this space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '22, '23

IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	2
Demonstration	4
Desirability	7
Investment	2
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

2 MRL /9

3 TRL /9

6 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

BODY AREA NETWORKS

BODY AREA NETWORKS, which is in the Prototype Stage, is the field of research concerned with trying to turn the human body, and all its individual systems, into the biological equivalent of a computer-like communications and data network which has better security than almost all of today's wireless authentication systems, like Bluetooth. Recent breakthroughs in the field include using low power magnetic fields and wearables to turn the human body into a data network which, when combined with other technologies such as Biological Computing and Organic Networks could open up a phenomenal range of weird and interesting opportunities.

DEFINITION

Body Area Networks is the technology that turns the human body into the equivalent of a computer data network.

EXAMPLE USE CASES

Today researchers are using the technology to turn the human body into data networks that, in turn, they were able to use as a form of unique, and presently unhackable authentication system to enable bluetooth-like secure payments. And as we look ahead at what the future could hold this use case alone opens the door to some exciting new security applications.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Technology sector, with support from university grants. In time we will see the technology mature, at which point it will then have to overcome some serious regulatory hurdles if it's to stand any chance of being fully commercialised.

While Body Area Networks are in the Prototype Stage, over the long term they will be enhanced by advances in Biological Computing, Organic Networks, as well as potentially Nanobots, Nanomachines, and Nanoparticles, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

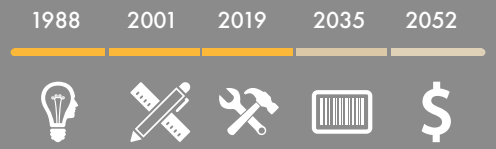
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '21

IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	2
Demonstration	5
Desirability	4
Investment	2
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

9 MRL /9

9 TRL /9

7 /10

COGNITIVE RADIO

COGNITIVE RADIO, which is in the Prototype Stage and early Productisation Stage, is the field of research involved with creating radio based communication platforms that can be programmed and configured dynamically to use the best wireless channels in their vicinity in order to avoid radio spectrum congestion, and interference. Recently there have been several breakthroughs in the field after researchers embedded Artificial Intelligence into their platforms which not only helped boost their platforms ability to detect interference, but also helped them their platforms respond in real time to minimise the impact.

DEFINITION

Cognitive Radio is a form of wireless communication where a transceiver can intelligently detect which communication channels are free and instantly move into them.

EXAMPLE USE CASES

Today we are using Cognitive Radio to help improve the radio quality for emergency responders, and to create the next generation of military communications platforms that cannot be jammed by increasingly advanced and technologically capable enemies.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, with the main investments coming from aerospace, defence, government, and industry consortiums.

While Cognitive Radio is in the Prototype Stage, over the long term it will be enhanced by advances in Artificial Intelligence, and in Nano-Manufacturing which will let researchers create new communications platforms capable of harnessing new parts of the electromagnetic spectrum, and potentially replaced by Nil Communication and new Quantum Communications technologies.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

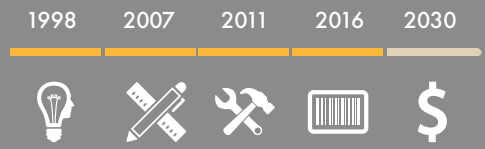
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22

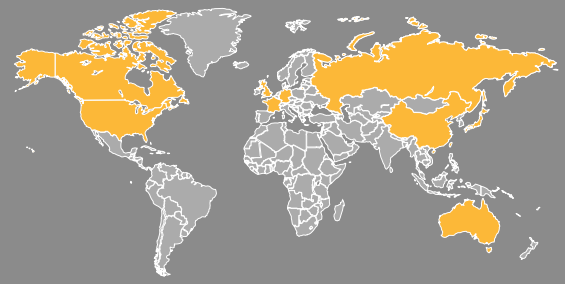
IMPACT

STATUS



Accessibility	4
Affordability	7
Competition	4
Demonstration	8
Desirability	7
Investment	4
Regulation	4
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



5 MRL /9

6 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

DELAY TOLERANT NETWORKS

DELAY TOLERANT NETWORKS, which are in the early Productisation Stage, is the field of research concerned with creating communication networks that can withstand long breaks and delays in the communications chain, such as when a satellite moves out of position when a space agency is trying to communicate with the International Space Station, or a network failure. Delay Tolerant Networks (DTN) work by managing these breaks in availability by letting each node in the network temporarily store the data that goes through them and then waiting for the best moment to pass that data along.

DEFINITION

Delay Tolerant Networks are communications networks designed to withstand long delays or outages in the data transmission chain.

EXAMPLE USE CASES

Today we are using Delay Tolerant Networks to send information from Earth to the International Space Station (ISS). In the future though primary applications will include using them to communicate with people and things where the communications chains are frequently broken or poor, such as in caves, the deep ocean, or in outer space, as well as in denied environments where communications are being specifically jammed by adversaries, and areas subject to frequent network breaks.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by aerospace, defence, and government funding, university grants, and industry consortiums.

While Delay Tolerant Networks are in the early Productisation Stage, over the long term they will be enhanced by Artificial Intelligence, Quantum Internet, and Quantum Sensors, but not replaced.

MATTHEW'S RECOMMENDATION

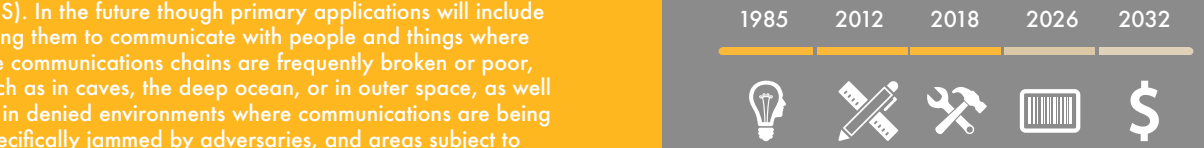
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22

IMPACT

STATUS



Accessibility	2
Affordability	3
Competition	3
Demonstration	8
Desirability	8
Investment	3
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

9 MRL /9

9 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

LOW EARTH ORBIT PLATFORMS

LOW EARTH ORBIT PLATFORMS, a GENERAL PURPOSE TECHNOLOGY, which are in the Productisation Stage, is the field of research concerned with building networks of satellites that orbit the Earth at altitudes of between 400 and 1,000 miles. As the cost of building and launching satellites, thanks to Advanced Manufacturing techniques, and re-useable rocket launch systems help drop the price of building and launching these platforms by more than a hundred fold this realm of space is becoming increasingly accessible and democratised. As a result organisations are now lining up to commercialise it.

DEFINITION

Low Earth Orbit platforms are satellite systems that orbit between 400 and 1,000 miles above the Earth's surface.

EXAMPLE USE CASES

Today we are using Low Earth Orbit Platforms to bring connectivity to every individual on the planet by launching 4,200 LEO satellites that can blanket the Earth with coverage and connect the last 3.5 Billion people, and launching new satellite platforms that can monitor and surveill the Earth and everyone and everything on it in real time in high definition, and starting to lay the foundations for the first large scale off Earth manufacturing facilities.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by visionary space start ups that want to push the boundaries, and the more visionary established space organisations.

While Low Earth Orbit Platforms are in the Productisation Stage, over the long term they will be enhanced by advances in Advanced Manufacturing, Artificial Intelligence, Energy and propulsion, and Robotics, but not replaced.

MATTHEW'S RECOMMENDATION

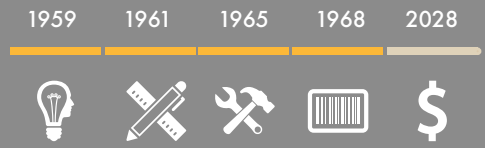
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

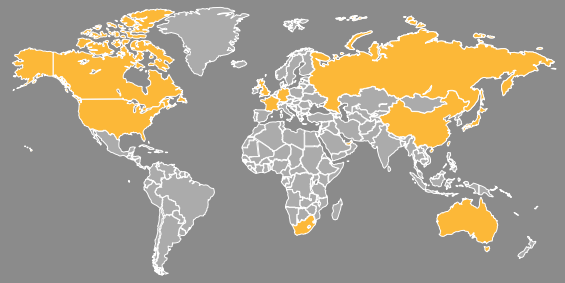
IMPACT

STATUS



Accessibility	6
Affordability	5
Competition	3
Demonstration	9
Desirability	9
Investment	8
Regulation	7
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



7 MRL /9

9 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

LOW POWER WIDE AREA NETWORKS

LOW POWER WIDE AREA NETWORKS, a GENERAL PURPOSE TECHNOLOGY, which are in the Productisation Stage, is the field of research concerned with the development of new low power communications platforms that use both licensed and unlicensed radio spectrum to allow organisations to create wide area networks capable of connecting and communicating with the billions of individual sensors and things that make up the Internet of Things. While there are now a number of competing LPWAN standards, including LORA, Narrowband-IOT, and Sigfox, increasingly there is a fight brewing between the incumbent telecommunications providers who want their chargeable licensed spectrum standards to be the preferred standard, and start ups in the space who want their unlicensed, non-proprietary standards to be the winner. As a result it is likely that there will be multiple competing standards for a while, until the favourites break away from the pack, which will continue to confuse consumers and hinder adoption.

DEFINITION

Low Power Wide Area Networks are wireless networks that allow the long range communication, at a low bit rates, between different wide spread devices, sensors and things.

EXAMPLE USE CASES

Today we are using Low Power Wide Area Networks to connect hundreds of millions of internet of Things devices, from agricultural machinery and industrial robotics platforms, to Vehicle to X infrastructure and Smart Cities, so the use cases, even through this is a communications technology, are unlimited.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Communications and Technology sectors.

While Low Power Wide Area Networks are in the Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Blockchain, Cognitive Radio, and Mesh Networks, but not replaced.

MATTHEW'S RECOMMENDATION

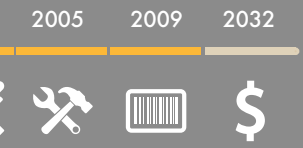
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22

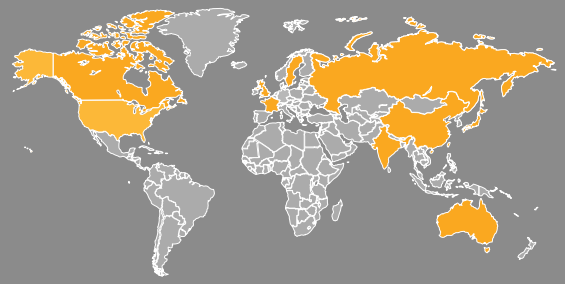
IMPACT

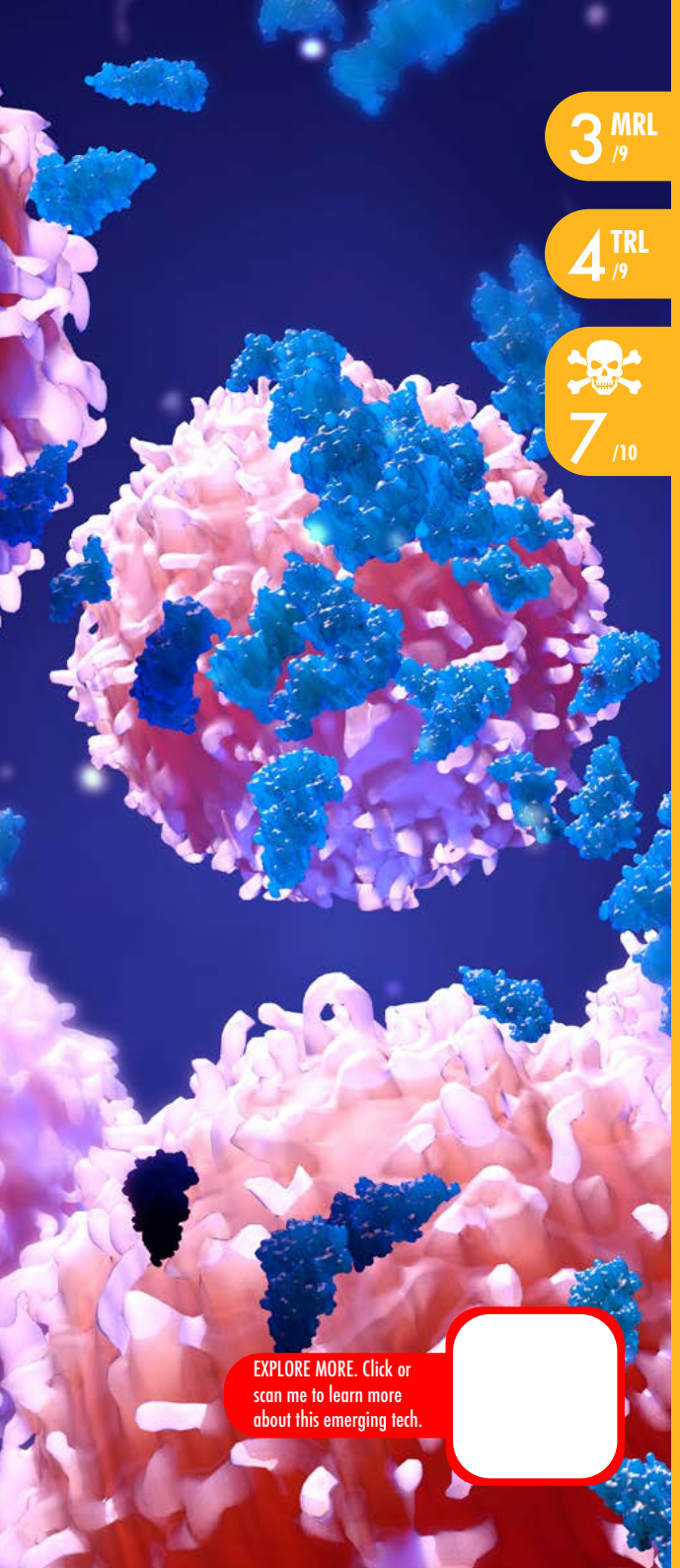
STATUS



Accessibility	8
Affordability	8
Competition	5
Demonstration	8
Desirability	8
Investment	7
Regulation	6
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





3 MRL /9

4 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

MOLECULAR COMMUNICATIONS

MOLECULAR COMMUNICATIONS, which is in the Concept Stage and Prototype Stage, is the field of research concerned with understanding how molecules and other chemicals and compounds in organic and inorganic systems communicate with one another, and discovering new ways to influence and control the mechanisms behind them for human benefit. While research in the area is very specialist, and the field is very complex, Molecular Communications is an area of increasing interest as researchers around the world build the first Biological, Chemical, DNA, Liquid and Molecular Computer platforms, and build and design new Semi-Synthetic and Synthetic cells and designer organisms. And that's all before we discuss the advances we've seen recently in creating Nanobots and Nano-Machines capable of cruising the body's blood stream, hunting down and killing disease, and performing basic in vivo surgery.

DEFINITION

Molecular Communication is where biological and hybrid cells and Nanomachines use molecules to communicate with one another and other systems to perform coordinated actions.

EXAMPLE USE CASES

Today the first Molecular Communications prototypes are being used to build enzyme engines that power the Nanobots that one day will seek out cancer within the human body, improve the accuracy and efficiency of new, powerful CRISPR Gene Editing and mRNA tools, and build the first generations of Biological, Chemical, DNA, Liquid, Molecular Computer platforms, and Nano-Sensors. In the future the other primary uses cases for the technology will also include the development of new materials, and even more extraordinary applications than we are examining today.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Biotech, Healthcare, and Technology sectors, as well as university grants.

While Molecular Communications are in the Concept Stage and Prototype Stage, over the long term it will be enhanced by advances in Nanotechnology and Synthetic Biology, and replaced by Atomic Communication.

MATTHEW'S RECOMMENDATION

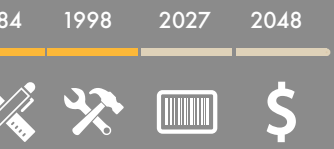
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19

IMPACT

STATUS



Accessibility	4
Affordability	2
Competition	2
Demonstration	4
Desirability	7
Investment	3
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

4 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

NIL COMMUNICATION

NIL COMMUNICATION, which are in the Concept Stage and very early Prototype Stage, is the field of research concerned with sending data in new ultra-secure ways, and recently researchers discovered how to send data without sending data, and doing so without having to use particles, which are the foundation of how all data is transmitted today whether it's sending E-Mails with electrons, or listening to music using air molecules. In order to accomplish their feat the researchers involved managed to send data without sending data and communicate using a phenomenon known as the Quantum Zeno effect, and Quantum Wave Functions. And yes, I know how weird all that sounds, but now that the first prototypes have been built and tested, this could be one of, if not the most secure forms of communication ever known.

DEFINITION

Nil Communication is the process of exploiting quantum mechanics to send information without transmitting any data.

EXAMPLE USE CASES

Today the first Nil Communication prototypes have been used to demonstrate the feasibility of the technology, and so far the tests, which sent information without sending information, used Quantum Zeno waves to accomplish their feat.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, but it will be from a very low base and primarily led by organisations in the Defence sector, assisted by specialist Government funding.

While Nil Communications are in the Concept Stage and very early Prototype Stage, at this point in time it is unclear what it will be replaced by.

MATTHEW'S RECOMMENDATION

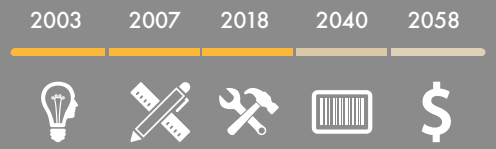
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '19, '20, '21

IMPACT

STATUS



Accessibility	1
Affordability	1
Competition	1
Demonstration	4
Desirability	5
Investment	1
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

2 MRL /9

4 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ORGANIC NETWORKS

ORGANIC NETWORKS, which are in the Prototype Stage, is the field of research concerned with finding new ways to leverage biology and biological systems to create the next generation of computer-like communication and data networks, and recently there have been a number of developments in the space. Recently researchers have discovered and designed new technologies that connect biological and artificial systems together which allow the quick and uninterrupted flow of data between previously distinct biological and digital systems, thereby opening the door to the development of completely new hybrid communications, computing, electronics, and health opportunities.

DEFINITION

Organic Networks are computer-like data networks that are made from exclusively biological and, or organic components.

EXAMPLE USE CASES

Today the first Organic Networks are being used to test the theory but it is not hard to imagine how they could be used to create entirely new classes of computing and electronics that marry together the best of both organic and non-organic worlds, as well as how they could be used to compliment other healthcare innovations, such as Bio-Hybrid Organs, and accelerate the symbiosis and unification of Man and Machine, whether it be in the form of AI Symbiosis, Human 2.0, or the Singularity.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Healthcare and Technology sectors, with support from government funding and university grants. In time we will see the technology become mature at which point it will revolutionise multiple technology fields and fuel a new technology revolution.

While Organic Networks are in the Prototype Stage, over the long term they will be enhanced by advances in 3D and 4D Printing, Bio-Hybrid Organs, Bioelectronic Medicine, Biological Computing, Brain Machine Interfaces, Genetic Engineering, Neuro-Prosthetics, Synthetic Biology, and Synthetic Cells, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

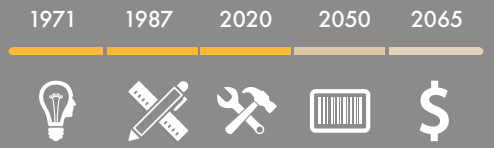
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

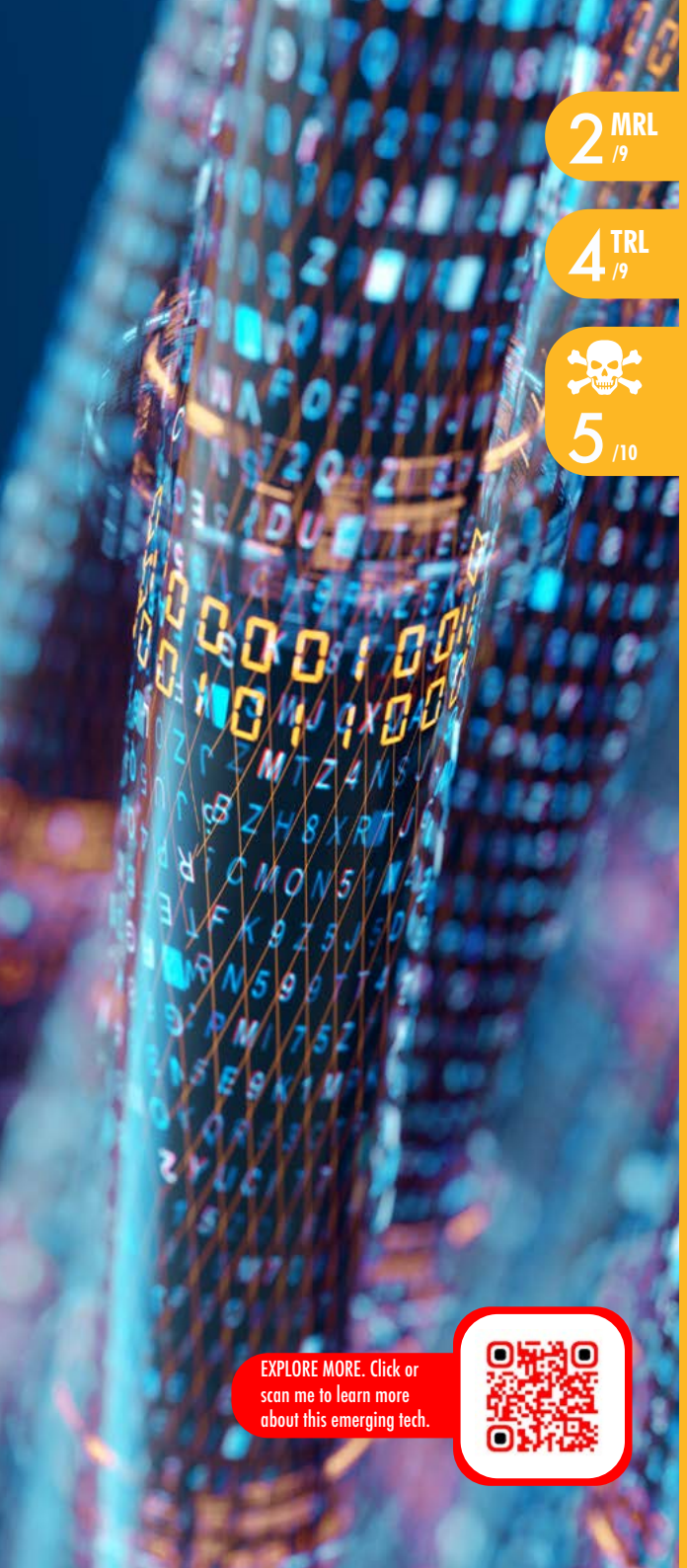
IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	2
Demonstration	4
Desirability	8
Investment	2
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



PETABIT NETWORKS

PETABIT NETWORKS, a General Purpose Technology, which are in the Prototype Stage, is the field of research concerned with trying to develop ultra-fast network systems that can transmit petabits worth of data per second. Recently there have been some major breakthroughs in the space, at both the compute and network level with researchers managing to push upto 11Pbs through aggregated network equipment, and nearly 2Pbs via a 15 core fiber optic cable - enough brandwidth to download over 230 Million photographs per second and more traffic than travels through the entire internet's backbone network per second. On a smaller scale researchers have also managed to deliver over 1Pbs over standard local 4 Core Fiber, which means that one day your local broadband connection could finally fill your data fetish.

DEFINITION

Petabit Networks are networks capable of transmitting over one quadrillion bits of data per second.

EXAMPLE USE CASES

The obvious use cases for this technology are to support the internet's connectivity backbone and provide massive amounts of bandwidth to countries, organisations, and eventually individuals. However, while it's one thing to have access to networks that are capable of running at these massive speeds the real question is what data needs could ever possibly come close to maxing them out. Perhaps those of an Artificial Super Intelligence (ASI) ...

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate, predominantly led by the Communications and Defence sectors, with support from government grants. Today data is oil, as they say, and it's arguably the world's most valuable commodity so being able to shuttle massive volumes of it around the world at insane speeds is an advantage

While Petabit Networks are still in the Prototype Stage they could be enhanced by advances in AI, Exascale Computing, Federated Supercomputing, Laser technology, Materials, Photonic Computing, and other technologies, however over the long term it's unclear what it could be superceded by.

MATTHEW'S RECOMMENDATION

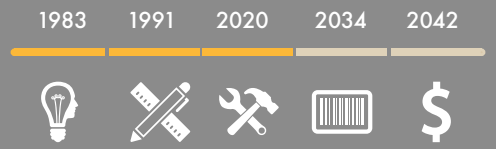
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23, '24

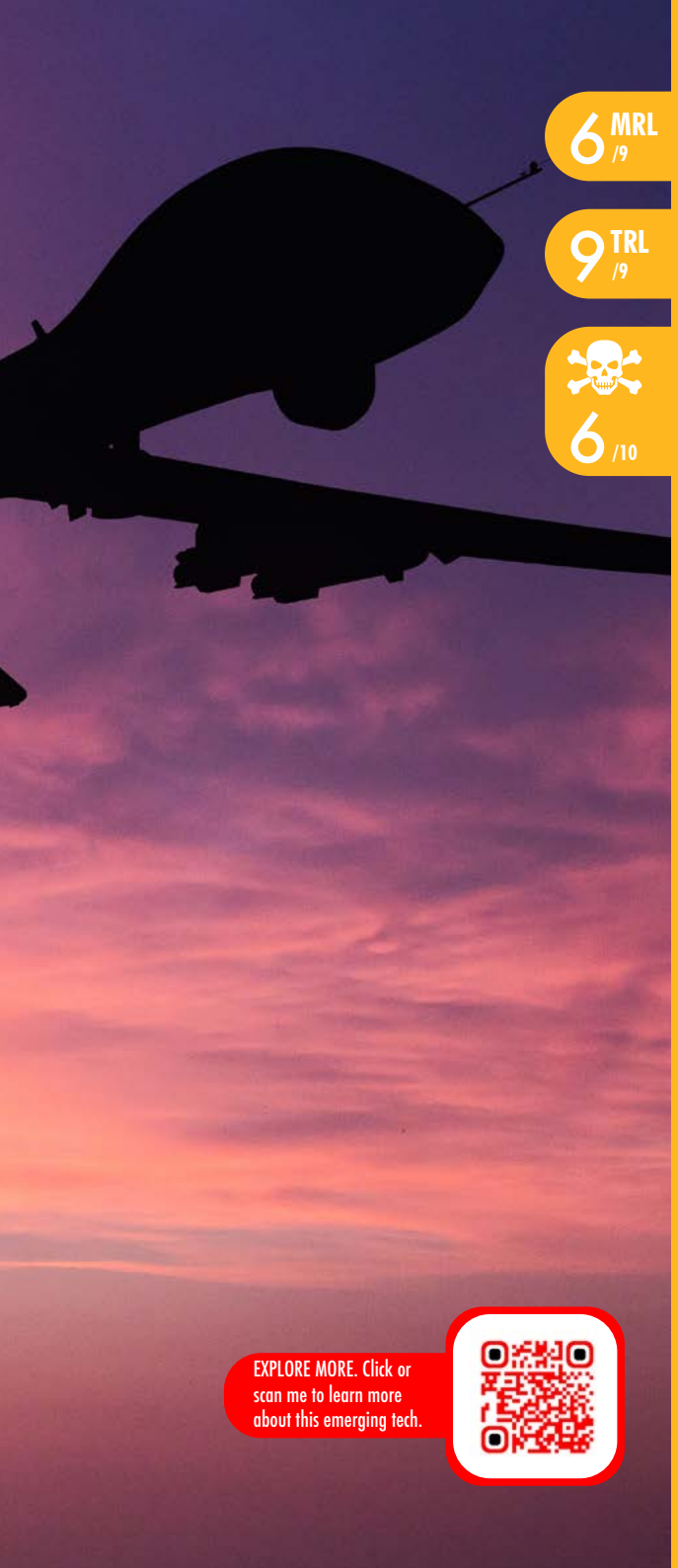
IMPACT

STATUS



Accessibility	4
Affordability	4
Competition	2
Demonstration	8
Desirability	9
Investment	4
Regulation	2
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



6 MRL /9

9 TRL /9

6 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

PSEUDO SATELLITES

PSEUDO SATELLITES, which are in the Productisation Stage, is the field of research concerned with developing high altitude platforms that fly close to the Earth's Stratosphere, acting as a half way house, per se, between Low Earth Orbit Platforms, such as satellites, and ground based stations. Currently there is a lot of buzz around these platforms as companies race to create and deploy platforms, from passive balloons to highly advanced drones with wingspans larger than a 747's, that provide organisations with new ways to provide a whole new range of services that up until recently were either infeasible or impossible without the use of expensive satellite systems.

DEFINITION

Pseudo Satellites are high-altitude aircraft or platforms that are designed to fill in the gaps between satellites and Unmanned Aerial Vehicles.

EXAMPLE USE CASES

Today we are using Pseudo Satellites to provide connectivity services to disaster zones and remote areas of the planet, as well as using them to create Persistent Surveillance Systems that can monitor and police entire cities in real time with just one or more drones.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Communications and Technology sectors.

While Pseudo Satellites are in the Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence, 3D Printing, Drones, Optics, Photovoltaics, Self-Healing Materials, and Virtual Reality, but it is unlikely that they will be replaced.

MATTHEW'S RECOMMENDATION

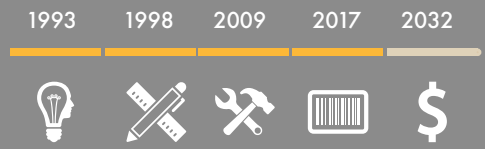
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '23

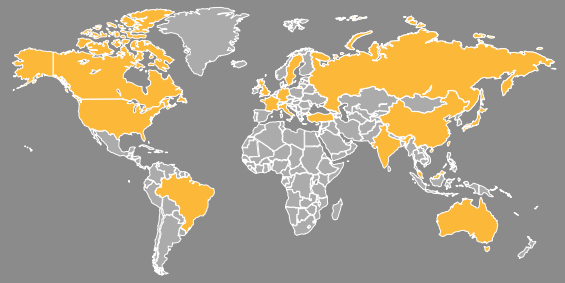
IMPACT

STATUS



Accessibility	8
Affordability	5
Competition	6
Demonstration	9
Desirability	7
Investment	7
Regulation	6
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



4 MRL /9

8 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

QUANTUM INTERNET

QUANTUM INTERNET, which is in the Prototype Stage and very early Productisation Stage, is the field of research concerned with using the weirdness of Quantum Mechanics to create a new unhackable, or at the very least ultra-secure, internet platform. Over the past couple of years there have been a string of breakthroughs in developing Quantum Internet platforms, including the deployment of Quantum Communications satellites, and the development of new Quantum Key Distribution (QKD) encryption technologies, through to the development of new longer distance Quantum Repeaters, that have allowed researchers build and test the first viable, working Quantum Internet platforms.

DEFINITION

Quantum Internet is an ultra-secure network of interconnected computers and devices that use the properties of Quantum Theory to send and receive information.

EXAMPLE USE CASES

Today we are using the Quantum Internet almost in the same way as the regular internet, to transmit data and host video conference calls, but in an ultra-secure way. In the future the primary use case for the technology will be at first to use it as a way to transmit classified and sensitive data, such as defence, financial, and government data, before it eventually becomes a more general purpose technology.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Communications and Technology sectors, coupled with university grants and increased government funding.

While Quantum Internet is in the Prototype Stage and very early Productisation Stage, over the long term the technology may be replaced by Nil Communication.

MATTHEW'S RECOMMENDATION

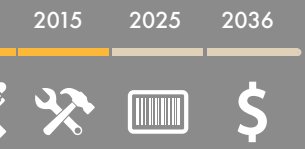
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '19, '20, '21, '22, '23, '24

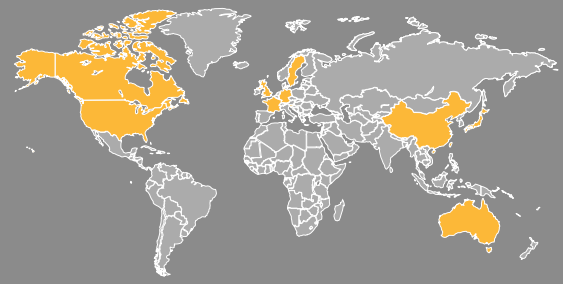
IMPACT

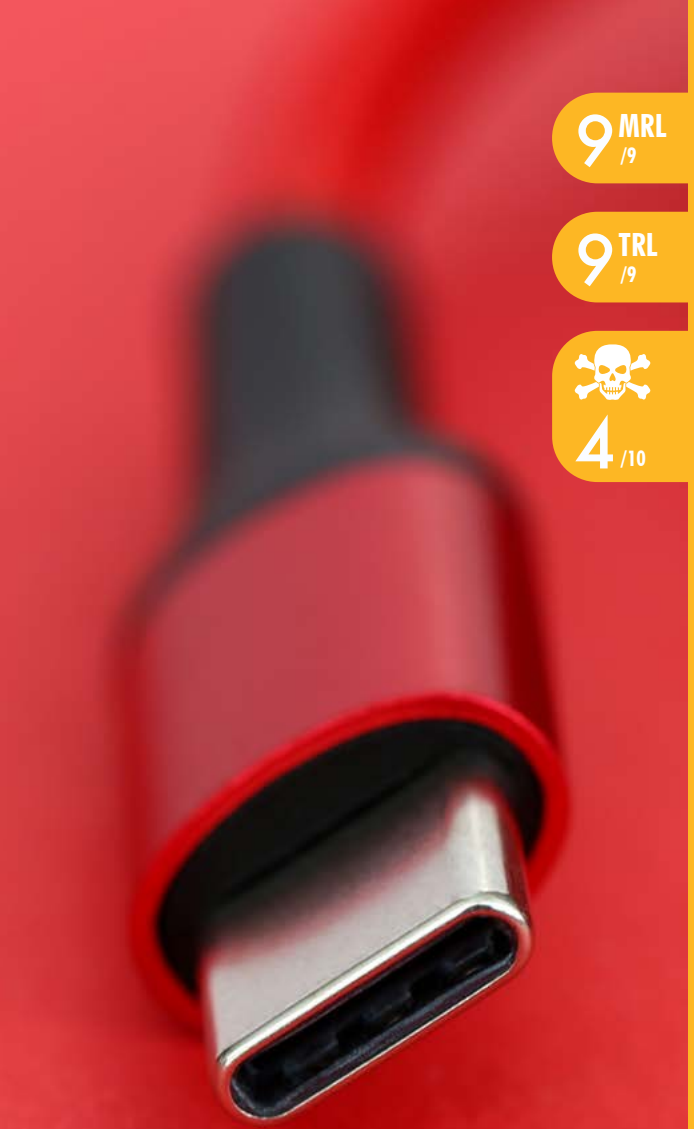
STATUS



Accessibility	4
Affordability	3
Competition	2
Demonstration	8
Desirability	8
Investment	6
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





9 MRL /9

9 TRL /9

4 /10

USB 4

USB 4, which is in the Productisation Stage, is the field of research concerned with developing the next USB standard. Having finally reached the productisation stage Version 2.0 of the USB 4 standard has now been announced and it doubles transfer speeds from 40Gbps for USB 4 Version 1.0 to over 80Gbps. Crucially Version 2.0 is also backwards compatible with older USB standards down to USB 3.2, as well as with some USB-C cables, meaning that people with older cables will be able to benefit from the new technology. However, with such a giant leap in speed many in the field believe that this latest version merits being called USB 5.

DEFINITION

USB 4 is the next iteration of the USB standard and is based on the Thunderbolt 3 protocol.

EXAMPLE USE CASES

Faster data transfer speeds between different devices ultimately mean less time sitting at your computer, and with the new USB standard letting you transfer a 4K movie in just 5 seconds the leap in speed is significant. The new standard will also let people connect and drive bigger higher resolution displays, which as we see those pushing towards 16K and above in the future will be useful.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in USB 4 accelerate, predominantly led by the technology sector. As technology never stands still though USB 4 and its various versions will be undoubtedly be usurped by USB 5 which, given the speed increases we've already seen, will likely push beyond 100Gbps. There's also no doubt that in time USB 4 will become the dominant global USB standard for all devices.

While USB 4 is still in the Productisation Stage, over the long term it could be enhanced by advances in AI, Materials, and other technologies, however over the longer term it will be superceeded by USB5 as well as possibly other as yet unannounced wireless transmission technologies.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

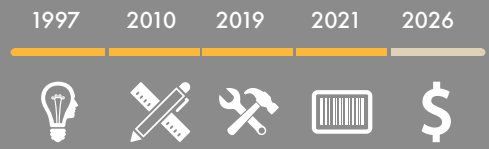
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

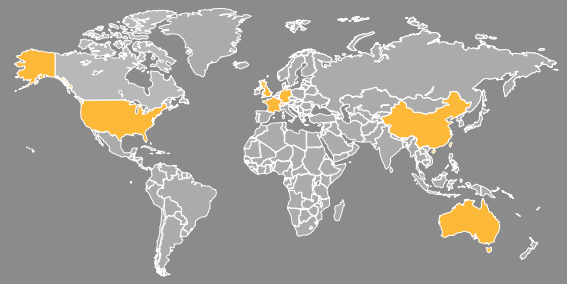
IMPACT

STATUS



Accessibility	5
Affordability	6
Competition	7
Demonstration	7
Desirability	9
Investment	7
Regulation	6
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



ULTRA LOW FREQUENCY COMMS

ULTRA LOW FREQUENCY COMMUNICATIONS, which is in the Productisation Stage, is the field of research involved with developing ELF and ULF communications systems that are capable of penetrating everything from the deep oceans to complex cave systems. While the technology has been around for decades researchers are now being asked to develop next generation systems that are more deployable and powerful than their predecessors.

DEFINITION

Ultra Low Frequency Communications are communications technologies which operate at frequencies in the 0.3 to 30 kHz range.

EXAMPLE USE CASES

Today this technology is being used especially by the world's militaries to allow them to communicate with their submarine and nuclear submarine fleets. In the future though it is hoped that the technology will provide high speed internet access to assets in the deep oceans, which could bring about the Internet of Ocean Things, and in complex cave systems.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace and Defence sector, with support from government funding and university grants. In time we will see the technology mature at which point it is unlikely to face any regulatory barriers to adoption.

While Ultra Low Frequency Communications are in the Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Cognitive Radio, Metamaterials, Quantum Sensors, and other Material and Sensor technologies, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

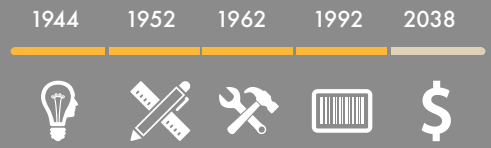
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: '21, '22

IMPACT

STATUS



Accessibility	6
Affordability	7
Competition	4
Demonstration	7
Desirability	8
Investment	4
Regulation	4
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

9 MRL /9

9 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

VISIBLE LIGHT COMMUNICATIONS

VISIBLE LIGHT COMMUNICATIONS, which is in the Commercialisation Stage, is the field of research concerned with using the visible electromagnetic spectrum as a means to transmit data. Recently there have been multiple breakthroughs in the field including the development of the fastest deep space communications systems which can run at the Gigabit range, as well as a host of new satellite to intra-satellite laser communications systems which, in time will dramatically improve the data rates and latencies of today's emerging Low Earth Orbit satellite constellations.

DEFINITION

Visible Light Communications is the use of the visible light spectrum to transfer data between two points.

EXAMPLE USE CASES

Today Visible Light Communications is being used to dramatically increase the point to point data transmission speeds between space based systems where visible light communications systems aren't going to be impacted or limited by clouds or the vagaries of atmospheric weather. Other use cases include navigation and positioning, LiFi, which is a subset of VLC, and the ability to provide wireless communications systems in hazardous environments where RF communications might pose a safety risk or suffer from interference.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see the interest and investment in Visible light Communications increase, primarily led by the Aerospace, Communications, and Defense sectors. Over the longer term this technology will likely play an increasingly significant role as a backbone communications technology to help deliver high speed and resilient global internet connectivity which means that as a technology it has longevity especially as new laser light modulation systems are developed to increase its speed, range, and resilience.

While Visible Light Communications is still in the Commercialisation Stage it could be enhanced by advances in Artificial Intelligence, Materials, Optics and Sensors, and other technologies, however over the long term it could be replaced by Data Teleportation and Nil Communication.

MATTHEW'S RECOMMENDATION

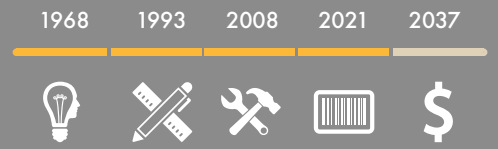
In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

IMPACT

STATUS



Accessibility	5
Affordability	5
Competition	8
Demonstration	7
Desirability	7
Investment	3
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

WIFI 7

WIFI 7, which is in the Prototype Stage, is the field of research concerned with developing the next generation of WiFi networks which will eventually supersede the WiFi 6 standard. Recently there have been several developments in the field including the release of new chipsets and some of the first real world tests of the technology which when released will be able to accommodate 30 Gbps, triple that of WiFi 6 standard, with sub 10ms latencies.

DEFINITION

WiFi 7 is the seventh generation of WiFi technology.

EXAMPLE USE CASES

While there are many use cases for the technology it is going to have to compete with 5G which while slower has much lower latency - something that could be an important differentiator for the gaming community in the consumer space. At the moment it's expected that most early use cases will be enterprise focused with Immersive Reality use cases being the prime beneficiaries.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the telecommunications and technology sectors. In time we will see Wifi 7 become the dominant WiFi standard, but as with most technologies of its kind it will take a while to roll out.

While WiFi 7 is in the Prototype Stage, over the long term it will be enhanced by advances in Artificial Intelligence and Cognitive Radio, and replaced by WiFi 8.

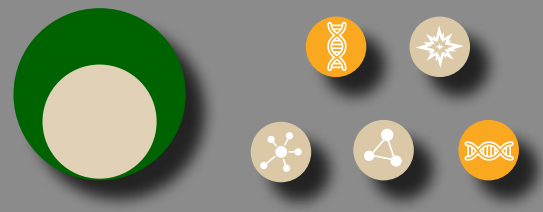
MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '22, '23, '24

IMPACT



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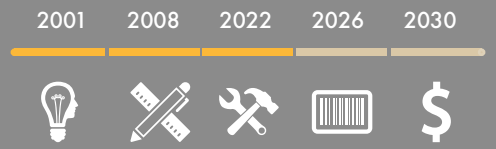
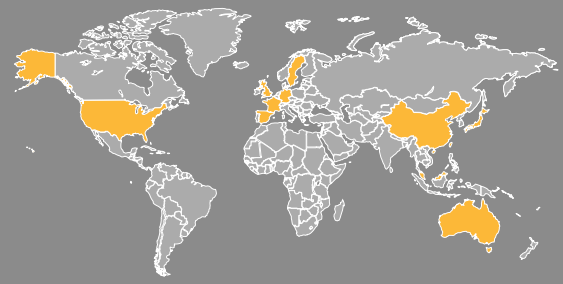
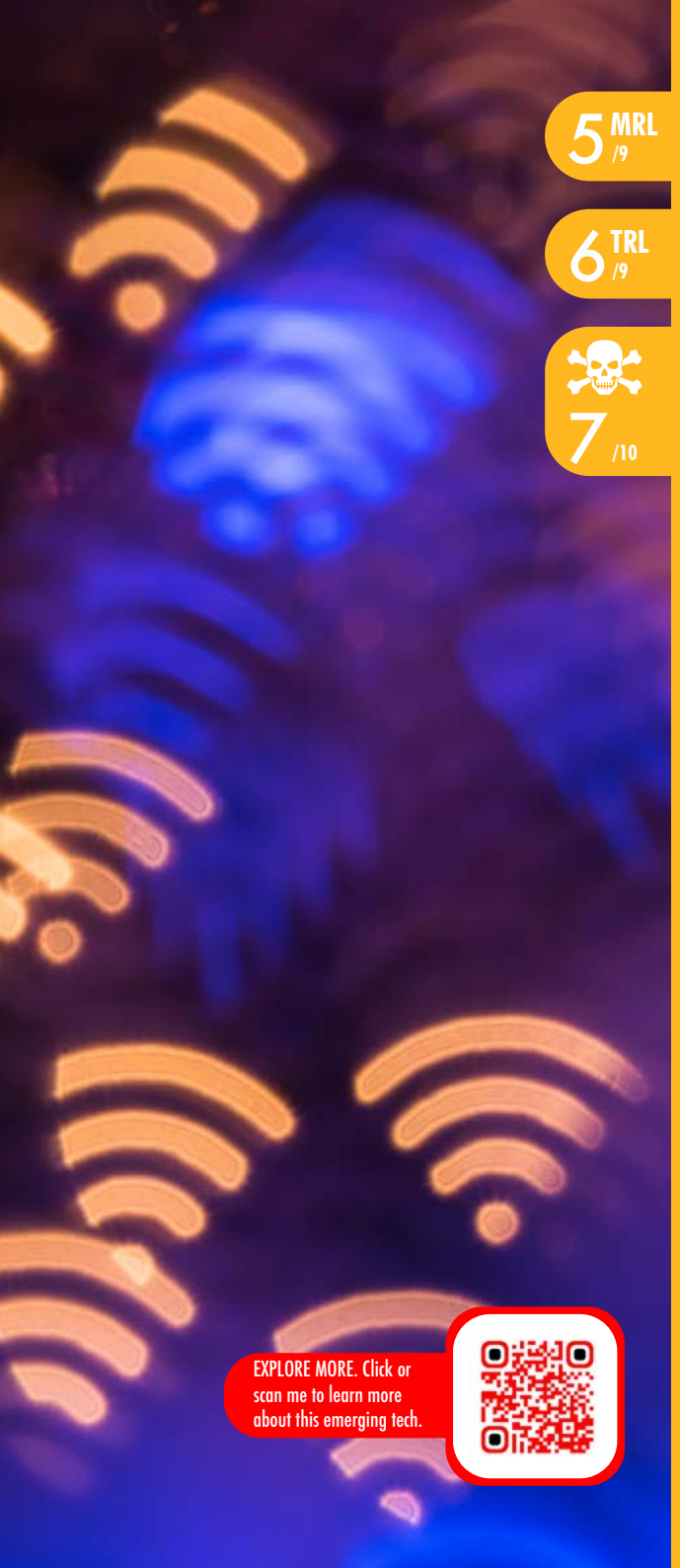


Accessibility	6
Affordability	6
Competition	5
Demonstration	8
Desirability	9
Investment	5
Regulation	6
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





5 MRL /9

6 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

WIGIG

WIGIG, which is in the Prototype Stage and early Productisation Stage, is the field of research concerned with increasing Wi-Fi speeds to Gigabit and multi-Gigabit speeds while maintaining interoperability with existing Wi-Fi standards using the 60GHz spectrum. One of the biggest challengers researchers in the field face, however, is that while WiGig's speeds are at least ten times faster than current Wi-Fi standards WiGig's range is limited to a paultry10 meters, and even though a new standard is emerging that will increase that range to 100 meters the technology will still likely have trouble penetrating internal walls which means consumers will need to buy more access points and Wi-Fi repeaters than they do today.

DEFINITION

WiGig is a Wi-Fi standard that can support data transfer speeds of 7Gbps or more.

EXAMPLE USE CASES

Today the first WiGig prototypes are being used as test bed devices to help manufacturers refine the technology before it is commercialised. In the future the primary use cases for the technology will include combining WiGig routers with 5G networks to eliminate the need for fixed line broadband into homes, and increasing the speed and performance of wireless networks within buildings and outdoor spaces which will, just as in the case of 5G, allow consumers to stream 4K and 8K video, Augmented Reality, gaming and Virtual Reality experiences direct to their headsets and other devices.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Consumer Electronics and Technology sectors, and industry consortiums.

While WiGig is in the Prototype Stage and early Productisation Stage, over the long term it will be enhanced by advances in 5G, 6G, Artificial Intelligence, Blockchain, and Cognitive Radio, but at this point in time it is unclear what will replace it.

MATTHEW'S RECOMMENDATION

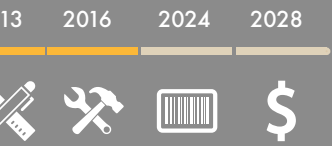
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21

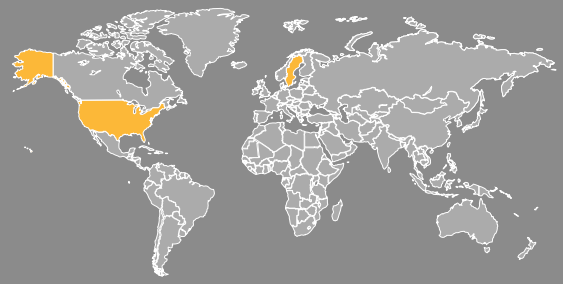
IMPACT

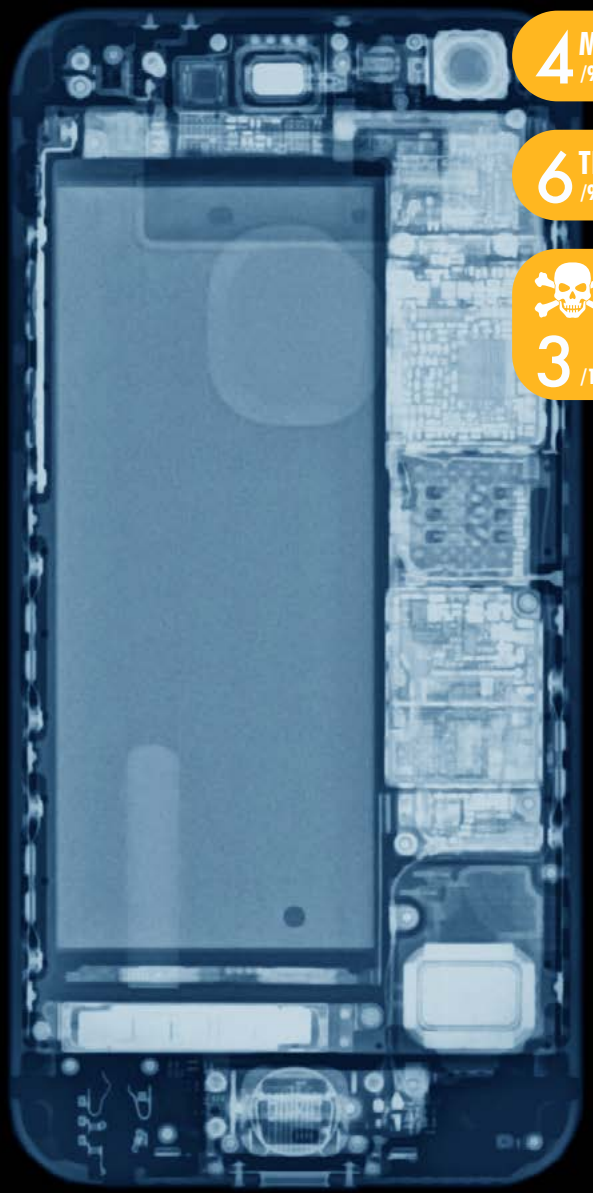
STATUS



Accessibility	5
Affordability	4
Competition	4
Demonstration	8
Desirability	9
Investment	5
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





4 MRL /9

6 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

X-RAY COMMUNICATIONS

X-RAY COMMUNICATIONS, which are in the early Productisation Stage, is the field of research concerned with trying to find new frequencies and ways to communicate over long distances using less power while trying to minimise interference from non-traditional sources such as plasma interference. Recently there have been several interesting developments in the field including space based trials which saw NASA use XCOM technology to enable spacecraft to communicate while re-entering the Earth's atmosphere at hypersonic speeds - something that is impossible using traditional radio frequency technologies because ordinarily the plasma build up around the spacecraft blocks communications for several minutes.

DEFINITION

X-Ray Communications is the use of X-Rays to transmit and receive data.

EXAMPLE USE CASES

X-Ray Communications have much shorter wavelengths than both laser and radio communications and can broadcast in tighter beams which means they can transmit more data using less power making them ideal for space and deep space missions such as the upcoming Mars missions. They are also an ideal communications technology to use for Low Earth Orbit and standard satellite communications, but will also have applications for GPS based communications as well.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, albeit from a low base, primarily led by organisations in the aerospace sector. In time we will see X-Ray Communications play a much greater role in space based communications, but it's unlikely that it will play a significant role in Earth based communications systems because better options exist.

While X-Ray Communications are in the early Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence and Cognitive Radio, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

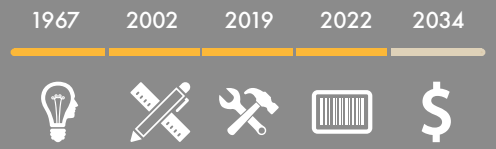
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and re-visit it every few years until progress in this space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '22

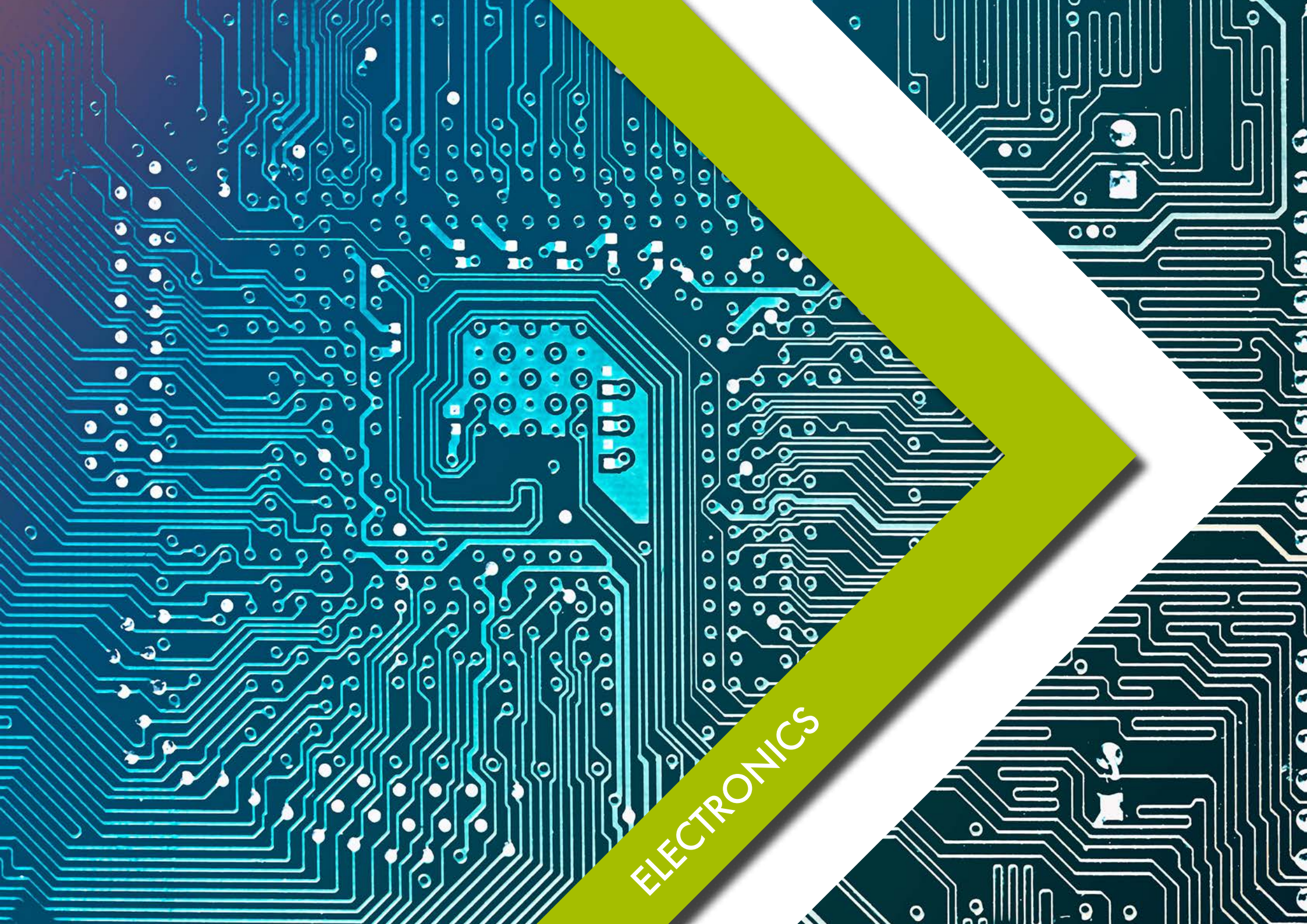
IMPACT

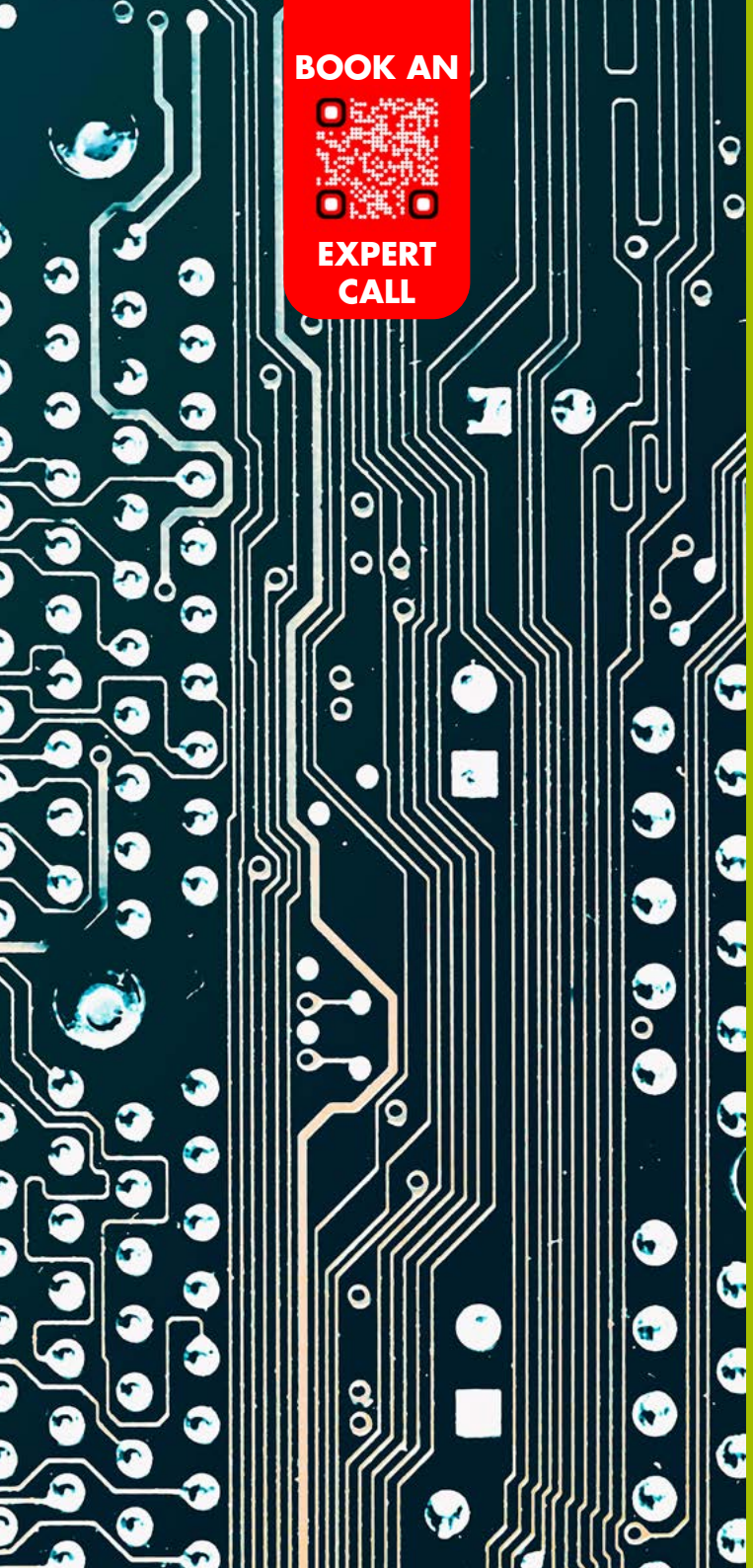
STATUS



Accessibility	2
Affordability	3
Competition	2
Demonstration	6
Desirability	8
Investment	3
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS


ELECTRONICS



THE ADVENT of electronics represented a pivotal turning point in human history and today there is no questioning their impact on our society. However, just as everything else changes so too does the field of electronics, and as we look forwards towards a future repleat with a wide variety of new advanced manufacturing and computing technologies it's these technologies, combined with human ingenuity, that will help open the door to a whole variety of new classes of electronics, from biological and liquid electronics to more exotic forms of electronic systems, which will help transform our society all over again and spur us onwards as we head towards the twenty second century.

In this section you will find details of the emerging technologies that made it into this years Griffin Emerging Technology Starburst along with details of other impactful emerging technologies:

1. Bio-Compatible Electronics
2. Biological Electronics
3. Edible Electronics
4. Flexible Electronics
5. Liquid Electronics
6. Molecular Electronics
7. Neuro-Electronics
8. Printed Electronics
9. Quantum Electronics
10. Re-configurable Electronics
11. Self-Healing Electronics
12. Transient Electronics
13. Transparent Electronics

In addition to these emerging technologies there are many others that have yet to get an entry in this codex. These include, but are not limited to:

14. Bio-Degradable Electronics
15. Bio-Electronic Circuits
16. Injectable Electronics
17. Nano-Electronics
18. Optoelectronics
19. Organic Optoelectronics
20. Papertronics
21. Printed Electronics
22. Quantum Optoelectronics
23. Wave Electronics

BIO-COMPATIBLE ELECTRONICS

BIO-COMPATIBLE ELECTRONICS, which are in the Prototype Stage and early Productisation Stage, is the field of research concerned with developing new forms of computing platforms, electronics, and materials that are bio-compatible and can be embedded and integrated into biological tissue. Recent breakthroughs in the space include the development of the first bio-compatible transistors and Bio-Materials that can be embedded into the human brain without degrading over time or adversley affecting the patients tissue.

DEFINITION

Bio-Compatible Electronics are a class of electronics that are compatible with biological material and don't corrode or degrade over time.

EXAMPLE USE CASES

Today we are using Bio-Compatible Electronics to create better Brain Machine Interfaces for patients suffering from debilitating conditions such as ALS. In the future the primary use of this technology will be to enable the integration of technology into the human body either as a treatment, for example, of dementia, or as a form of Cyborg-like augmentation.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by organisations in the Healthcare sector, with support from univesity grants. In time we will see the development of Bio-Compatible Electronics that don't degrade and don't have any negative impacts on organic tissue, at which point we will then be able to accelerate the development of a wide range of invasive devices and technologies that can be merged with the human body and organic tissue. That said though the technology will continue to face stringent regulator scrutiny which will slow down its adoption, but it is highly likely that in time all concerns, other than cultural concerns, will be successfully overcome.

While Bio-Compatible Electronics are in the Prototype Stage and early Productisation Stage, over the long term they will be enhanced by advances in Bio-Materials, Brain Machine Interfaces, Neuro-Prosthetics, Neuromorphic Computing, and Robotics, and potentially replaced by Biological Computing, and Biological Electronics.

MATTHEW'S RECOMMENDATION

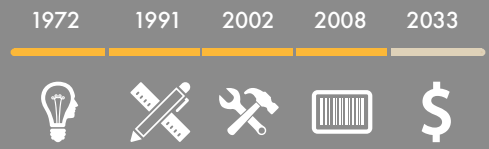
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	5
Affordability	5
Competition	3
Demonstration	7
Desirability	8
Investment	3
Regulation	3
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

2 MRL /9

4 TRL /9

6 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

BIOLOGICAL ELECTRONICS

BIOLOGICAL ELECTRONICS, which are in the early Productisation Stage, is the field of research concerned with developing a new class of electronics that are biological in nature and biologically inspired. Recently there have been numerous breakthroughs in the space including the simplification of designing and manufacturing biological circuits, as well as new genetic tools to identify design errors and debug them.

DEFINITION

Biological Electronics are a class of electronics where biological based circuits and components replace and mimick the logical functions traditional electronic circuits.

EXAMPLE USE CASES

Today we are using Biological Electronics and the principles underpinning them to develop basic biological circuits and the first rudimentary biological AI's and neural networks. In the future the primary use of this technology will be to augment and replace existing traditional electronics where its practical to do so, and in time they could also be used to augment Biological Computing platforms and be merged with organic life to create hybrid lifeforms and new manufacturing paradigms.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Technology sector, with support from univesity grants. In time the technology will become mature and become easier to implement and integrate into new products and applications, however since it is biological by nature it will likely face increased regulator scrutiny before being green lighted for wide use.

While Biological Electronics are in the early Productisation Stage, over the long term they will be enhanced by advances in Biological Computing, Gene Editing, Stem Cells, and Synthetic Biology, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

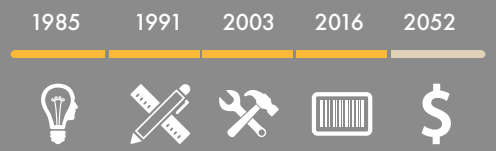
In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22, 23

IMPACT

STATUS



Accessibility	2
Affordability	5
Competition	6
Demonstration	4
Desirability	7
Investment	1
Regulation	1
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

EDIBLE ELECTRONICS

EDIBLE ELECTRONICS, which are in the Concept Stage and early Prototype Stage, is the field of research concerned with developing a new class of electronics that have a variety of use cases and that can be eaten and ingested without causing harm. Recent breakthroughs in the field include the development of basic Graphene based Edible Electronics that can be laser etched onto foods so their provenance can be tracked throughout their lifecycle before the consumer then eats them.

DEFINITION

Edible Electronics are a class of electronics that can be ingested safely without any negative consequences.

EXAMPLE USE CASES

Today we are using Edible Electronics as a way to tag and track food throughout its lifecycle before being finally consumed by the customer. In the future the technology could be used across all food stuffs and combined with sensors to track everything from the foods provenance and location through to its nutritional value and freshness, additionally though the same principles can be applied to pharmaceutical drugs and many more use cases.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Retail sector, with support from univesity grants. In time we will see the technology mature to the point where it becomes ubiquitous and I don't forsee many regulatory hurdles that would hamper adoption.

While Edible Electronics are in the Concept Stage and early Prototype Stage, over the long term they will be enhanced by advances in 3D Printing, Materials, and Sensor technology, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

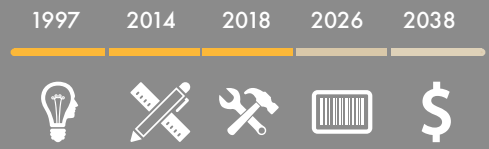
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	3
Affordability	7
Competition	3
Demonstration	6
Desirability	7
Investment	2
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

6 MRL /9

7 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

FLEXIBLE ELECTRONICS

FLEXIBLE ELECTRONICS, which is still in the Prototype Stage and early Productisation Stage, is the development of electronics that can bend, flex and stretch without breaking, or loosing functionality, and as we continue to create new computing platforms that allow us to embed compute and intelligence into more products, from new flexible displays, gadgets, wearables, and even solar panels, to new fabrics and implanted medical devices, this will become increasingly important.

DEFINITION

Flexible Electronics use stretchable conductive materials laid on flexible substrates to produce circuits that can be twisted and stretched.

EXAMPLE USE CASES

Today we are using Flexible Electronics to help us create flexible displays and smartphones, sensors, smart tattoos and wearables, that help us monitor patient health, and new implanted medical devices that can help reverse paralysis.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the space will continue to accelerate, and interest and investment will continue to grow substantially as companies see the period of Wide Spread Adoption near.

While Flexible Electronics is still in the Prototype Stage and early Productisation Stage, over the long term they will be enhanced by Bio-Materials, Graphene, Polymers, Self-Healing Materials, Smart Materials and Spray On Materials, but not replaced.

MATTHEW'S RECOMMENDATION

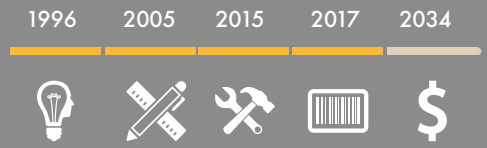
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

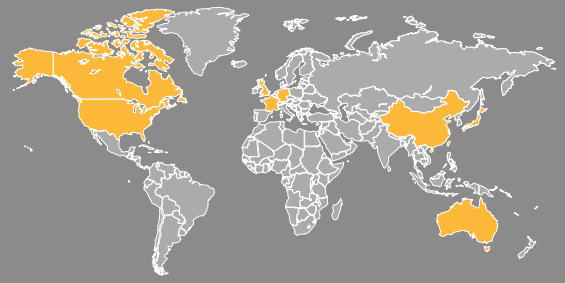
IMPACT

STATUS



Accessibility	5
Affordability	6
Competition	4
Demonstration	9
Desirability	8
Investment	6
Regulation	4
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



2 MRL /9

4 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

LIQUID ELECTRONICS

LIQUID ELECTRONICS, which are in the Concept Stage and early Prototype Stage, is the field of research concerned with developing a new class of liquid based electronics. Recent brteakthroughs include the use of 3D Printing to develop micro-fluidic electronic channel products and devices that contained charged liquids which were then used to conduct electrical charges through liquid circuitry.

DEFINITION

Liquid Electronics are a class of electronics that use liquids to create and complete electrical circuits.

EXAMPLE USE CASES

Today Liquid Electronics are still in the experimental stage and researchers are using their prototypes to prove the theory and refine the technology. In the future the primary use case of the technology would include being able to embed liquid electronics and components into a wide range of products and objects, from Soft Robots and even to 3D Printed biological tissue where it could be combined with new classes of computing platforms such as Biological and DNA Computing platforms.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by univesity grants. In time as the technology matures more researchers in the field will discover viable and interesting use cases for it, and given the nature of the technology it's unlikely to face particularly strict regulatory scrutiny which means that uptake and aoption could acceleate quickly.

While Liquid Electronics are in the Concept Stage and early Prototype Stage, over the long term they will be enhanced by advances in 3D Printing, 3D Bio-Printing, 4D Bio-Printing, 4D Printing, Liquid Computing, and Materials, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

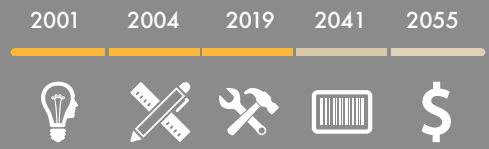
In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	2
Affordability	6
Competition	6
Demonstration	5
Desirability	8
Investment	1
Regulation	1
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

2 MRL /9

4 TRL /9

6 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

MOLECULAR ELECTRONICS

MOLECULAR ELECTRONICS, which are in the Prototype Stage, is the field of research concerned with developing a new class of electronics which, rather than using electronics and conventional circuits, uses molecules and molecular based circuits to fulfil much the same functions. Recently researchers have managed to make a number of breakthroughs that include finding new ways to manipulate and arrange molecules, and assign them new sophisticated properties, at a speed and scale never seen before for incredibly low cost.

DEFINITION

Molecular Electronics is the creation and use of molecules and molecular constructs with sophisticated properties to create a new class of electronics.

EXAMPLE USE CASES

Today researchers are using this technology to develop molecular based computer memory and storage systems that have 100 times the density of today's top of the line systems. In the future this technology could form the foundation of an entirely new class of computing and open the door to a wide range of revolutionary new use cases that include the ability to embed compute, electronics, and intelligence into anything and everything irrespective of whether it is a solid object or a liquid based one.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Technology sector, with support from university grants. In time we will see this technology mature to the point where it is ready to be deployed, and it is highly likely that it will lead to the development of a new range of "Wet" electronics.

While Molecular Electronics are in the Prototype Stage, over the long term they will be enhanced by advances in 3D Printing, Chemical Computing, Liquid Computing, Liquid Electronics, Molecular Computing, and Synthetic Molecules, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

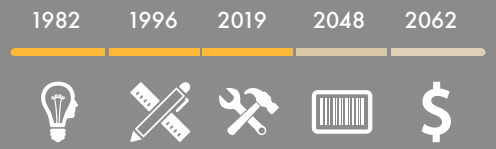
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and re-visit it every few years until progress in this space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '21, '22, '23, '24

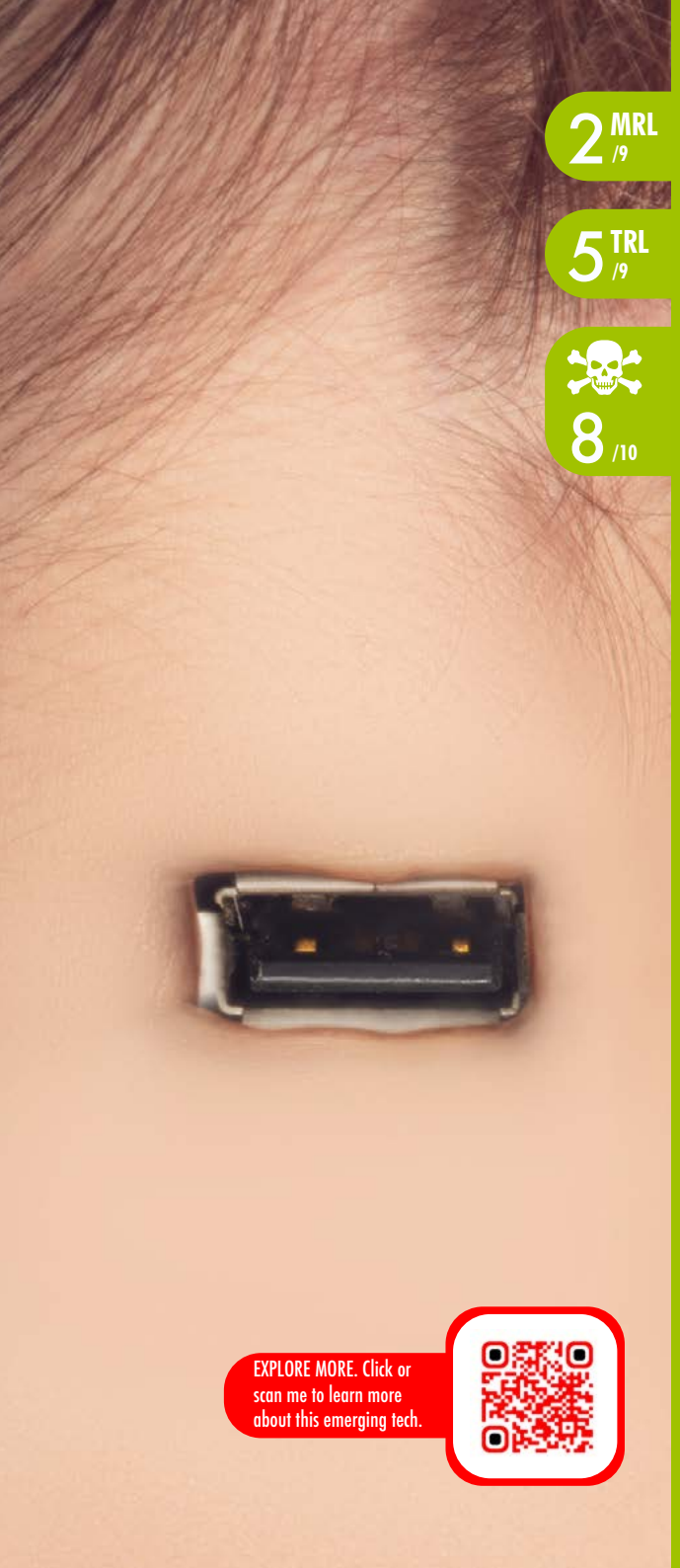
IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	1
Demonstration	4
Desirability	9
Investment	5
Regulation	2
Viability	1

PRIMARY GLOBAL DEVELOPMENT AREAS



2 MRL /9

5 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

NEURO-ELECTRONICS

NEURO-ELECTRONICS, which are in the Prototype Stage, is the field of research concerned with developing new products that allow the human nervous system to fuse and interface directly with electronics and electronic components. Recently there have been a number of developments in the space which include the development of the first Biological-Artificial neurons and synapses which were able to communicate with one another over the internet, which could herald the age of the Internet of Neuro-Electronic "Things."

DEFINITION

Neuro-Electronics is the interfacing of the biological neurons of the human nervous system with electronic devices.

EXAMPLE USE CASES

Today basic Neuro-Electronic devices are being used to provide therapeutic brain stimulation to monitor and treat neurological diseases such as epilepsy. In the future though they could be used to monitor and treat chronic pain, and a variety of other ailments including IBS and the effects of limb amputations, as well as be used to develop new bionic bodyparts, such as bionic eyes and ears, and even create the Internet of Neuro-Electronics which would see biological brains and nervous systems become nodes on the network in much the same way we do with Internet of Things technologies today.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Technology sector, with support from government funding and university grants. In time we will see the technology mature at which point there will be serious regulatory hurdles to overcome before it can be commercialised and sold.

While Neuro-Electronics are in the Prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Bio-Compatible electronics and materials, Bioelectronic Medicine, Brain Machine Interfaces, Cyborgs, Memristors, Neuromorphic Computing, Neuro-Prosthetics, as well as Sensor technologies, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

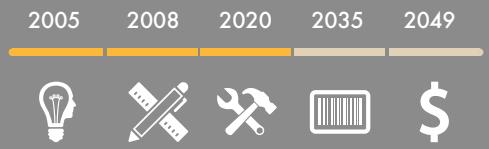
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and re-visit it every few years until progress in this space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '21, '22, '23

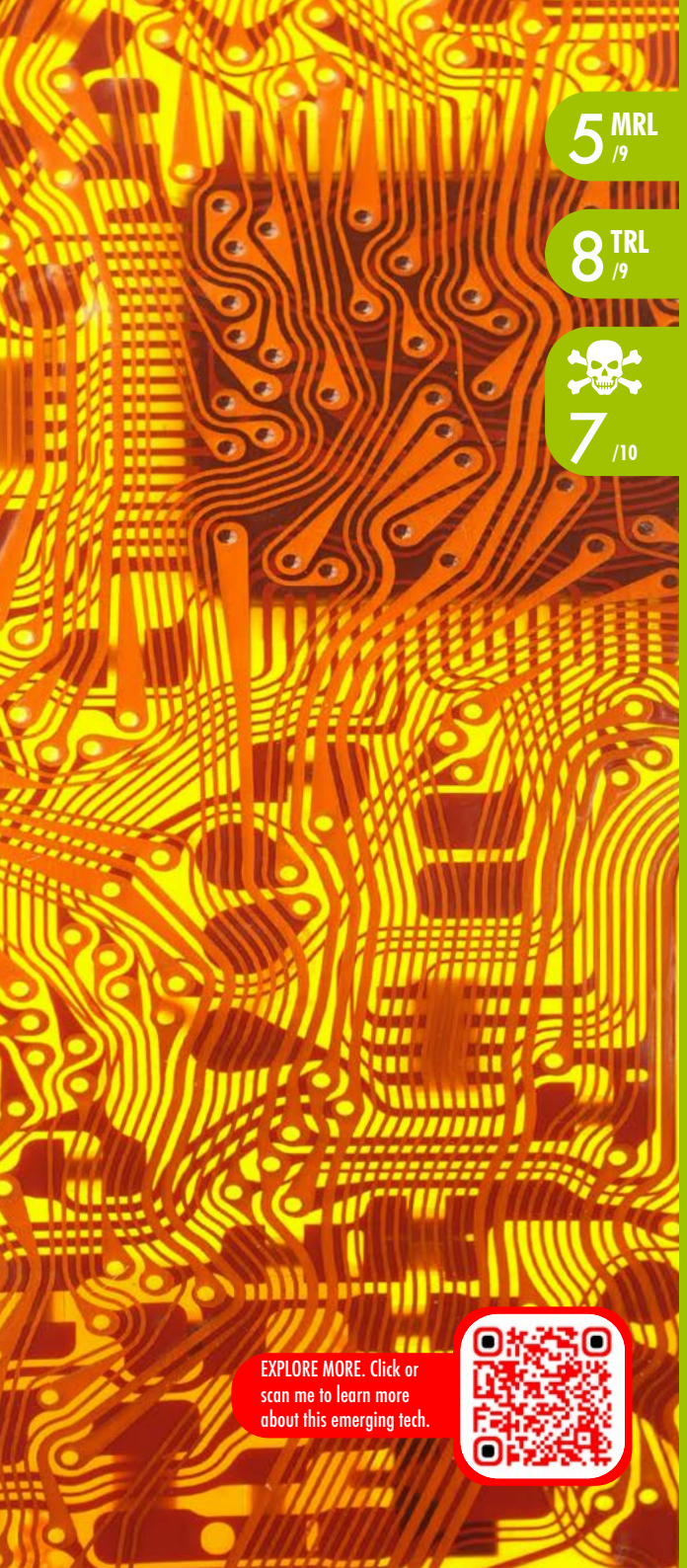
IMPACT

STATUS



Accessibility	3
Affordability	3
Competition	2
Demonstration	6
Desirability	9
Investment	2
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



PRINTED ELECTRONICS

PRINTED ELECTRONICS, which is in the early Productisation Stage, is the field of research concerned with developing new ways to print electronics and electronic components, from Capacitors to PCB's using a variety of manufacturing methods including 3D Printing. Recently there have been significant advances in being able to print an increasingly wide aray of electronics and electronic components, even including the printing of Edible Electronics and Liquid Electronics.

DEFINITION

Printed Electronics are a class of electronics that are printed using a range of different technologies and techniques.

EXAMPLE USE CASES

Today we are using Printed Electronics in only a narrow range of use cases including military use cases and certain consumer products such as cars, where companies are now 3D printing electric vehicles complete with embeded electronics, and food items where Graphene based electronic circuits are laser etched onto food so it can be tracked and monitored throughout their lifecycle. In the future the primary use cases for the technology will include the printing of almost any and all types of electronic circuits and components in all their forms, and advances in manufacturing technologies means that electronics will be able to be embedded and integrated into everyday objects very easily.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by organisations in the Manufacturing sector, with support from univesity grants. As manufacturing technologies improve in capability and speed in time we'll be able to print increasingly complex electronic systems that are embedded and integrated into products in entirely new ways which will not only change global supply chains, but will also let us manufacture complete products in one single printing run.

While Printed Electronics are in the early Productisation Stage, over the long term they will be enhanced by advances in 3D Printing, 3D Bio-Printing, 4D Printing, Materials, and Molecular Assemblers, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

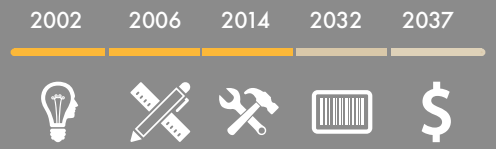
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22, '23, '24

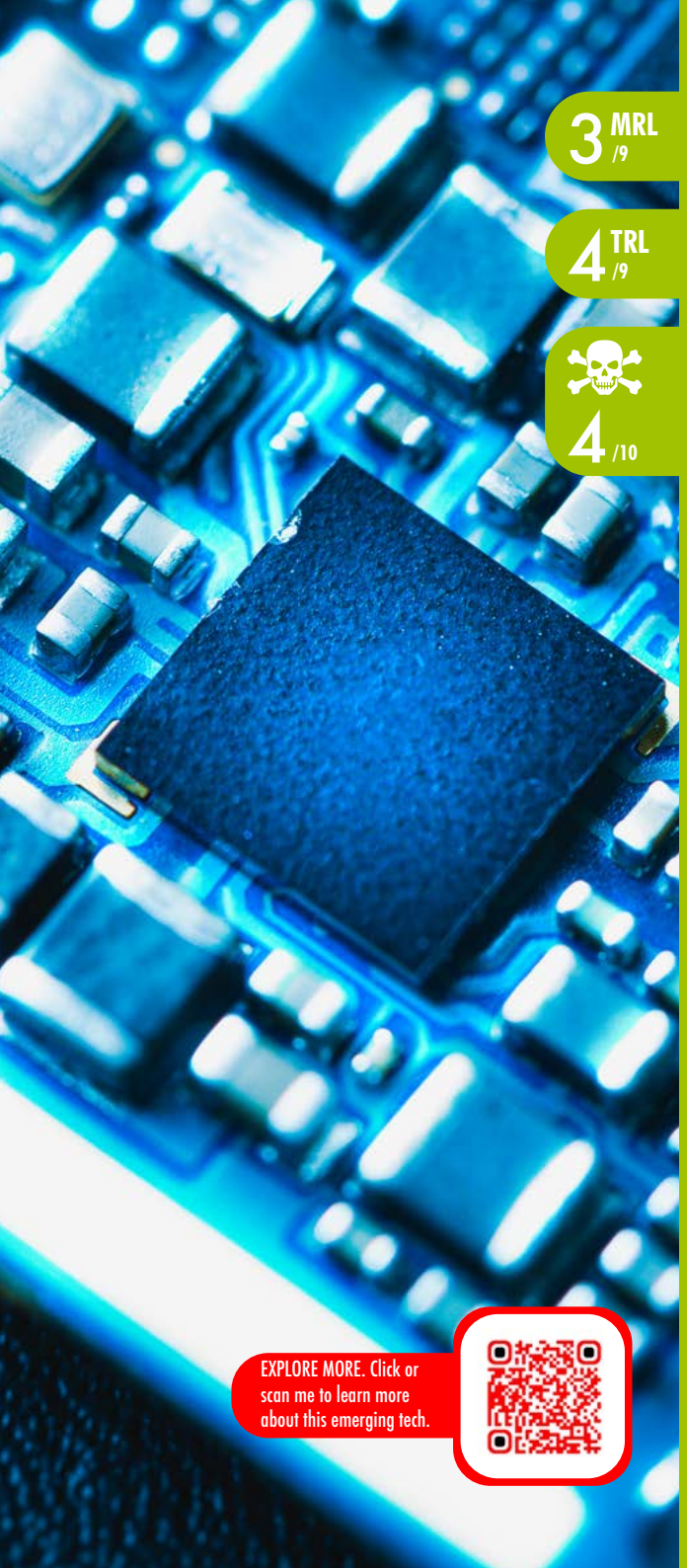
IMPACT

STATUS



Accessibility	5
Affordability	6
Competition	6
Demonstration	5
Desirability	8
Investment	3
Regulation	1
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

4 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

QUANTUM ELECTRONICS

QUANTUM ELECTRONICS, which are in the Prototype Stage, is the area of research concerned with developing a new class of compute and electronics that can harness the power of Quantum Computers, which are hundreds of millions more powerful than today's best computing technologies but that need to run near 0 Kelvin, at room temperature. Recently there have been a run of breakthroughs in the space including the development of the first Silicon based Quantum chip design, and the use of Quantum Dots to protect Qubits, the Quantum Computing equivalent of a conventional Binary bit, from the cold.

DEFINITION

Quantum Electronics is the area of physics dealing with the effects of quantum mechanics on the behaviour of electrons in matter.

EXAMPLE USE CASES

Today there are no commercial products available using this technology. In the future though this technology would bring the power of Quantum Computing to conventional style computing platforms and smart devices, as well as allow the creation of unhackable electronics systems.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Technology sector, with support from government funding and university grants. In time we will see the technology mature, albeit a way off at the moment, and there is a high likely hood that it could usurp and replace many of today's conventional compute and electronics technologies.

While Quantum Electronics are in the prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Quantum Artificial Intelligence, Quantum Computing, Quantum Dots, and Quantum Sensors, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

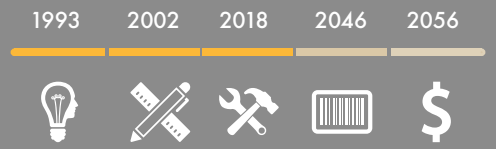
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and re-visit it every few years until progress in this space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '21, '22, '23, '24

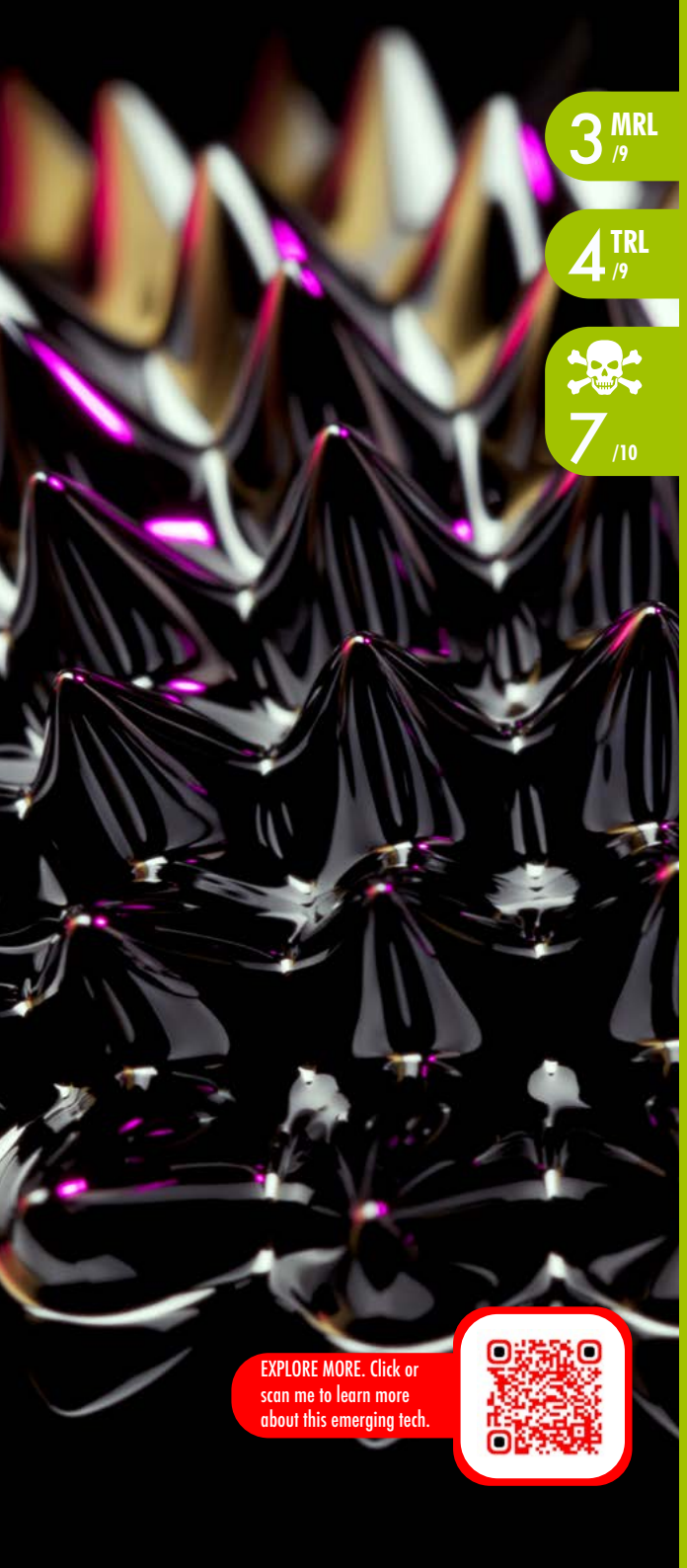
IMPACT

STATUS



Accessibility	2
Affordability	3
Competition	2
Demonstration	5
Desirability	9
Investment	4
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

4 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

RE-CONFIGURABLE ELECTRONICS

RE-CONFIGURABLE ELECTRONICS, which are still in the Prototype Stage, is the field of electronics concerned with trying to create the next generation of adaptable electronics platforms capable of re-configuring their electronic circuits and pathways on the fly, in response to specific stimuli, in order to change their behaviours, capabilities, performance, and resiliency. While research in the field has been boosted recently by new advances in Materials, Memristors, Liquid Computing, Nanotechnology, and Self-Healing Electronics, to name but a few, today I am already seeing the emergence of the next generation of the technology emerging in the form of new Biological Electronic technologies that whose circuits and pathways are made from DNA and living matter.

DEFINITION

Reconfigurable Electronics can alter and re-route fixed and fluid electronic circuits and pathways dynamically in order to become more capable, performant or resilient.

EXAMPLE USE CASES

Today the first Re-Configurable Electronics prototypes are being used in very basic ways to test the theory that we can create viable electronic circuits and pathways capable of re-configuring themselves on the fly in response to certain stimuli. However, over time, and given the ubiquity of electronics the use cases of where this technology could be applied will be almost unlimited.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the field will continue to accelerate, albeit from a low base, and interest and investment will continue to grow, although it is highly likely that much of that investment will be in the form of aerospace, defence and government funding, and university grants.

While Re-Configurable Electronics are still in the Prototype Stage, over the long term it will be replaced by the next generation of electronics, Biological Electronics.

MATTHEW'S RECOMMENDATION

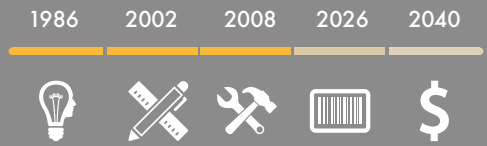
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	2
Affordability	1
Competition	2
Demonstration	5
Desirability	8
Investment	3
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

SELF-HEALING ELECTRONICS

SELF-HEALING ELECTRONICS, which is still in the Prototype Stage, is the field of research concerned with making indestructible electronics, including computing components, that have the highest levels of survivability in even the harshest conditions. Recently there have been breakthroughs in creating self-healing electronics capable of recovering from "catastrophic damage," using combinations of hard and soft materials, which researchers say mimic the behaviours of biological systems on the account that when they detect breaks, they are able to intelligently re-route the signals around them, fix them, and resume normal services.

DEFINITION

Self-Healing Electronics are a category of electronics that can self-heal when broken or damaged.

EXAMPLE USE CASES

Today the first Self-Healing Electronics prototypes are being put through extreme testing as researchers try their best to cripple them.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, led principally by the Aerospace, Defence and Government sectors with some input from Consumer Electronics manufacturers. As researchers continue to make breakthroughs in related fields, especially in material sciences, and even within the Re-Configurable Electronics fields, it won't be too long before researchers are able to demonstrate full proof of concept products that are incredibly hard to disable or destroy under extreme conditions.

While Self-Healing Electronics is still in the Prototype Stage, over the long term the technology will be enhanced by advances in Bio-Materials, Nano-Materials, Re-Configurable Electronics, and Self-Healing Materials, and potentially replaced by Biological Electronics, Chemical Computing, DNA Computing, and Liquid Computing.

MATTHEW'S RECOMMENDATION

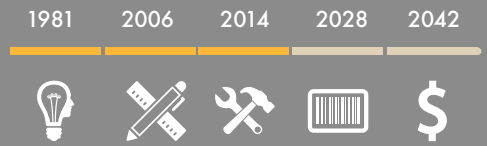
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	1
Affordability	1
Competition	2
Demonstration	5
Desirability	7
Investment	3
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

4 MRL /9

5 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

TRANSIENT ELECTRONICS

TRANSIENT ELECTRONICS, which are in the Concept Stage and early Prototype Stage, is the field of research concerned with developing new ways to develop a class of electronics that vaporises when exposed to specific stimulii. Recently developments in the field include the manufacture of biomedical transient electronics and other forms of transient electronics that vaporise when subjected to Infra Red light.

DEFINITION

Transient Electronics are a class of electronics that vapourise when exposed to specific external stimulii.

EXAMPLE USE CASES

Today we are embedding Transient Electronics into Smart Pills that allow doctors to track whether or not patients have taken their medication before the pills and the electronics harmlessly dissolve away, and also in the defense arena where the transient electronics in drones vaporise in the event the drones crash or are captured. In the future the primary use case of the technology is likely to remain tied to situations where temporary electronics or temparary products are useful such as environmental monitoring systems and medical applications.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by organisations in the Aerospace and Healthcare sectors, with support from univesity grants. In time as the materials needed to manufacture transient electronics improve in their utility and capability it is going to become increasingly easy to embed and integrate them into a wide range of products.

While Transient Electronics are in the Concept Stage and early Prototype Stage, over the long term they will be enhanced by advances in 3D Printing, 4D Printing, and Materials, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

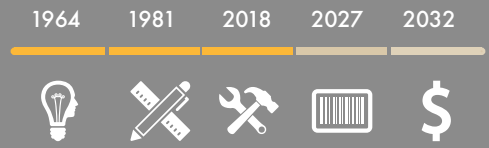
In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23

IMPACT

STATUS



Accessibility	3
Affordability	3
Competition	4
Demonstration	4
Desirability	8
Investment	2
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

1 MRL /9

2 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

TRANSPARENT ELECTRONICS

TRANSPARENT ELECTRONICS, which are in the Concept Stage and early Prototype Stage, is the field of research concerned with developing electronic systems that are invisible and fully transparent. Recent breakthroughs in the field include the use of supercomputers to analyse millions of different compound combinations to try to establish which compounds will be good candidates to create the first transparent electronic systems with.

DEFINITION

Transparent Electronics are a class of electronics that are completely see through and to all intents and purposes invisible.

EXAMPLE USE CASES

Today multiple research groups are running experiments to try to develop a common class of compunds that could be used to create viable transparent electronic systems with, and they are refining their knowledge and theories. In the future the primary use cases for this technology will include transparent consumer devices and wearable products, as well as a wide array of other products.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by organisations in the Consumer Electronics sector, with support from univesity grants. As researchers close in on the most viable compounds to use it is only a matter of time before we see the first true transparent electronic devices emerge, and given the lack of any need for stringent regulatory oversight I believe the adoption of these products will accelerate quickly once they're developed.

While Transparent Electronics are in the Concept Stage and early Prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence, High Performance Computing, and Materials, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

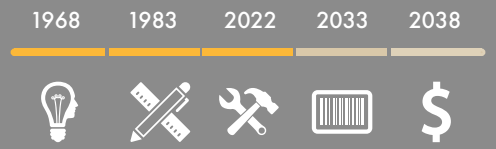
In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	1
Affordability	3
Competition	4
Demonstration	2
Desirability	8
Investment	1
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

ENERGY

IT'S THE one thing that megalamaniacs and children have in common - a thirst for power. But in the latter's case it's to power their gadgets and gizmos rather than to control their errant populations. As we continue to see the decentralisation of the global energy industry, and its drive to greener renewable sources of energy, it is inevitable that over time we will see the cost of energy falling to zero. However, as huge amounts of investment pour into this sector we're seeing a literal Cambrian Era's worth of innovation which means that in the future the only energy problem we will have will be which one to pick for our needs.

In this section you will find details of the emerging technologies that made it into this years Griffin Emerging Technology Starburst along with details of other impactful emerging technologies:

1. Accelerator on a Chip
2. Aqueous Batteries
3. Artificial Photosynthesis
4. Backscatter Energy Systems
5. Bio-Batteries
6. Biofuels
7. Cold Fusion
8. Deep Sea Energy Systems
9. Dyson Spheres
10. Edible Batteries
11. Electric Plants
12. Electrofuels
13. Flow Batteries
14. Fuel Cells
15. Fusion
16. Gravity Power Plants
17. Grid Scale Energy Storage
18. Laser Energy Transmission
19. Lithium-Metal Batteries
20. Lithium-Sulphur Batteries
21. Magneto Hydro Dynamic Drives
22. Mechanical Batteries
23. Microwave Energy Transmission
24. Molecular Energy Systems
25. Molecular Motors
26. Nano-Generators
27. Nuclear Batteries
28. Nuclear Transmutation
29. Ocean Thermal Energy
30. Photovoltaics
31. Piezoelectricitic Energy Systems
32. Plasma Drives
33. Polymer Batteries
34. Printed Batteries
35. Quantum Batteries
36. Quantum Energy Teleportation
37. Quark Energy
38. Semi-Synthetic Energy Systems
39. Solar Fuels
40. Solar Ovens
41. Solid State Batteries
42. Space Based Energy Platforms
43. Stellar Engines
44. Structural Batteries
45. Thermoelectric Generators
46. Thorium Reactors
47. Wireless Energy

In addition to these emerging technologies there are many others that have yet to get an entry in this codex. These include, but are not limited to:

48. Aluminium Air Batteries
49. Ambient Sound Energy Systems
50. Ammonia Based Fuels
51. Bacterial Batteries
52. Bacterial Energy Systems
53. Bio-Electricity
54. Biomechanical Harvesting
55. Blue Diesel
56. Calcium Based Batteries
57. Carbon Free Grid Scale Storage
58. Catalytic Reactors
59. Conductive Energy Systems
60. Dyson Sphere Swarms
61. Electromagnetic Drives
62. Electronic Blood
63. Energy Recuperation Technologies
64. Graphene Based Batteries
65. Green Hydrogen
66. Human Batteries
67. Hydrogen Fuels
68. Lithium Air Batteries
69. Metal Air Batteries
70. Metal-Air Batteries
71. Micro Stirling Engines
72. Microwave Engines
73. Molecular Batteries
74. Molten Energy Storage Systems
75. Nanotube Fuels
76. Nanowire Batteries
77. Nuclear Thermal Engines
78. Organic Batteries
79. Photoacoustics
80. Plasma Jets
81. Proton Batteries
82. Pyro-Electric Systems
83. Quantum Wire Batteries
84. Semi-Synthetic Photovoltaics

85. Smart Grids
86. Solar Flow Batteries
87. Solar Rechargable Batteries
88. Spray On Solar Panels
89. Thermal Resonators
90. Thin Film Batteries
91. Time Reflections
92. Travelling Wave Reactors
93. Triboelectricitic Energy Systems
94. Ultracapacitors
95. Virtual Power Stations
96. WiFi-Tricity
97. Z Machines

5 MRL /9

5 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ACCELERATOR ON A CHIP

PARTICLE ACCELERATOR ON A CHIP, which is in the Prototype Stage, is the field of research trying to find new ways miniaturise today's giant particle accelerators, like the Large Hadron Collider (LHC) or SLAC, and pack all their capability and power into a device no larger than a computer chip. Recently there have been several breakthroughs in the field including the development of laser driven electron accelerators engraved in silicon which can accelerate electrons to 94% the speed of light, as well as the development of new nanoscale photonic crystals that match the momentum of light and electrons in the system and which show the potential to magnify light emissions by a million fold.

DEFINITION

Accelerator on a Chip is development of Particle Accelerators on chip sized devices.

EXAMPLE USE CASES

This technology has multiple applications, from being used in cancer screening through to the eventual development of Neutral Particle Beam weapons. Other applications include general medical imaging and therapy applications, security screening, as well as helping advance biology and materials science, and many others.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate, albeit from a very low base, predominantly led by government grants. The ability to pack all the power of a commercial particle accelerator into a device the size of a computer chip is very attractive but this space is unsurprisingly highly specialised which means that progress is slower than it could or should be.

While Accelerator on a Chip is still in the Prototype Stage it could be enhanced by advances in AI, Lasers, Meta-Optics, Nanomanufacturing, and other technologies, however over the long term it is not clear what it could be replaced by.

MATTHEW'S RECOMMENDATION

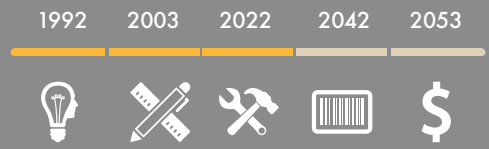
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

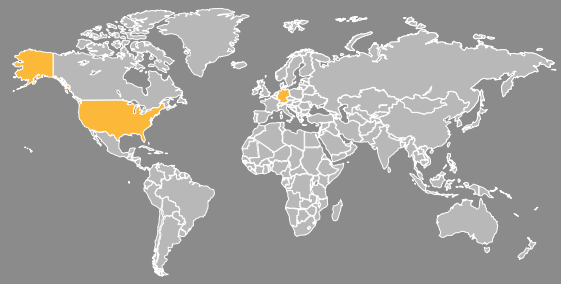
IMPACT

STATUS



Accessibility	2
Affordability	3
Competition	1
Demonstration	7
Desirability	9
Investment	2
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



4 MRL /9

6 TRL /9

1 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

AQUEOUS BATTERIES

AQUEOUS BATTERIES, which are in the early Commercialisation Stage, is the field of research concerned with developing batteries that are both energy dense but also less flammable and more stable than their Lithium Ion counterparts. Recent breakthroughs in this field include the development of water based electrolytes that are almost as energy dense as their LiON counterparts but that are cheaper and more environmentally friendly to produce, requiring far fewer commodity metals, and safer to boot.

DEFINITION

Aqueous Batteries are energy storage devices that use aqueous or water based electrolytes.

EXAMPLE USE CASES

Today the main use case for these batteries is to be the replacement for the ubiquitous LiON batteries in everything from our electric vehicles to our gadgets - or at least, as with all battery systems, that is the grand aspiration. However, as the technology evolves they could also become a cheap Grid Scale Storage solution, competing with Iron based Flow Batteries and other battery types, and find their ways into other industries where this technology's unique characteristics are an asset.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Aqueous Batteries increase, albeit from a low base, primarily led by university grants. While this technology has many attractive qualities the fact of the matter is that its only being developed by a few centers of excellence, and while the developers say that it has the potential to replace LiON batteries, with better cost, energy density, and environmental profiles, it will take more than just great tech to unseat the King of Batteries.

While Aqueous Batteries are still in the Prototype Stage they could be enhanced by advances in 3D Printing, Artificial Intelligence, Materials, and Nano-Manufacturing, and other technologies, however over the long term they could be replaced by a variety of energy technologies including Flow Batteries, Photovoltaics, Solid State Batteries.

MATTHEW'S RECOMMENDATION

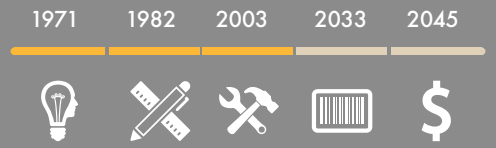
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

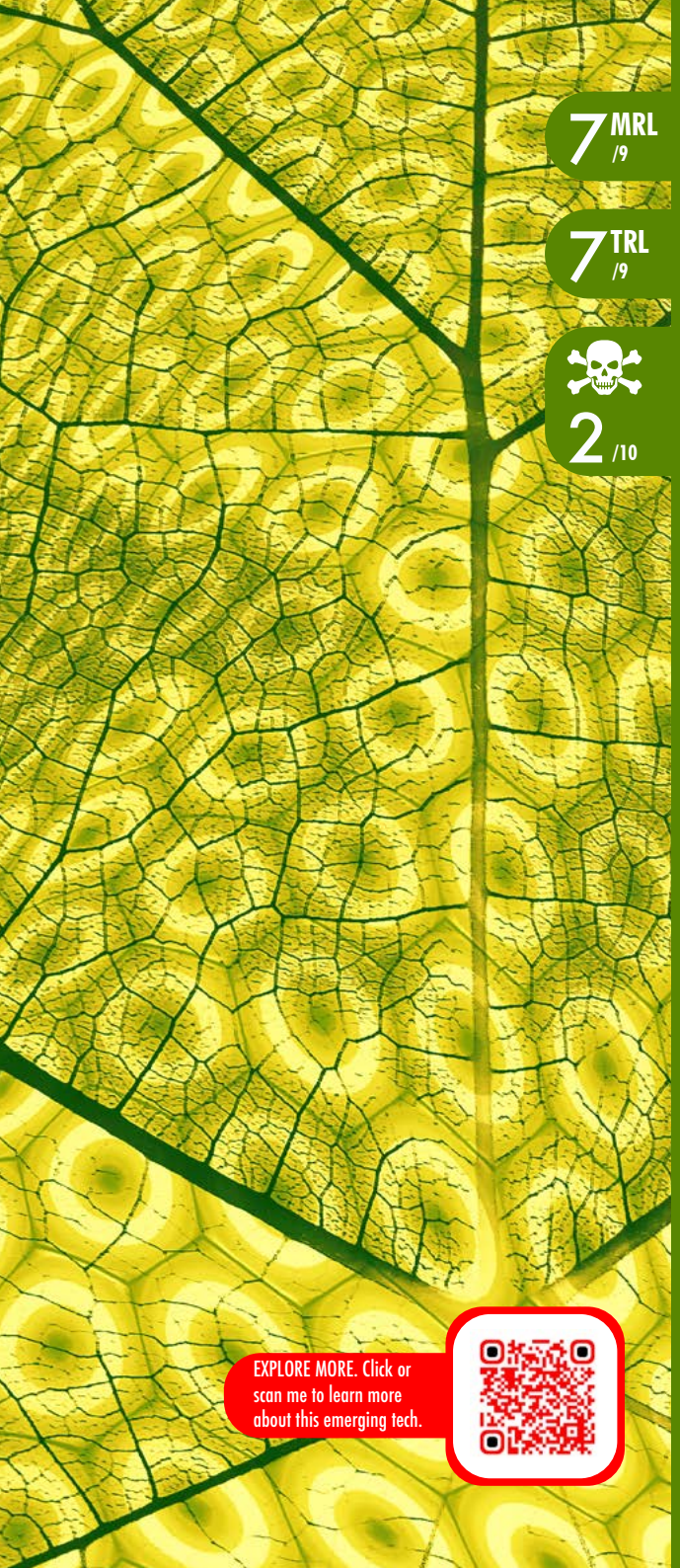
IMPACT

STATUS



Accessibility	3
Affordability	6
Competition	8
Demonstration	7
Desirability	7
Investment	3
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



7 MRL /9

7 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ARTIFICIAL PHOTOSYNTHESIS

ARTIFICIAL PHOTOSYNTHESIS, which is in the early Productisation Stage and very early Productisation Stage, is the field of research concerned with replicating the natural process of photosynthesis, but at higher efficiencies, in artificial systems, so that the energy and natural fuels produced by the chemical reactions can be used as a source of renewable, non polluting energy, with the by products being used to help manufacture new drugs, materials and products. With progress in the field accelerating thanks to breakthroughs in in biological and metabolic engineering, and inorganic catalysts the technology is now getting to the point where commercialisation is not far away.

DEFINITION

Artificial Photosynthesis is a chemical process that replicates the natural process of Photosynthesis.

EXAMPLE USE CASES

Today Artificial Photosynthesis is being used as a way to extract Carbon Dioxide from the air, and replace the need to use carbon captured in fossil fuels to create plastics. In the future the primary use cases for the technology will include developing new, sustainable sources of Hydrogen fuel, and generating electricity which can be fed into the electrical grid, and being used as a way to manufacture new biological, semi-synthetic and synthetic products, including new drugs and materials.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, albeit from a low base, primarily funded by organisations in the Energy and Manufacturing sectors, and university grants.

While Artificial Photosynthesis is in the early Productisation Stage, over the long term it will be enhanced by advances in 3D Printing, Biofuels, CRISPR Gene Editing, Nano-Phonic Materials, Semi-Synthetic Cells, and Synthetic Cells, and over time it could be replaced by Bio-Manufacturing, and Photovoltaics.

MATTHEW'S RECOMMENDATION

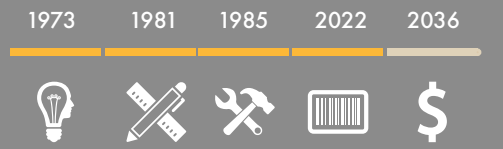
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19', '20, '24

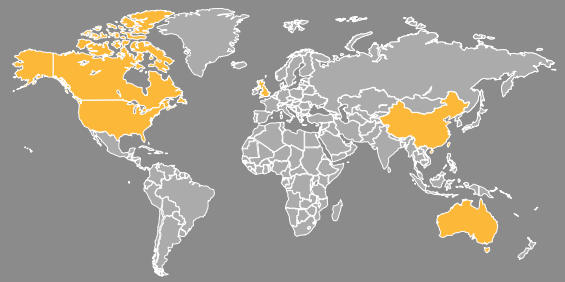
IMPACT

STATUS



Accessibility	5
Affordability	4
Competition	7
Demonstration	5
Desirability	7
Investment	4
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



5 MRL /9

9 TRL /9

2 /10

BACKSCATTER ENERGY SYSTEMS

MBACKSCATTER ENERGY SYSTEMS, which are in the Concept Stage and early Productisation Stage, is the field of research concerned with capturing the ambient Electro-Magnetic Radiation in the air and the environment, such as radio waves, and converting it into electrical electricity that can be used to create battery-less devices that don't have to rely on drawing their power from batteries or plug sockets. Recently there have been a number of breakthroughs in the field with researchers being able to capture and convert more energy in this way to power larger and larger devices, from sensors to smartphones.

DEFINITION

Backscatter Energy Systems use radio frequencies present within an environment to power devices.

EXAMPLE USE CASES

Today we are using Backscatter Energy Systems to create the first battery free smartphones, and battery free Passive WiFi devices capable of generating WiFi signals, and the first battery free Bluetooth and Internet of Things sensors. In the future the primary use case of the technology will continue to be to create more battery-less devices.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, albeit from a low base, primarily led by organisations in the Consumer Electronics, Manufacturing and Technology sector, backed up by government funding and university grants.

While Backscatter Energy Systems are in the Concept Stage and early Productisation Stage, over the long term it will be enhanced by advances in Artificial Photosynthesis, Bio-Batteries, Bio-Manufacturing, Nano-Photonic Materials, and Photovoltaics, but over the long term it will be replaced by Wireless Energy.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

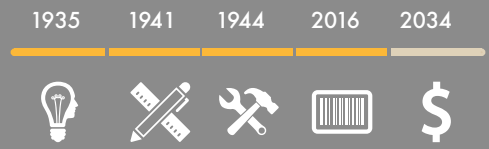
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '19, '20, '21, '22

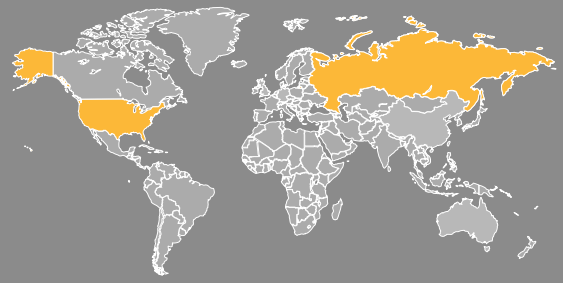
IMPACT

STATUS



Accessibility	4
Affordability	4
Competition	7
Demonstration	4
Desirability	7
Investment	2
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

7 TRL /9

5 /10

BIO-BATTERIES

BIO-BATTERIES, which are in the Concept Stage and early Productisation Stage, is the field of research concerned with developing batteries that are inspired by nature and living organisms, such as bacteria and Electric Eels, who can generate and discharge their own electricity on demand. Not only are these energy sources green, but, with the right engineering they can also be used to reign in climate change, by converting Carbon Dioxide into energy, and provide humanity with an almost limitless, and infinite sources of energy. While research in the space is still currently quite slow, especially when compared to the rate of development of other energy technologies, with a recent spate of breakthroughs it shows great promise.

DEFINITION

Bio-Batteries are energy storage devices that are powered by organic components and compounds.

EXAMPLE USE CASES

Today we are using Bio-Batteries to create battery-less devices in the form of paper, sensors and wearables. In the future the primary use case for the technology could be unlimited as we find new ways to integrate it into everything from our clothing and Smart Contact Lenses, to our Implanted Medical Devices and the structures of our Electric Vehicles.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, albeit from a low base, primarily led by organisations in the Consumer Electronics and Technology sectors, and university grants.

While Bio-Batteries are in the Concept Stage and early Productisation Stage, over the long term they will be enhanced by advances in 3D Bio-Printing, Backscatter Energy Systems, Bio-Manufacturing, CRISPR Gene Editing, Nano-Photonic Materials, Photovoltaics, Semi-Synthetic Cells, Structural Batteries, and Synthetic Cells, but at this point in time it looks unlikely that they will be replaced.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

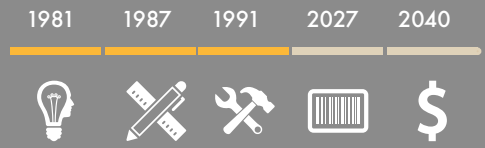
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, ' 21, '22, '23

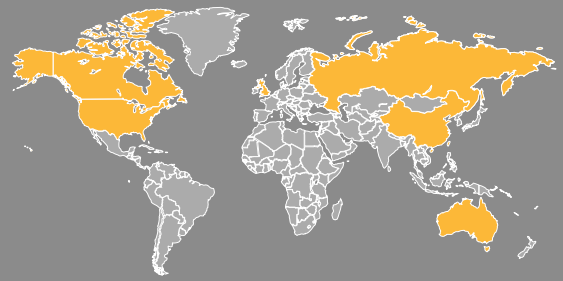
IMPACT

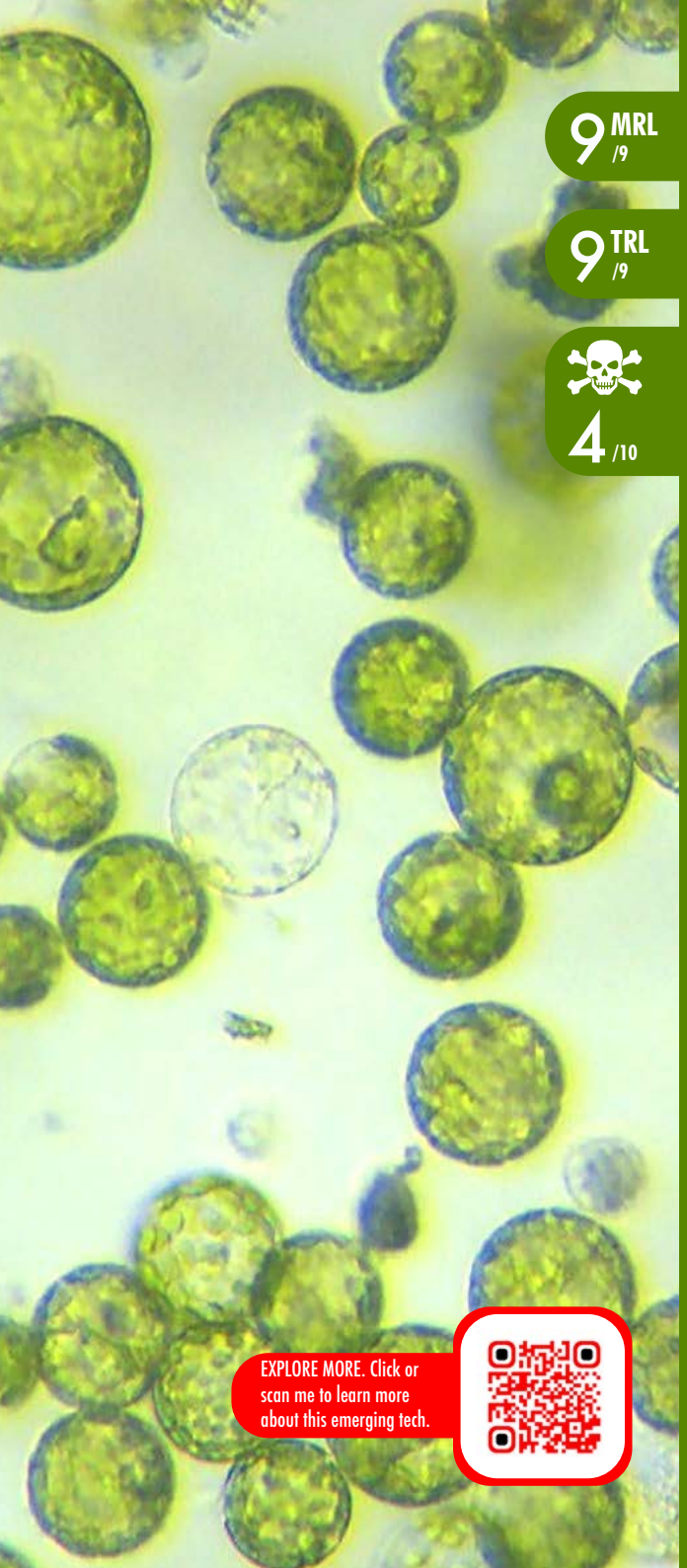
STATUS



Accessibility	5
Affordability	4
Competition	7
Demonstration	4
Desirability	7
Investment	3
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





9 MRL /9

9 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

BIOFUELS

BIOFUELS, which are in the Prototype Stage and Productisation Stage, is the field of research concerned with developing biologically inspired and sourced fuels that can augment and replace today's fossil fuels. Since their emergence onto the global stage Biofuels have found it difficult to gain a foothold, in part because of people's concerns about the impact that replacing crops grown for food with crops grown to produce fuel, would have on the global food production, but as the manufacturing processes used to produce the fuels have improved, and with breakthroughs in producing energy from non crop sources, such as Algae, Bacteria, and even Seaweed accelerate, over the past number of years they have seen a renaissance, particularly within certain sectors such as the airline industry.

DEFINITION

Biofuels are fuels that are produced as a result of harnessing contemporary biological processes.

EXAMPLE USE CASES

Today we are using Biofuels to power commercial airliners, cooking appliances, lubricants, and even clean up crude oil spills. In the future the primary use cases for the technology will ultimately lie in energy generation and transportation, but as both those sectors undergo their own transformations, it is likely that ultimately Biofuels future will lie elsewhere.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Defence, Biotech, Energy and Transportation sector, with support from government funding and university grants. In time we will see a dramatic diversification occur in the field, as researchers move away from crops as a primary fuel source to other biological alternatives, such as genetically engineered Algae and Bacteria.

While Biofuels are in the Prototype Stage and Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Creative Machines, and CRISPR Gene Editing, but over the long term it is unlikely that they will be replaced.

MATTHEW'S RECOMMENDATION

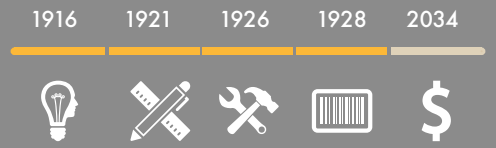
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

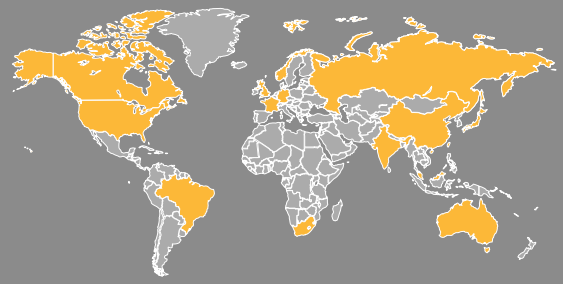
IMPACT

STATUS



Accessibility	7
Affordability	6
Competition	7
Demonstration	5
Desirability	7
Investment	6
Regulation	5
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



1 MRL /9

2 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

COLD FUSION

COLD FUSION, which is still in the Concept Stage, is the field of research concerned with trying to mimic the same fusion processes in the Sun, which run at temperatures of millions of degrees Celsius, at or near room temperature. While Cold Fusion is generally thought to be unachievable by most mainstream experts recently researchers have been using Artificial Intelligence to test a variety of different theories with one, which uses 2D materials to start the reactions, looking as though it's not just plausible but achievable.

DEFINITION

Cold Fusion is a type of nuclear reaction that would occur at, or near, room temperature.

EXAMPLE USE CASES

Today there are no example of Cold Fusion. In the future though it is hoped that the technology will be able to generate limitless amounts of green, zero emission energy at scale.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Energy sector, with support from government funding. In time we will see the feasibility of the technology questioned and it will likely be decades before anyone has any finite answers, but that said Artificial Intelligence could be the game changer that experts in the field need to make it a reality.

While Cold Fusion is in the Concept Stage, over the long term it will be enhanced by advances in Artificial Intelligence,Quantum Artificial Intelligence, Fusion, and Quantum Computing, and in the long term it is likely that it will be replaced by Renewable Energy and Space Based Solar Plants.

MATTHEW'S RECOMMENDATION

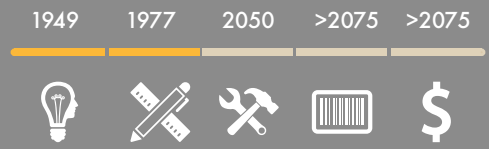
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and re-visit it every few years until progress in this space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	6
Demonstration	1
Desirability	8
Investment	1
Regulation	1
Viability	2

PRIMARY GLOBAL DEVELOPMENT AREAS

5 MRL /9

9 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

DEEP SEA ENERGY SYSTEMS

DEEP SEA ENERGY SYSTEMS, which is in the late Prototype Stage, is the field of research concerned with harnessing the power and momentum of the world's deep sea currents to generate electricity. Recently there have been a few breakthroughs in the field including the successful trials of the world's first Megawatt (Mw) deep sea generators which, when scaled up, it's believed could help countries such as Japan generate in excess of 200Gw from the seas around their country. Furthermore, the fact that deep sea energy is a consistent and predictable form of electricity generation means that it's a very attractive technology as countries everywhere look to wean themselves off of their fossil fuel addictions and secure their energy independence.

DEFINITION

Deep Sea Energy is the process of producing electrical energy from deep sea currents and movements.

EXAMPLE USE CASES

In terms of raw generating capacity deep sea energy generation has the potential to dwarf even the largest terrestrial nuclear power plants and hydroelectric energy installations.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate, predominantly led by the energy and manufacturing sectors with government grants. Given the potential of this technology, which theoretically could be scaled up to generate electricity in the Terrawatt range, it could be the energy industry's dark horse and become a viable competitor to today's hydro, solar, and wind installations - provided, of course, that it can be economically competitive which, as we see generating costs for solar for example fall to historic lows, could be its major challenge.

While Deep Sea Energy Systems are still in the late Prototype Stage, over the long term they could be enhanced by advances in Materials, Robotics, and UHVC systems, however with so many alternative multi Gigawatt energy systems emerging including Fusion, Geothermal, and Space Based Energy Systems, if the companies involved in helping make it mainstream aren't careful they could find it being sidelined.

MATTHEW'S RECOMMENDATION

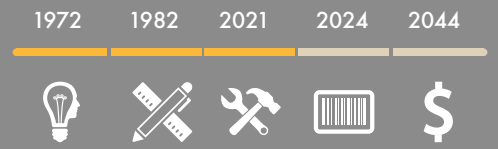
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23, '24

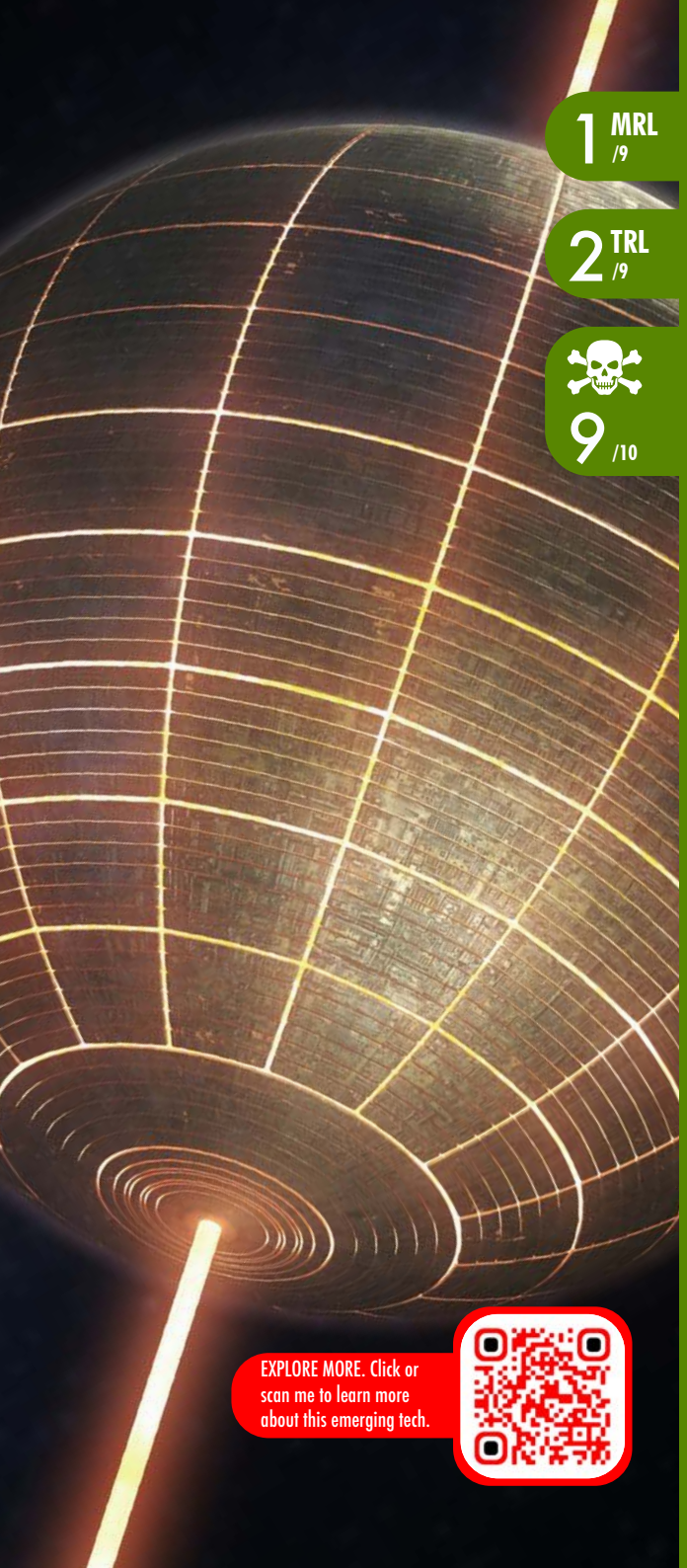
IMPACT

STATUS



Accessibility	5
Affordability	5
Competition	8
Demonstration	7
Desirability	8
Investment	6
Regulation	4
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



1 MRL /9

2 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

DYSON SPHERES

DYSON SPHERES, which are in the Concept Stage, is the field of research concerned with developing a new generation of megastructures which, in this case could capture and harness the majority of a Star's energy output. While the theory behind Dyson Spheres is sound it will optimistically be many centuries before human civilisation has the capability to build one.

DEFINITION

Dyson Spheres are hypothetical megastructures that completely encompass a star in order to capture and harness its power output.

EXAMPLE USE CASES

Today Dyson Spheres are purely theoretical but when humanity is able to build one we would move from being a planetary Stage I civilisation on the Kardashev scale to a Stellar Stage 2 civilisation.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate but the technology will remain entirely theoretical.

While Dyson Spheres are in the Concept Stage, over the long term they will be enhanced by advances in Advanced Manufacturing and Materials, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars and re-visit it every decade or two.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20

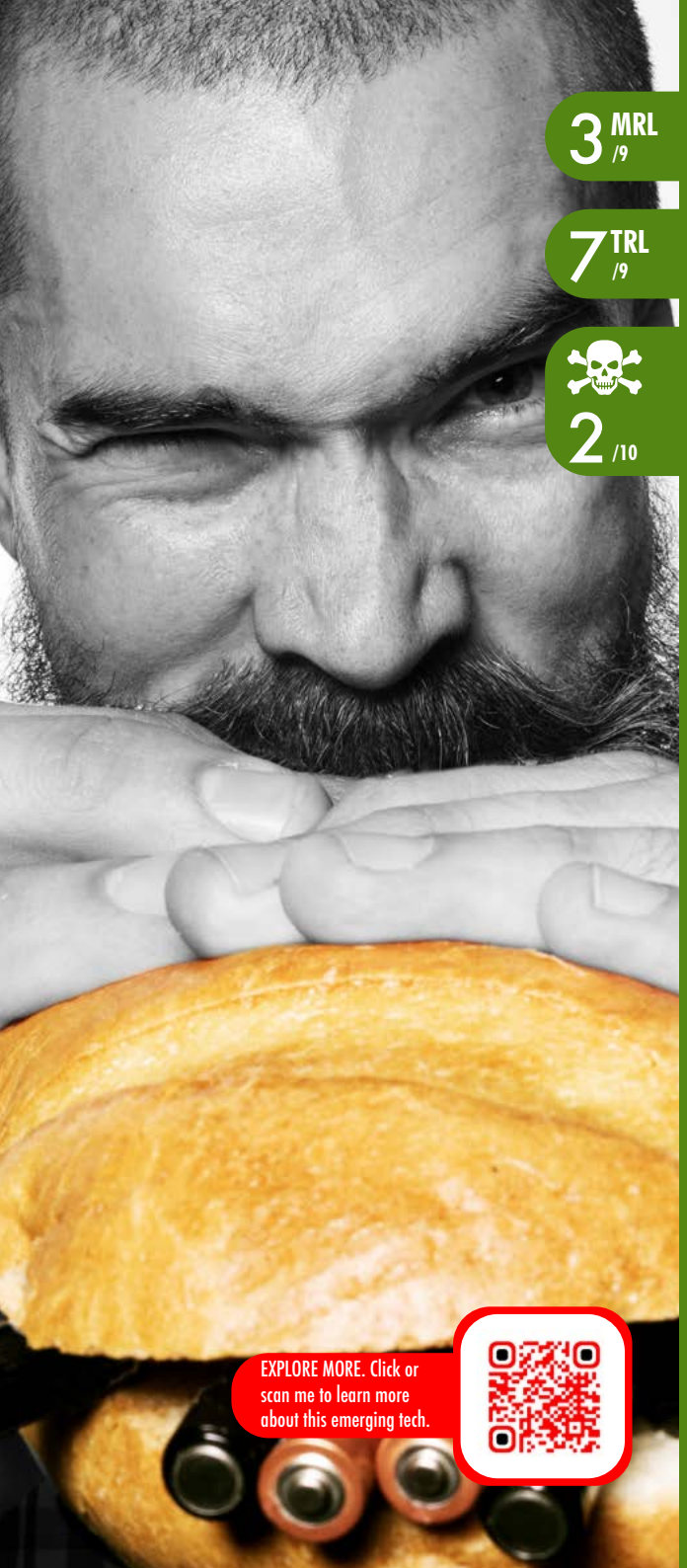
IMPACT

STATUS

1964	1981	>2075	>2075	>2075

Accessibility	1
Affordability	1
Competition	1
Demonstration	1
Desirability	7
Investment	1
Regulation	1
Viability	2

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

7 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

EDIBLE BATTERIES

EDIBLE BATTERIES, which are in the Prototype Stage, is the field of research concerned with trying to make batteries that can be safely eaten and ingested by living beings, including people, and while this might sound odd there are several viable reasons why this is capability is of interest. Recent breakthroughs in this field include the development of a completely edible battery system, made from food based materials, that was safe to eat and had no side effects.

DEFINITION

Edible Batteries are batteries that can be safely ingested and eaten by people that don't cause harm.

EXAMPLE USE CASES

Today there are a number of use cases for this technology that involve powering items outside of the human body that might get eaten, such as powering children's toys where today over 2,600 children in the US alone are admitted to hospital having eaten traditional LiON batteries, through to edible batteries being embedded into foods to power food related IOT use cases. Additionally though this technology could also be used as a biodegradable environmentally friendly alternative to traditional batteries which all too often end up as E-Waste and landfill, and could also be used to power ingestible Smart Pills for medical applications. Also, with some minor modifications this technology could form the foundation of new kinds of electronics, including Transient Electronics which are highly prized by the military.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Edible Batteries increase, albeit from a very low base, primarily led by university grants. While it is easy to focus on the edible part of this technology as a novelty let it not be lost on you that this is also a novel way to power items in a more environmentally friendly way, so in time we could see this technology split and give birth to some interesting new variants.

While Edible Batteries are still in the Prototype Stage they could be enhanced by advances in Backscatter Energy Systems, Materials, Photovoltaics, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

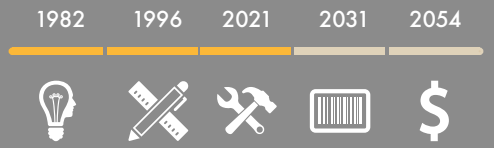
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

IMPACT

STATUS



Accessibility	3
Affordability	5
Competition	3
Demonstration	7
Desirability	7
Investment	2
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

9 MRL /9

9 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ELECTRIC PLANTS

ELECTRONIC PLANTS, which are in the Prototype Stage, is the field of research concerned with trying to find new ways to turn plants into viable, local, electricity generation systems. An odd technology for sure this one has almost made it into the Codex for it's sheer wierdness, but as we see the growth in Vertical Farming, for example, it's just possible that electric plants could one day power their own robotic farms. Recently there have been a few breakthroughs in the fiel, by using the process of microbial physics, where energy is generated by bacteria and harvested by microbial fuel cells in roots of plants, much like a battery, researchers have been able to generate 0.1mW of power from individual plants which was then used to power lights and devices.

DEFINITION

Electronic Plants is the development of plants with energy generating capabilities.

EXAMPLE USE CASES

Today the first "Living Energy" plants are being used to power lighting in homes, but obviously the applications are broader - albeit dependent on the means of energy distribution and the amount of power produced.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate, albeit from a very very low base, predominantly led by government grants. The ability to harness nature's own biological energy processes to power our world is attractive, but harnessing natural energy in this way is much harder than it looks. As such until the technology can be developed to the point where it's generating interesting amounts of electrical energy it's likely to stay a very niche technology with possibly quite a short shelf life.

While Electronic Plants are still in the Prototype Stage they could be enhanced by advances in CRISPR Gene Editing, Materials, Synthetic Biology, and other technologies, however over the long term it could be replaced by all manner of alternative energy technologies such as Wireless Energy.

MATTHEW'S RECOMMENDATION

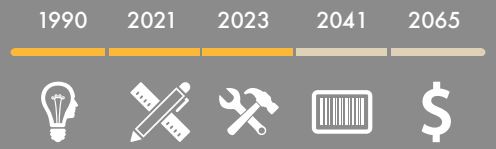
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

IMPACT

STATUS



Accessibility	2
Affordability	5
Competition	8
Demonstration	7
Desirability	5
Investment	2
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

8 MRL /9

9 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ELECTROFUELS

ELECTROFUELS, which are in the Productisation Stage, is the field of research concerned with finding new ways to produce carbon based synthetic fuels such as e-Methanol that can be used to replace today's traditionally extracted fossil fuels as an energy source. A close cousin of Solar Fuels, which directly harness sunlight to create carbon based synthetic fuels, electrofuels harness Carbon Dioxide or Carbon Monoxide along with electricity from a multitude of renewable sources, which can include any renewable energy source from wind and solar to green hydrogen, to create carbon neutral fuels. It's also the use of renewable energy that has given rise to the term "Green Electrofuels." Recently there have been a number of breakthroughs in the field including the development of new single step catalysts and new exotic photobiological bacteria which reduce the cost of producting electrofuels to commercially sensible levels.

DEFINITION

Electrofuels use a mix of catalysts, microbes, and electricity to convert Carbon Dioxide or Carbon Monoxide into synthetic fuel.

EXAMPLE USE CASES

Green electrofuels are especially attractive to sectors that are heavily reliant on traditional fossil fuels for their energy source that have to achieve net zero.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in the field accelerate, predominandly led by the energy sector. As the cost of producing electrofuels falls, and as new regulations continue to pile on the pressure for sectors to decarbonise and achieve Net Zero, we can see several large organisations ramping up their production capacity to serve clients, for example, in the shipping industry.

While Electrofuels are still in the Productisation Stage, over the long term they could be enhanced by advances in Biomanufacturing, CRISPR Gene Editing, Materials, and other technologies, however over the longer term it's likely that they will be superceeded by more authentic renewable energy technologies.

MATTHEW'S RECOMMENDATION

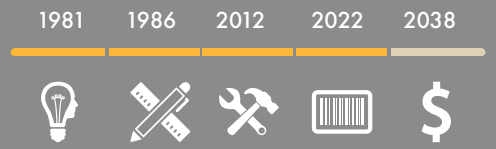
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

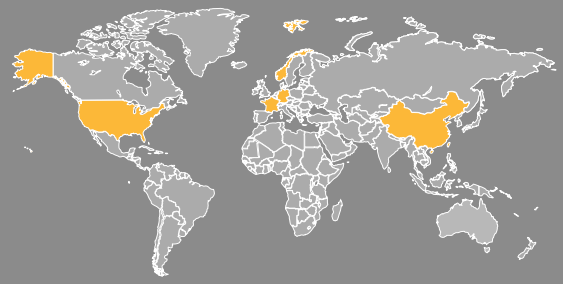
IMPACT

STATUS



Accessibility	5
Affordability	5
Competition	9
Demonstration	7
Desirability	7
Investment	4
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



9 MRL /9

9 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

FLOW BATTERIES

FLOW BATTERIES, which are in the Productisation Stage, is the field of research concerned with developing easily scalable, low cost, long lifecycle battery systems. Touted by many as a better solution for Grid Scale Energy Storage than more common Lithium Ion (LiON) battery systems because they can last for over 30 years, and they're safer and lower cost - even though they have lower energy densities - recently there have been a number of breakthroughs in the field including the development of Aqueous, Iron, and even Salt Water Flow Batteries which some experts believe might replace more common Bromine and Vanadium Flow Batteries. Furthermore, depending on their chemistry flow batteries also have another advantage over their LiON cousins - many of the chemicals they rely on are massively abundant unlike Cobalt and Lithium.

DEFINITION

Flow Batteries are rechargeable batteries where electrolyte flows through one or more electrochemical cells from one or more reservoirs to generate electricity.

EXAMPLE USE CASES

Today the most common use cases for Flow Batteries is as a Grid Scale Energy Storage energy storage medium for energy grids and industrial complexes as countries and organisations embrace renewables.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see investment in this field accelerate, albeit from a low base, predominantly led by the energy sector and government grants. While Flow Batteries have distinct advantages over alternative battery systems their low energy densities make them impractical for many non-grid use cases which, unless this can be overcome soon, will limit their overall appeal. That said though with certain countries still keen on them it looks certain that they will play a role in the energy mix for a many decades to come.

While Flow Batteries are in the Productisation Stage over the long term they could be enhanced by advances in 3D Printing, AI, Bio-Manufacturing and Manufacturing, Materials, Synthetic Chemistry, and other technologies, but over the long term it is likely they will be superceeded by alternative battery types as comparitive costs continue to fall.

MATTHEW'S RECOMMENDATION

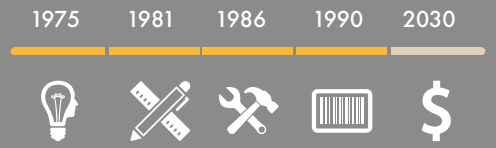
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23

IMPACT

STATUS



Accessibility	7
Affordability	7
Competition	9
Demonstration	8
Desirability	8
Investment	6
Regulation	4
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

7 MRL /9

9 TRL /9

5 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

FUEL CELLS

FUEL CELLS, which are in the Productisation Stage, is the field of research concerned with creating the most optimal chemical reactions to create electricity and fuel, and it's a field of research that is now decades old. Over the past few years there has been much debate about whether Fuel Cells, or their competitive Lithium Ion battery counterparts will win in the end, and while there have been significant breakthroughs in the field it is increasingly looking like Fuel Cell technology won't see the mass adoption it had once hoped. That said though as the world's thirst for energy increases, and as the raw commodities needed to build LiOn batteries, such as Cobalt and Lithium, start to face unprecedented demand, there will be opportunities for the technology to outshine its traditional foe.

DEFINITION

Fuel Cells are devices that produce electricity as the result of a chemical reaction between a source fuel and an oxidant.

EXAMPLE USE CASES

Today we are using Fuel Cells to generate Hydrogen fuel to power vehicles. In the future the primary use case for the technology could be to augment mass scale and distributed energy generation.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by organisations in the Energy sector, and industry consortiums, however, as alternative forms of energy generation and storage gain attention it is increasingly likely that Fuel Cell technology will fail to live up to its initial promise and fade by the wayside.

While Fuel Cells are in the Productisation Stage, over the long term they will be enhanced by advances in 3D Printing, Artificial Intelligence, Creative Machines, Nano-Manufacturing, and Printable Batteries, but in the long term they will be replaced by a myriad of alternatives including Bio-Batteries, Biofuels, Photovoltaics, Semi-Synthetic Energy Systems, and Structural Batteries.

MATTHEW'S RECOMMENDATION

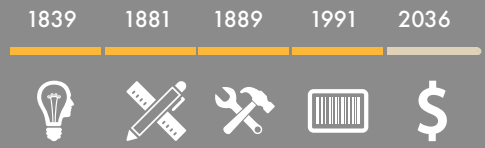
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '24

IMPACT

STATUS



Accessibility	8
Affordability	6
Competition	8
Demonstration	7
Desirability	7
Investment	7
Regulation	5
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

4 TRL /9

5 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

FUSION

FUSION, which is in the early Prototype Stage, is the field of research concerned with trying to create a Star in a Jar, a version of our Sun, captured in a magnetic containment vessel, that is capable of generating almost limitless amounts of clean energy. Currently researchers have made multiple breakthroughs in what is a vastly complex and difficult field, and in the past couple of years not only have the temperatures they have been able to run the fusion reactions at increased substantially, but so too has the period of time that they've been able to run them for.

DEFINITION

Fusion is a form of power generation where energy is generated by harnessing nuclear fusion reactions in order to produce heat for electricity generation.

EXAMPLE USE CASES

Today the first Fusion prototypes are being used to prove the theory that Fusion can be harnessed as a viable energy source before it is eventually productised. In the future the primary use cases for the technology will be as a centralised power generation facility capable of feeding huge amounts of electricity into the connected, global energy grid.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by Government funding and university grants, with help from large industrial consortiums. However, as the rate of progress in the field accelerates it is many researchers goal to one day create small truck sized Fusion reactors, and then eventually Cold Fusion energy systems capable of operating at room temperature.

While Fusion is in the early Prototype Stage, over the long term it will be enhanced by advances in Artificial Intelligence, Mega Magnets, Self-Healing Materials, and Vascular Nano-Composites, and eventually replaced by Quark Energy.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

IMPACT

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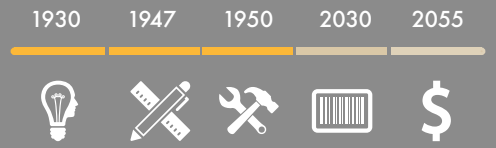
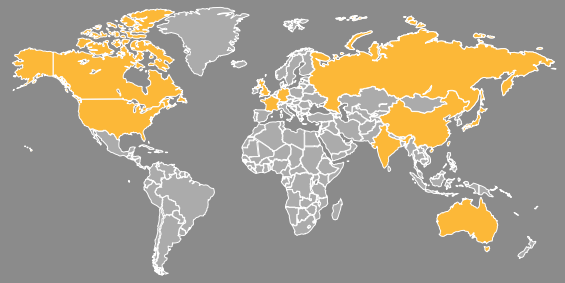
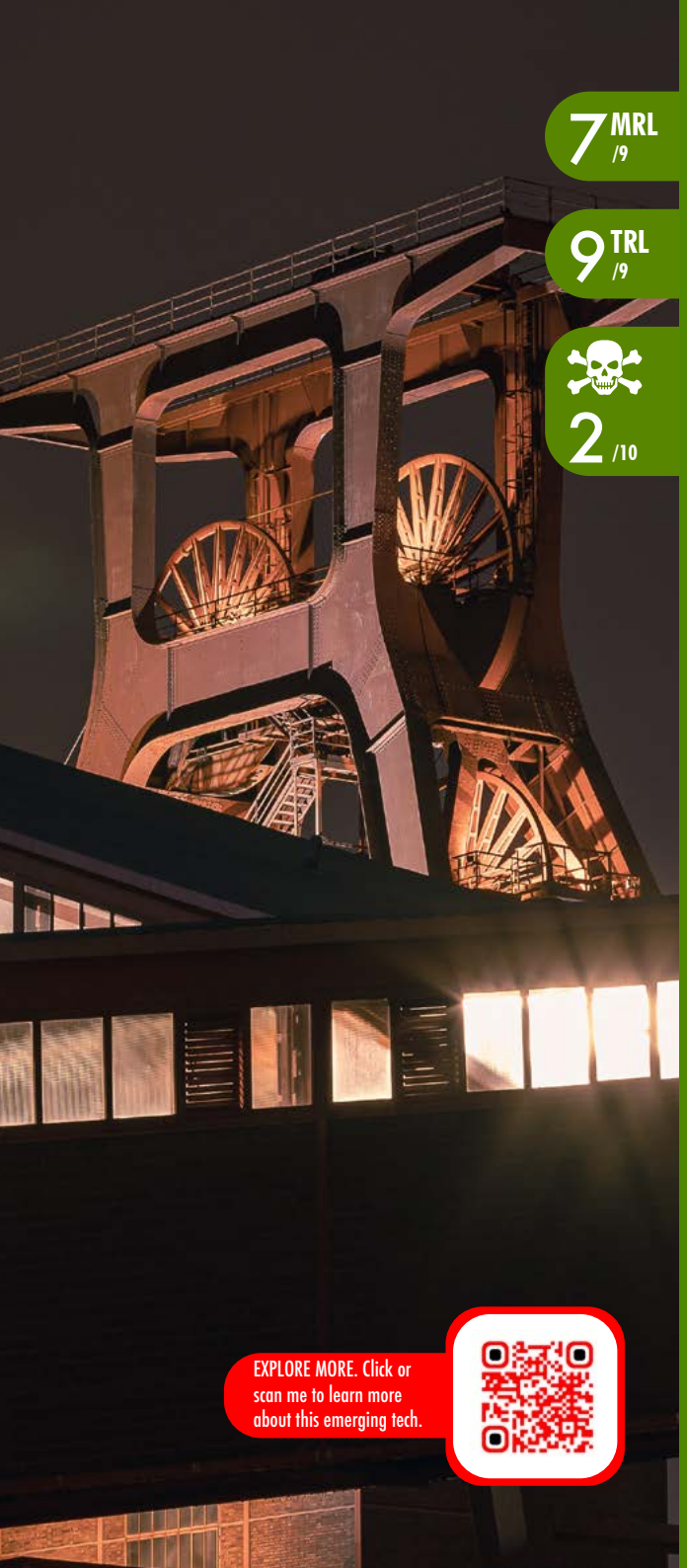


Accessibility	6
Affordability	1
Competition	2
Demonstration	4
Desirability	9
Investment	7
Regulation	4
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS





7 MRL /9

9 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

GRAVITY BATTERIES

GRAVITY BATTERIES, which are in the early Productisation Stage, is the field of research concerned with developing new alternative battery systems that can store and release energy on demand, in this case by using power to lift a large mass during periods of energy surplus, and then dropping it during periods of increased energy demand to release the gravitational potential energy back to the grid as electricity. While there have been a variety of attempts to create these kinds of low cost battery systems it has only been recently that new designs have made them commercially feasible and now the technology is scaling.

DEFINITION

Gravity Batteries are large masses which accumulate and store gravitational energy when they are raised and release it as electricity when they are dropped.

EXAMPLE USE CASES

While there are a number of examples the two most common include the raising and lowering of giant concrete masses within deep mine shafts, and the use of massive terrestrial crane-like systems which again raise and lower concrete blocks to store and release electricity as and when the grid demands it.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, albeit from a low base, primarily led by organisations in the energy sector. In time we will see Gravity Batteries play a greater role in supporting the energy mix than they do today but it is highly likely that they will remain a fringe technology that's unlikely to see mass adoption.

While Gravity Batteries are in the early Productisation Stage over the long term they will be enhanced by advances in Artificial Intelligence, however in the longer term it is highly likely that they will be superseded by cheaper battery and energy storage alternatives such as Polymer Batteries and others.

MATTHEW'S RECOMMENDATION

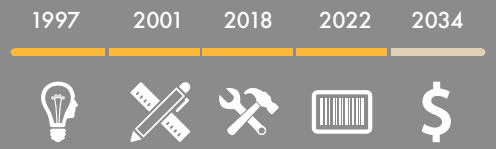
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and re-visit it every few years until progress in this space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '22

IMPACT

STATUS



Accessibility	5
Affordability	5
Competition	4
Demonstration	7
Desirability	7
Investment	4
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

9 MRL /9

9 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

GRID SCALE ENERGY STORAGE

GRID SCALE ENERGY STORAGE, which is in the early Mass Adoption Stage, is the field of research concerned with finding new ways to store energy, especially that produced from renewable energy sources, for long periods of time and at low cost until it needs to be released and used by the grid. Recently there have been a number of breakthroughs in the field with the development of affordable, low cost Carbon Dioxide, ice, iron, and molten salt storage solutions, as well as the development of carbon free supercapacitors using new "miracle" Metal Organic Framework materials that will help dramatically lower the cost of manufacturing supercapacitors. In another boon for the field though car manufacturers have now realised that there's a great after market for their Electric Vehicle's (EV) second hand Lithium Ion batteries which can be used as the backbone of more traditional low cost Grid Scale Energy Storage platforms, as well as the ability to use EV's themselves to support the grid.

DEFINITION

Grid Scale Energy Storage is a collection of methods used to store electrical energy on a large scale within an electrical power grid.

EXAMPLE USE CASES

Today we are using Grid Scale Energy Storage to store electricity from a mix of energy generation sources so that it can be fed into the grid when it's needed. As it is today, in the future Grid Scale Energy Storage's primary use case will be to act as a reserve power back up for the energy grid.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Energy, Manufacturing, and Technology sector, with support from government funding, industrial consortiums, and university grants.

While Grid Scale Energy Storage is in the early Mass Adoption Stage, over the long term it will be enhanced by advances in 3D Printing, Artificial Intelligence, Bio-Batteries, Biofuels, Creative Machines, CRISPR Gene Editing, Graphene, Metal Organic Frameworks, and Supercapacitors, but it is unlikely to be replaced.

MATTHEW'S RECOMMENDATION

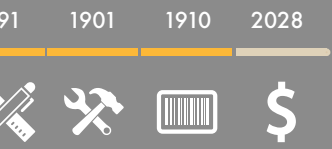
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '19, '20, '21, '23

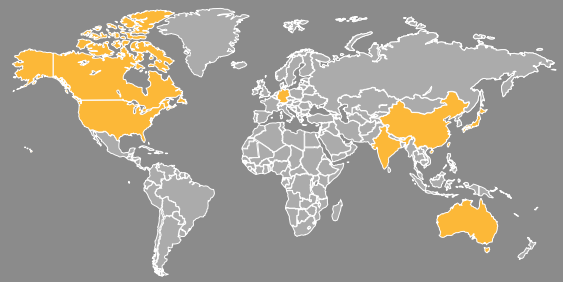
IMPACT

STATUS



Accessibility	9
Affordability	5
Competition	6
Demonstration	3
Desirability	9
Investment	7
Regulation	6
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



5 MRL /9

8 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

LASER ENERGY TRANSMISSION

LASER ENERGY TRANSMISSION, which is in the early Productisation Stage, is the field of research concerned with finding new ways to use lasers to transmit electrical energy between systems. Recently there have been several breakthroughs in the field in increasing the efficiency and range of the technology, which can now operate over several miles, and researchers have been able to demonstrate that by using the technology to target photovoltaic cells on an aircraft's wings they've been able to charge that aircraft in mid flight to keep it airborne indefinitely. As the technology's efficiency and range continue to increase there will inevitably be more applications

DEFINITION

Laser Energy Transmission is the transmission of energy in the form of laser light through free space.

EXAMPLE USE CASES

Today Laser Energy Transmission prototypes have been used to keep drones airborne indefinitely. In the future the primary use cases for the technology will include using lasers to replenish failing satellites energy reserves, helping keep Pseudo Satellites that are providing communications services to rural communities aloft, and using the system to transmit energy from space based solar collectors and farms to base stations on Earth.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Defence and Energy sectors, with support from government funding. In time we will see the amount of energy that can be transmitted in this way, and the accuracy and distances it can be transmitted increase substantially, and while some of the lower power use cases, such as those operating at the KWh and MWh scale, will inevitably be replaced by new decentralised and sustainable energy generation technologies, it is unlikely that use cases where Gigawatt capacities need to be transmitted will be replaced any time soon.

While Laser Energy Transmission is in the early Productisation Stage, over the long term it will be enhanced by advances in Artificial Intelligence, Bio-Batteries, Nuclear Batteries, Lasers, Optics, Pseudo Satellites, and Photovoltaics, but at this point in time it's unclear what will replace it.

MATTHEW'S RECOMMENDATION

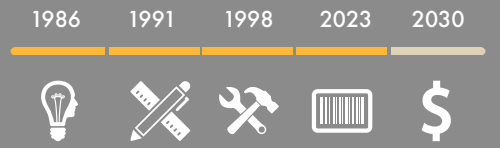
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19

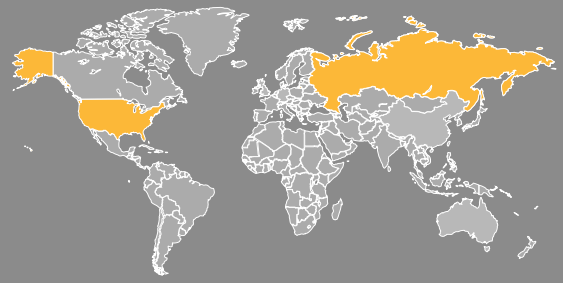
IMPACT

STATUS



Accessibility	6
Affordability	5
Competition	6
Demonstration	2
Desirability	7
Investment	5
Regulation	4
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



6 MRL /9

7 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

LITHIUM-METAL BATTERIES

LITHIUM-METAL BATTERIES, which are in the Prototype Stage, is the field of research concerned with trying to find better alternative battery types to today's ubiquitous Lithium-Ion Batteries. Recently there have been a number of breakthroughs in the field which include the development of the first viable products that had a significantly higher energy density than other battery alternatives. Lithium-Metal Batteries are also gaining additional interest from organisations around the world because many see them as being a viable on ramp to the development of more ground breaking Solid State Batteries (SSBs).

DEFINITION

Lithium-Metal Batteries are lithium batteries with metal anodes.

EXAMPLE USE CASES

Today Lithium-Metal Batteries are generally being used in electric vehicle demonstrators, since that is where in the short term at least, the main market appears to be. In the future though this battery technology could find its way into all kinds of battery powered products and help fuel the transition to SSBs.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Energy sector, with support from government funding and university grants. In time we will see the technology mature and be commercialised, although there will likely be questions raised about its ability to scale. The technology could also end up being an important but transitional technology before industries switch to SSBs which are widely regarded as the "Jesus" of battery technology.

While Lithium-Metal Batteries are in the Prototype Stage, over the long term they will be enhanced by advances in 3D Printing, Materials, and Printed Batteries, and in the long term it is likely that it will be replaced by different forms of Renewable Energy technologies, such as Photovoltaic Materials, as well as SSBs.

MATTHEW'S RECOMMENDATION

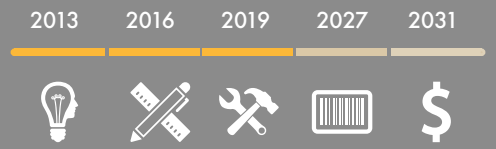
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '21, '22, '23

IMPACT

STATUS



Accessibility	4
Affordability	4
Competition	8
Demonstration	4
Desirability	6
Investment	2
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

LITHIUM-SULPHUR BATTERIES

LITHIUM SULPHUR Batteries, which are in the Concept Stage and early Prototype Stage, is the field of research concerned with developing new types of batteries that have a reduced dependence on rare Earth metals and that have superior energy density and performance to today's traditional Lithium Ion Batteries. Recently there have been a number of breakthroughs in this field after researchers managed to create the first fast charging, viable Lithium-Sulphur Batteries capable of meeting the punishing demands of electric vehicles.

DEFINITION

Lithium-Sulphur Batteries are a type of rechargable battery with a high specific energy that are very light weight and cost effective to manufacture.

EXAMPLE USE CASES

Today researchers are still experimenting Lithium-Sulphur Batteries and are refining the technology. In the future the primary use cases for the technology include being the primary energy source used in electric aircraft, drones, and electric vehicles, as well as in any other platform or product where a low weight to high energy density ratio are an advantage.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Energy and Transportation sectors. In time the technology will mature, but whether it can become a commercial reality and compete with all the other forms of battery technologies that are emerging is highly dubious.

While Lithium-Sulphur Batteries are in the Concept Stage and early Prototype Stage, over the long term they will be enhanced by advances in 3D Printing and Materials, and in the longer term they could be replaced by a broad range of battery and energy technologies including but not limited to Bio-Batteries, Fuel Cells, Photovoltaics, Polymer Batteries, Solid State Batteries, Structural Batteries, and many others.

MATTHEW'S RECOMMENDATION

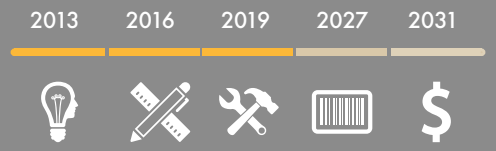
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20

IMPACT

STATUS



Accessibility	4
Affordability	4
Competition	8
Demonstration	4
Desirability	6
Investment	2
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

4 MRL /9

7 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

MAGNETO HYDRO DYNAMIC DRIVES

MAGNETO HYDRO DYNAMIC DRIVES, which are in the Prototype Stage, is the field of research concerned with trying to extract the kinetic energy from the movement of gasses into electricity using magnetic fields. Recent breakthroughs include the development of new forms of hypersonic jet engines that not only generate ten times more thrust than traditional systems but do it consistently and smoothly - unlike conventional combustion engines which can only produce bursts of power because the fuels they use cannot produce ionised fluids fast enough to feed the engine quickly enough. While this technology has its roots in the 1970's it's now been re-imagined by the Chinese military who seem to be developing it successfully.

DEFINITION

Magneto Hydro Dynamics Drives are devices that convert the kinetic energy from hot ionised gasses into electricity using magnetic fields.

EXAMPLE USE CASES

While the main use cases for this technology are propulsion based this could be a key technology in the quest to create high performance engines for hypersonic vehicles and hypersonic weapons systems, and it could also could play a pivotal role in the future of space travel. Asides from these major use cases it could also be used in industrial processes where the precise control of fluid flow and propulsion is required, as well as for more conventional power generation applications that use conductive fluids, sea water, and even molten metal as the combustion source, including space based applications.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Magneto Hydro Dynamic Generators increase, primarily driven by the Aerospace and Defense sectors. While this is an old technology at heart it is now increasingly looking like it could be key to helping China become dominant in the hypersonics field, and as the technology is developed it's also highly likely that we could see several spin off technologies emerge.

While Magneto Hydro Dynamic Generators are still in the Prototype Stage they could be enhanced by advances in Artificial Intelligence, Materials, Quantum Computing, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

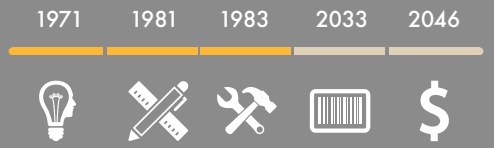
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	5
Demonstration	7
Desirability	8
Investment	3
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

5 MRL /9

7 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

MECHANICAL BATTERIES

MECHANICAL BATTERIES, which are in the Productisation Stage, is the field of research concerned with developing new ways to develop batteries that have a mechanical component. Recent developments in adjacent technology fields including Carbon Nanotubes mean that researchers now have a path to creating Mechanical Batteries for electric vehicles that are capable of a 17,000 km range.

DEFINITION

Mechanical Batteries are batteries that store electricity by mechanical means.

EXAMPLE USE CASES

Today most Mechanical Batteries are being used within engine systems or industrial environments and are used as a compliment to other battery technologies and Grid Scale Energy Storage platforms. In the future the primary use case for this technology will be tied to mid to large scale products that are off grid or that have grid connectivity issues.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Energy sector. In time we will see the technology mature to the point where mechanical batteries become more of a competitor to many of the other alternative battery technologies, but alot of that potential will be reliant on developments in other complimentary technology areas.

While Mechanical Batteries are in the Productisation Stage, over the long term they will be enhanced by advances in 3D Printing and Carbon Nanotubes, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

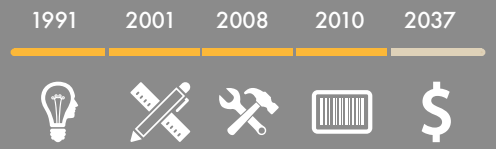
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20

IMPACT

STATUS



Accessibility	5
Affordability	5
Competition	7
Demonstration	5
Desirability	8
Investment	2
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

5 MRL /9

9 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

MICROWAVE ENERGY TRANSMISSION

MICROWAVE ENERGY TRANSMISSION, which is in the Productisation Stage, is the field of research concerned with developing new ways to wirelessly beam, or transmit, energy from one location to another generally over long distances, including across mountain ranges and from space based orbiting power stations. Recently there have been a number of developments in the field which include building systems that can transmit more power, over greater distances, with greater reliability. Additionally, simultaneous advances in new Electromagnetic Metamaterials now also mean that the transmitted energy can be converted back into electricity with much greater efficiency which moves the whole field closer to mass commercialisation.

DEFINITION

Microwave Energy transmission is a technology that enables the long range wireless transmission of energy.

EXAMPLE USE CASES

Today the majority of Microwave Energy Transmission systems are being used either by the military to remotely charge different types of drones, UAV's, and vehicles, or by researchers who are now trying to scale the technology up to eliminate the need for overhead or underground electrical transmission cables, as well as open the door to beaming solar energy captured in space back down to ground stations on Earth. In the future this technology will be used to transmit large quantities of energy to various terrestrial and non-terrestrial based assets and locations.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Defence, Energy and Transportation sectors, with support from government funding and university grants. In time we will see the technology mature and become commercially viable at scale, but it will likely face adoption challenges as people question its safety as it scales up.

While Microwave Energy Transmission systems are in the Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Metamaterials and Optics, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

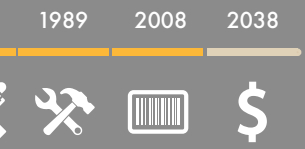
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

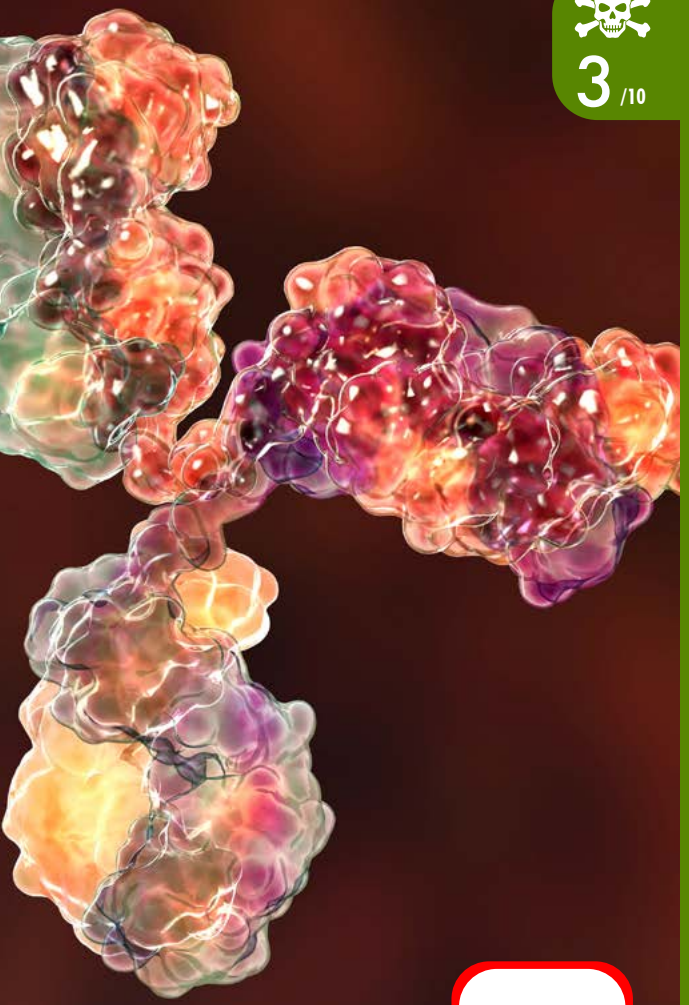
IMPACT

STATUS



Accessibility	6
Affordability	6
Competition	6
Demonstration	7
Desirability	9
Investment	7
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



2 MRL /9

4 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

MOLECULAR ENERGY SYSTEMS

MOLECULAR ENERGY SYSTEMS, which is in the Prototype Stage, is the field of research concerned with unlocking the mysteries of how inorganic and organic molecules and matter communicate and interact with one another to transmit information and instructions between entities, and as researchers try to create more efficient energy systems being able to unlock these mysteries becomes increasingly important, both at a large scale, for example, in the development of new mass market battery systems, and at the nanoscale when it comes to using the technology to power tomorrow's Nano-Machines.

DEFINITION

Molecular Energy Systems are small molecular sized energy systems capable of generating energy that can be harnessed by a range of devices.

EXAMPLE USE CASES

Today the first Molecular Energy Systems prototypes are small enzyme engines that are being used to power the first generation of in vivo Nano-Machines. In the future the technology's primary use case will include helping create better Artificial Photosynthesis products, new Bioelectronic Medicine treatments, and powering Nano-Machines.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Biotech, Defence and Energy sectors, with support from government funding and university grants.

While Molecular Communications is in the Prototype Stage, over the long term it will be enhanced by advances in Artificial Photosynthesis, Bio-Batteries, Bioelectronic Medicine, Biological Computing, Chemical Computing, DNA Computing, DNA Robots, Molecular Assemblers, Molecular Computing, Molecular Robots, Nano-Machines, and Syncell Robots, but this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

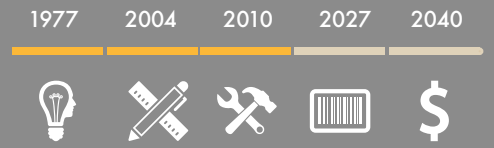
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19

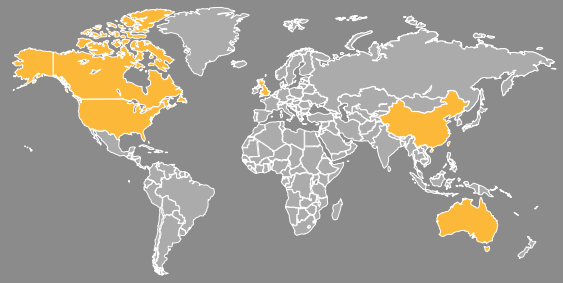
IMPACT

STATUS



Accessibility	5
Affordability	3
Competition	3
Demonstration	4
Desirability	4
Investment	3
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

4 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

MOLECULAR MOTORS

MOLECULAR MOTORS, which are in the Prototype Stage, is the field of research concerned with harnessing some of natures smallest materials to create a new class of microscopic and nanoscale energetic propulsion systems which can be used to enable and power everything from Nanobots and Nanomachines to future Molecular Assemblers whose benefits will influence sectors as diverse as Healthcare, Manufacturing, and beyond. Recently there have been several breakthroughs in the field including researcher's ability to reliably manufacture the technology and demonstrate fine grained control of its outputs to power and propel a variety of different devices and products.

DEFINITION

Molecular Motors are molecular sized mechanical devices that are independently capable of generating and sustaining motion.

EXAMPLE USE CASES

Today Molecular Motors are helping doctors deliver drugs and therapies in a highly targeted way in order to minimise the collateral damage and errant side effects that are often caused by more traditional "scatter gun" treatments. They are also being used in the first basic Molecular Assemblers to help scientists build next generation Lithium-Ion Batteries for Electric Vehicles. In the future this technology will help open the door to a whole new era of Advanced Manufacturing, Biotech, and Robotics opportunities.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Manufacturing sector, with support from university grants. In time we will see the technology mature and commercialise, but adoption will be slowed by challenges that involve the reality of reliably manufacturing products at the nanoscale, integrating them with other processes and technologies, and regulation.

While Molecular Motors are in the Prototype Stage, over the long term they will be enhanced by advances in 3D Printing, Artificial Intelligence, Molecular Assemblers, Molecular Computing, Molecular Electronics, Nano-Manufacturing, and Nanotechnology, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

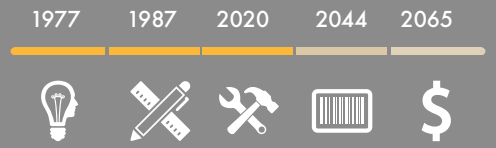
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and re-visit it every few years until progress in this space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

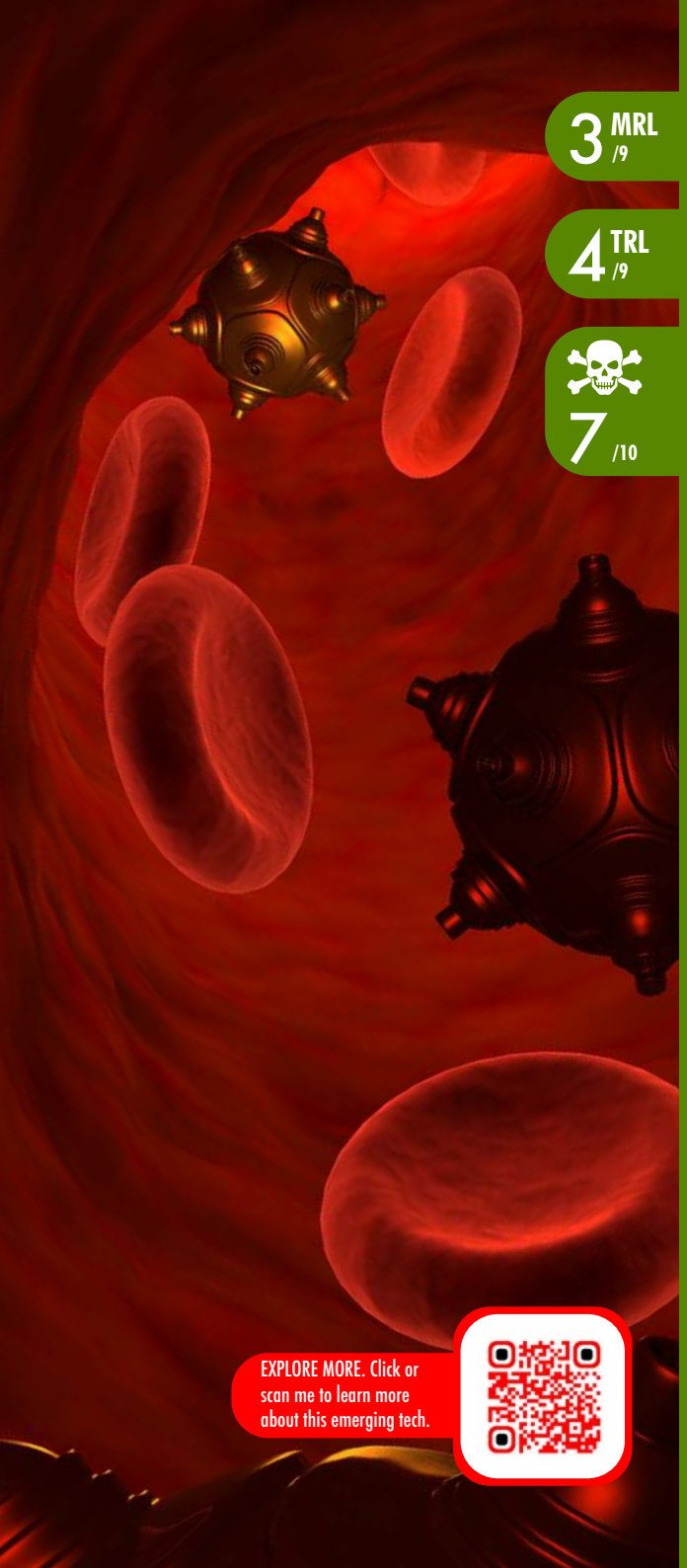
IMPACT

STATUS



Accessibility	4
Affordability	4
Competition	3
Demonstration	6
Desirability	7
Investment	4
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

4 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

NANO-GENERATORS

NANO-GENERATORS, which are in the Prototype Stage, is the field of research concerned with finding new ways to use nano sized devices and machines to generate minuscule amounts of energy that can be harnessed to perform and carry out specific actions. Recently breakthroughs in the space have seen the development of a range of Nano-Generators that can turn human blood vessels and other fluids into energy sources, in the same way that a hydroelectric dam generates energy from water flowing through its turbine halls.

DEFINITION

Nano Generators are nano scale devices capable of converting small scale mechanical and thermal changes within a material or fluid into electricity.

EXAMPLE USE CASES

Today we are using the first Nano-Generator prototypes to produce electricity from animals blood streams. The future applications of this technology are as yet unclear, other than as a primary way to generate electricity from fluids at the nanoscale to power nanoscale or larger sized devices.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by university grants.

While Nano-Generators are in the Prototype Stage, over the long term they will be enhanced by advances in 3D Printing, Carbon Nanotubes, Nano-Manufacturing, and Nano-Machines, but at this point in time it is unclear what they could be replaced by.

MATTHEW'S RECOMMENDATION

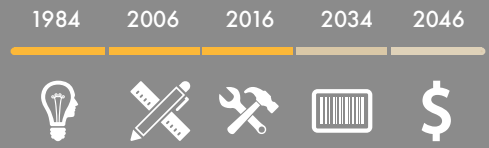
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	4
Affordability	2
Competition	2
Demonstration	5
Desirability	3
Investment	3
Regulation	2
Viability	6

PRIMARY GLOBAL DEVELOPMENT AREAS

NUCLEAR BATTERIES

NUCLEAR BATTERIES, which are in the Prototype Stage, is the field of research concerned with harnessing the radiation present in nuclear materials to create batteries that last for thousands of years or more before running out. Recently there has been an acceleration in the development of the technology as certain sovereign states see the technology as providing them with a tactical military advantage, especially in the space realm where satellites die when their on board energy reserves run out. That said though the technology also has more benign and practical applications, such as providing surgeons with a solution to the problem of having to replace batteries every ten or so years in pacemakers and other implanted medical devices.

DEFINITION

Nuclear Batteries are devices which use energy from the decay of radioactive isotopes to generate electricity.

EXAMPLE USE CASES

Today we have created the first Nuclear Battery prototypes from nuclear waste, by compressing them into diamonds, that can be used to power implanted medical devices indefinitely, and more conventional nuclear batteries that can be used to power satellites. In the future the primary use cases for the technology will include installing the batteries in any devices where changing a battery is complex, impractical, or impossible.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, albeit from a low base, primarily led by organisations in the Defence and Energy sectors, with support from government funding and university grants.

While Nuclear Batteries are in the Prototype Stage, over the long term they will be enhanced by advances in 3D Printing, Backscatter Energy Systems, Molecular Energy Systems, Printable Batteries, and Nano-Manufacturing, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

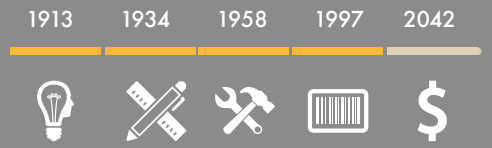
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21

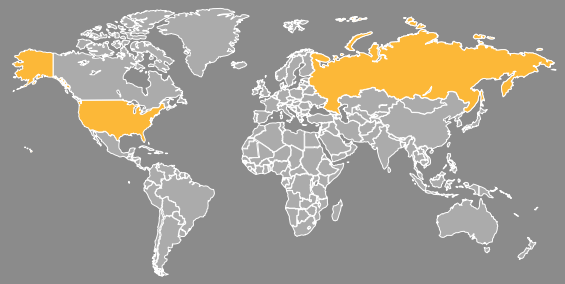
IMPACT

STATUS



Accessibility	3
Affordability	2
Competition	4
Demonstration	9
Desirability	5
Investment	5
Regulation	6
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



1 MRL /9

2 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

NUCLEAR TRANSMUTATION

NUCLEAR TRANSMUTATION, which is in the early Prototype Stage, is the field of research concerned with trying to convert long lived radioactive waste nuclei into short lived or stable nuclei. Recently there have been very few breakthroughs in the field, however it now seems theoretically possible to use this technology to reduce the volume and hazard of nuclear waste by bombarding it with neutrons and transforming a large fraction of the long term source of heat, radioactivity, and radiotoxicity in it into stable or short lived - less than 30 years - materials that are easier to handle, manage, and store. And, as the world faces having to dispose of even greater amounts of nuclear waste in the future, this is an interesting technology to watch.

DEFINITION

Nuclear Transmutation is a change undergone in atomic nuclei that is bombarded by neutrons or other particles.

EXAMPLE USE CASES

Today the primary use case for Nuclear Transmutation is to use it to turn nuclear waste into a short lived stable and safe material that can be disposed of quickly, safely, and cheaply.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in the field accelerate, albeit from a very low base, predominantly led by the energy sector and government grants. The problem of nuclear waste is a global scourge that's growing and the cost associated with managing and storing it is only getting worse so while this technology is difficult to develop it's very attractive. As a result it's a technology that will likely remain on the fringes being developed by highly specialised teams.

While Nuclear Transmutation is in the early Prototype Stage over the longer term it could be enhanced by advances in AI, Materials, Quantum Computing, and other technologies, however over the long term it's unclear what it could be superceeded by.

MATTHEW'S RECOMMENDATION

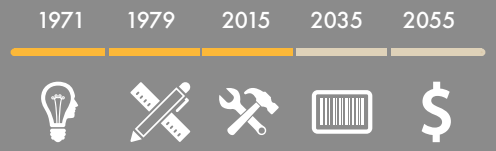
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23

IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	2
Demonstration	2
Desirability	8
Investment	3
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

5 MRL /9

9 TRL /9

2 /10

OCEAN THERMAL ENERGY

OCEAN THERMAL ENERGY, which is in the early Productisation Stage, is the field of research concerned with trying to extract energy from the temperature differences between cooler deep sea waters and shallow warm sea waters. While there have been few breakthroughs in the field recently, including the use of phase changing Ammonia to boost power generation, ironically this is one energy generation technology that could be turbo charged by the anthropogenic warming of the oceans whose temperatures have been creeping up steadily for decades, the result of which means that over the long term this technology could end up generating over 46% more power.

DEFINITION

Ocean Thermal Energy is a technology that generates energy from the temperature differences in ocean water.

EXAMPLE USE CASES

The primary use case for Ocean Thermal Energy is to use it to generate electricity in countries that have access to steep continental shelves and where other forms of electricity generation make less sense.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in the field accelerate, albeit from a very low base, predominantly led by the energy sector and government grants. Being eyed up as a potential energy source for countries and islands surrounded by deep waters interest in this technology has remained weak, but as we see heavyweights such as Australia and China entering the field this could change. That said though it is highly likely that this technology will only ever be used to supplement other major energy sources such as renewables.

While Ocean Thermal Energy is in the early Productisation Stage over the long term it could be enhanced by advances in 3D Printing, Materials, Thermoelectric Generators, and other technologies, however over the longer term it's likely that it will be superceeded by other energy technologies.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

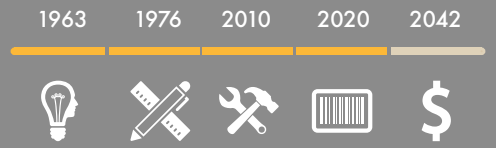
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

IMPACT

STATUS



Accessibility	7
Affordability	7
Competition	9
Demonstration	8
Desirability	8
Investment	6
Regulation	4
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

PHOTOVOLTAICS

PHOTOVOLTAICS, which is in the early Mass Adoption Stage, is the field of research concerned with improving the efficiency of photovoltaic cells, and recently there have been a plethora of breakthroughs. As researchers continue to experiment with 3D Printed Perscovite systems that prevent the brittle Perscovite from breaking, as well as hybrid Graphene coated silicon systems that generate energy from both sun and rain, and even the use of genetically modified cyborg bacteria that combine themselves with Perscovite crystals to generate electricity, it is clear we are nowhere near the limits of the technology, and that eventually the cost of electricity at the point of use will become close to zero.

DEFINITION

Photovoltaics is the conversion of light into electricity using semiconducting materials that exhibit the photovoltaic effects.

EXAMPLE USE CASES

Today we are using Photovoltaics to bring electricity to locations around the world that would otherwise be off the grid, and to help wean the world off of its fossil fuel addiction. In the future the primary use for the technology will to provide decentralised, ubiquitous energy to anything and everything.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Energy and Manufacturing sectors, with support from government funding, industry consortiums, and university grants. In time we will see the efficiency of photovoltaic technology increase to well above 50 percent, thanks to a combination of new materials and manufacturing methods, as well as the continued development of hybrid, genetically engineered products. Tomorrow's photovoltaics will also be more flexible and durable as researchers make breakthroughs in Polymers, Semiconductors and photovoltaic substrates.

While Photovoltaics is in the early Mass Adoption Stage, over the long term it will be enhanced by advances in 3D Printing, Carbon Nanotubes, CRISPR Gene Editing, Graphene, Grid Scale Energy Storage, Flexible Electronics, Nano-Photonic Materials, Polymers, Semiconductors, Semi-Synthetic Cells, and Synthetic Cells, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

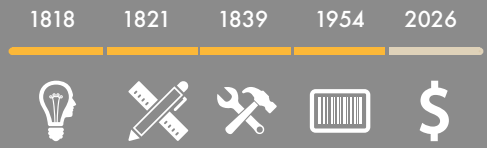
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

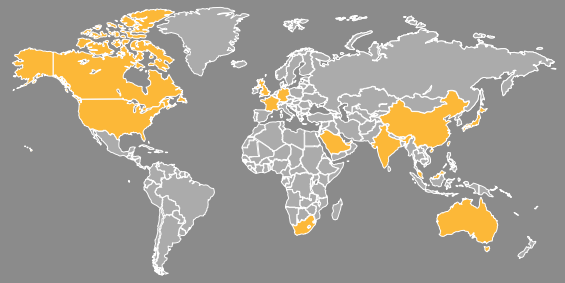
IMPACT

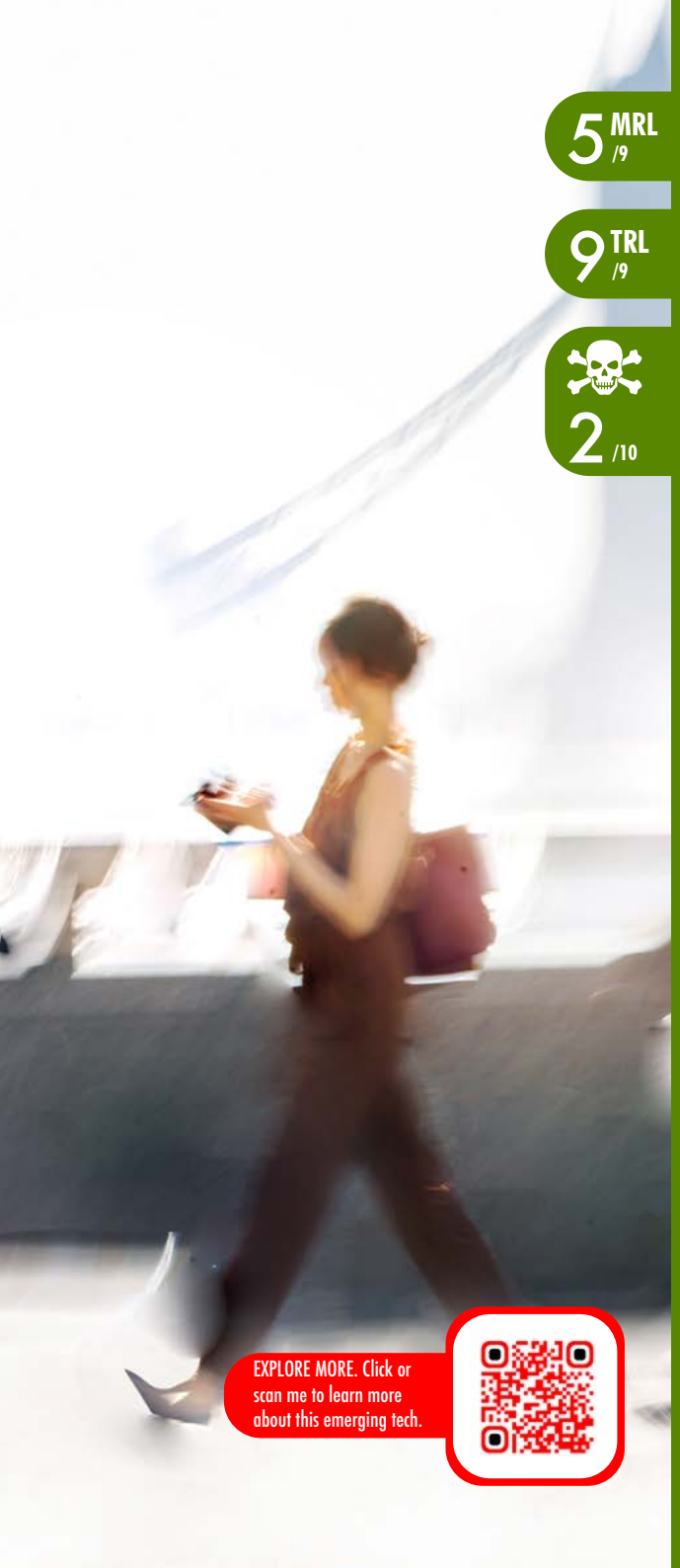
STATUS



Accessibility	9
Affordability	7
Competition	7
Demonstration	8
Desirability	9
Investment	9
Regulation	7
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





5 MRL /9

9 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

PIEZOELECTRIC ENERGY SYSTEMS

PIEZOELECTRIC ENERGY SYSTEMS, which are in the Prototype Stage, is the field of research concerned with finding new convenient ways to tap into the natural electrical charges present in all materials when they go under mechanical stress, something that's very convenient if the devices we need to power can't use conventional battery systems. Recently researchers have managed to find new ways to easily, and safely, tap into these energy sources to power sensors and wearables, and reduce the power consumption of traditional home appliances, such as washer dryers, by up to 70 percent in the effort to thwart climate change.

DEFINITION

Piezoelectricity Energy Systems harness the electrical charges that accumulate in solid materials in response to applied mechanical stress.

EXAMPLE USE CASES

Today we are using Piezoelectric Energy Systems to re-invent the humble washer dryer, create ultrasound patches that help democratise access to primary healthcare services, and nerve zapping Bio-Electrical medical implants that can help heal wounds faster, and reverse neurological disorders such as paralysis. In the future the primary uses cases of this technology will be to power small devices, implants, sensors and wearables that perform a myriad of functions.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Consumer Electronics and Healthcare sector, with support from government funding and university grants.

While Pezoelectric Energy Systems are in the Prototype Stage, over the long term it will be enhanced by advances in Bio-Batteries, Nano-Generators, Nano-Manufacturing, Prinatble Batteries, Triboelectric Energy Systems, and Wireless Energy, but not replaced.

MATTHEW'S RECOMMENDATION

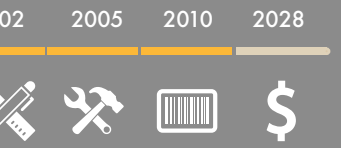
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '19

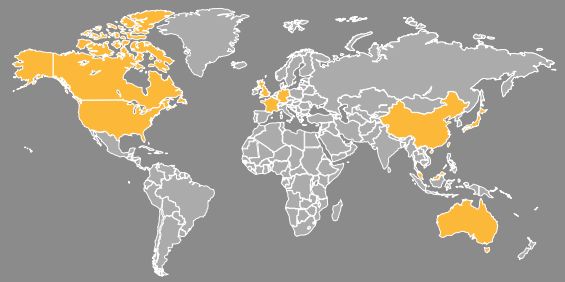
IMPACT

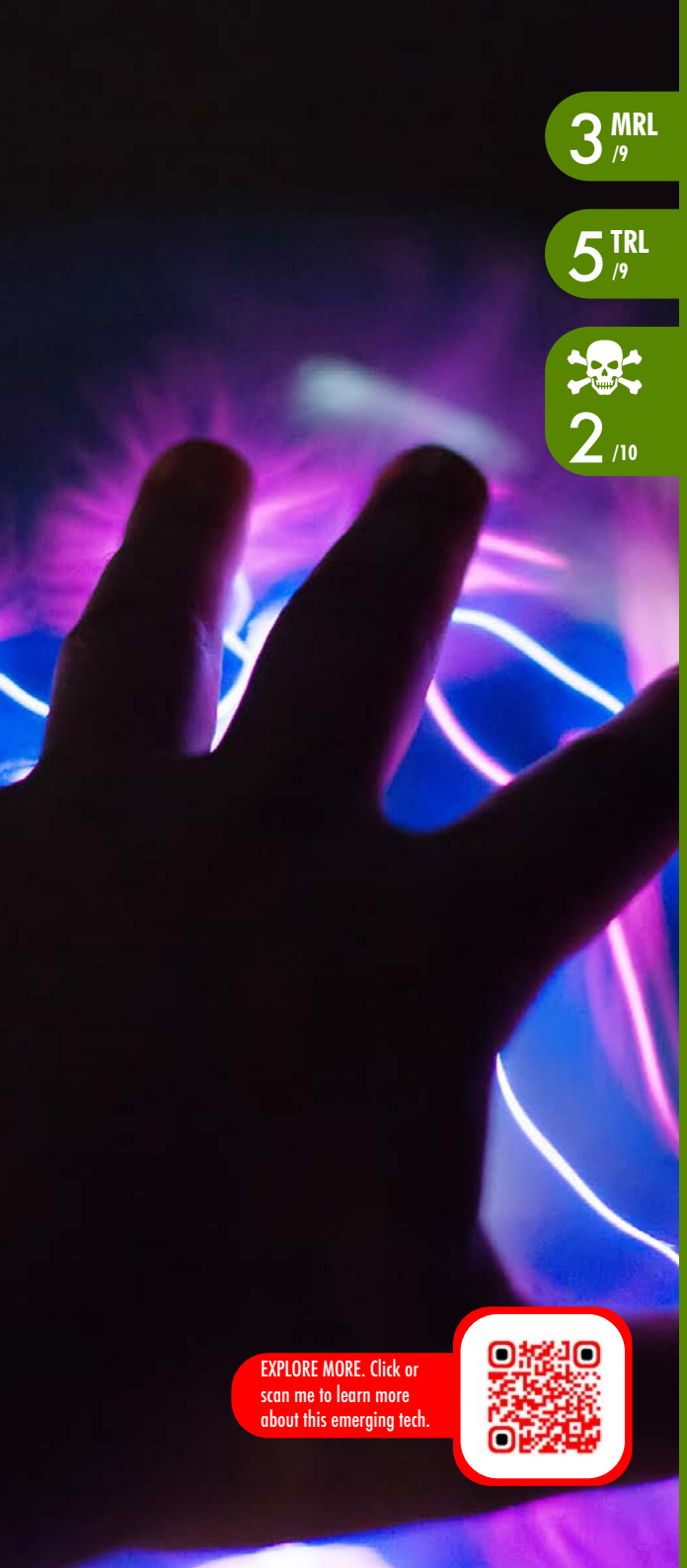
STATUS



Accessibility	7
Affordability	6
Competition	6
Demonstration	7
Desirability	7
Investment	6
Regulation	4
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





3 MRL /9

5 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

PLASMA DRIVES

PLASMA DRIVES, which are in the Concept Stage and Prototype Stage, is the field of research concerned with finding new ways to propel spacecraft through space and inter-stellar space at speeds of up to 123,000 mph, or more, without having to rely on fossil fuel or traditional energy propulsion systems, and at a fraction of the cost. Recently breakthroughs in the space mean researchers are now at the point of moving the prototypes in the labs out into the field to conduct real world trials, and if they are successful and if the research can be productised, which looks increasingly likely, then we will be able to open up a new frontier in space exploration and travel.

DEFINITION

Plasma Drives excite and compress gas to create high temperature plasma then contain it in a magnetic field to generate propulsion.

EXAMPLE USE CASES

Today we are using the first Plasma Drive prototypes to refine the technology before their eventual productisation. In the future the primary use cases for the technology will be to lower the cost of access to space, and subsequent exploration and travel.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, albeit from a low base, primarily led by organisations in the Aerospace and Defence sectors, with support from government funding and university grants.

While Plasma Drives are in the Concept Stage and Prototype Stage, over the long term they will be enhanced by advances in EM Drives, but at this point in time it is not clear what will replace them.

MATTHEW'S RECOMMENDATION

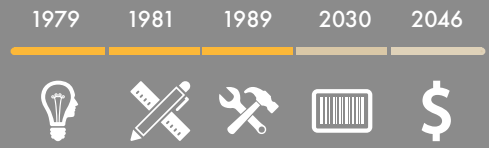
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: 2017, 2018, 2019, 2020, 2021

IMPACT

STATUS



Accessibility	3
Affordability	1
Competition	2
Demonstration	1
Desirability	6
Investment	4
Regulation	7
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

6 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

POLYMER BATTERIES

POLYMER BATTERIES, which are in the Prototype Stage, is the field of research concerned with developing new ways to develop battery systems that rely on polymer based electrolytes, which are easier and cheaper to produce than traditional Lithium based battery systems, rather than liquid electrolytes and bulk metals. Recent breakthroughs in the space include the development of several Polymer Batteries that have been shown to have very high specific energy densities and ultra fast charging times.

DEFINITION

Polymer Batteries are rechargeable batteries that use organic polymer electrolytes instead of liquid electrolytes and bulk metals to form a battery.

EXAMPLE USE CASES

Today we are using prototype Polymer Batteries to prove the theory behind the technology and refine it. In the future the primary use cases of the technology will involve any product of almost any scale or size that has any reliance on batteries to function or run.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by organisations in the Energy sector, with support from univesity grants. In time polymer batteries will become ubiquitous as the field develops primarily because of how cheap they will be to produce, the ubiquity of raw materials, and their superior functional properties.

While Polymer Batteries are in the Prototype Stage, over the long term they will be enhanced by advances in 3D Printing and Polymers, and in the longer term they could be replaced by a broad range of battery and energy technologies including but not limited to Bio-Batteries, Fuel Cells, Photovoltaics, Solid State Batteries, Structural Batteries, and many others.

MATTHEW'S RECOMMENDATION

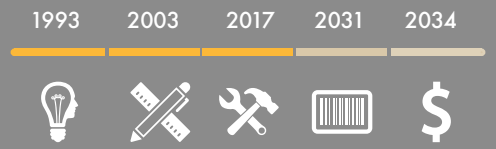
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22, '23, '24

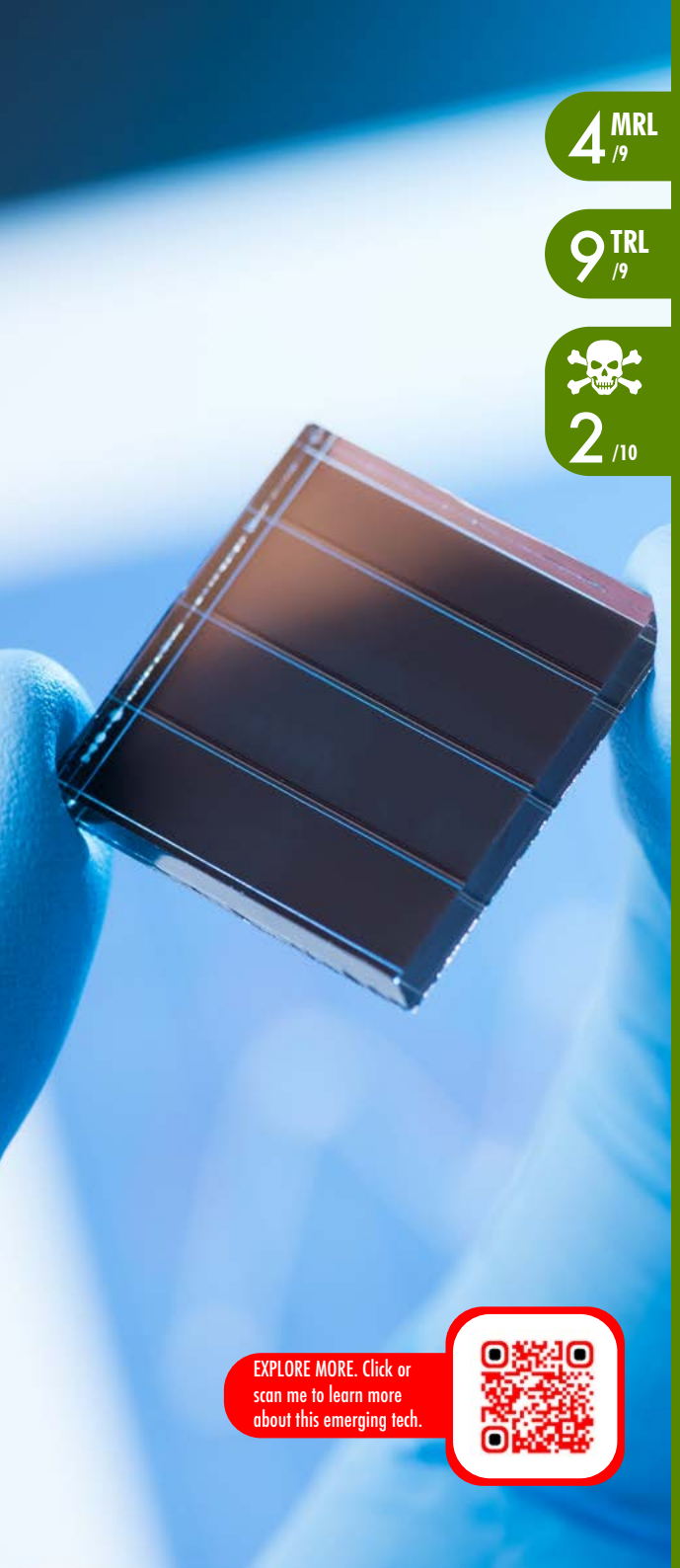
IMPACT

STATUS



Accessibility	4
Affordability	6
Competition	8
Demonstration	6
Desirability	7
Investment	2
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



4 MRL /9

9 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

PRINTED BATTERIES

PRINTABLE BATTERIES, which are in the Prototype Stage and very early Productisation Stage, is the field of research concerned with designing new batteries and battery manufacturing processes that allow organisations to print batteries, of all capacities, shapes and sizes, on demand, which will open up a whole variety of new use cases and applications. Recently there have been multiple breakthroughs in the field, which range from not only being able to 3D print fully functional battery systems, but also extend to being able to use 3D printing to print highly intricate and complex battery electrodes, at the nanoscale, with huge surface areas that not only dramatically extend the battery life of traditional battery systems, but also their capacities as well.

DEFINITION

Printable Batteries are battery systems that can be printed in a wide variety of shapes and sizes.

EXAMPLE USE CASES

Today we are using Printed Batteries to power custom, flexible wearable devices. In the future the primary use cases for the technology will include using it to design custom shaped batteries for a wide variety of applications, and using it to dramatically increase the capacities and life spans of more traditional fixed sized battery systems.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Energy and Manufacturing sector, with support from government funding and university grants.

While Printable Batteries are in the Prototype Stage and very early Productisation Stage, over the long term they will be enhanced by advances in 3D Printing, 3D Bio-Printing, Bio-Batteries, Bio-Manufacturing, CRISPR Gene Editing, Nano-Manufacturing, and Structured Batteries, but at this point in time it is unclear what will replace them.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

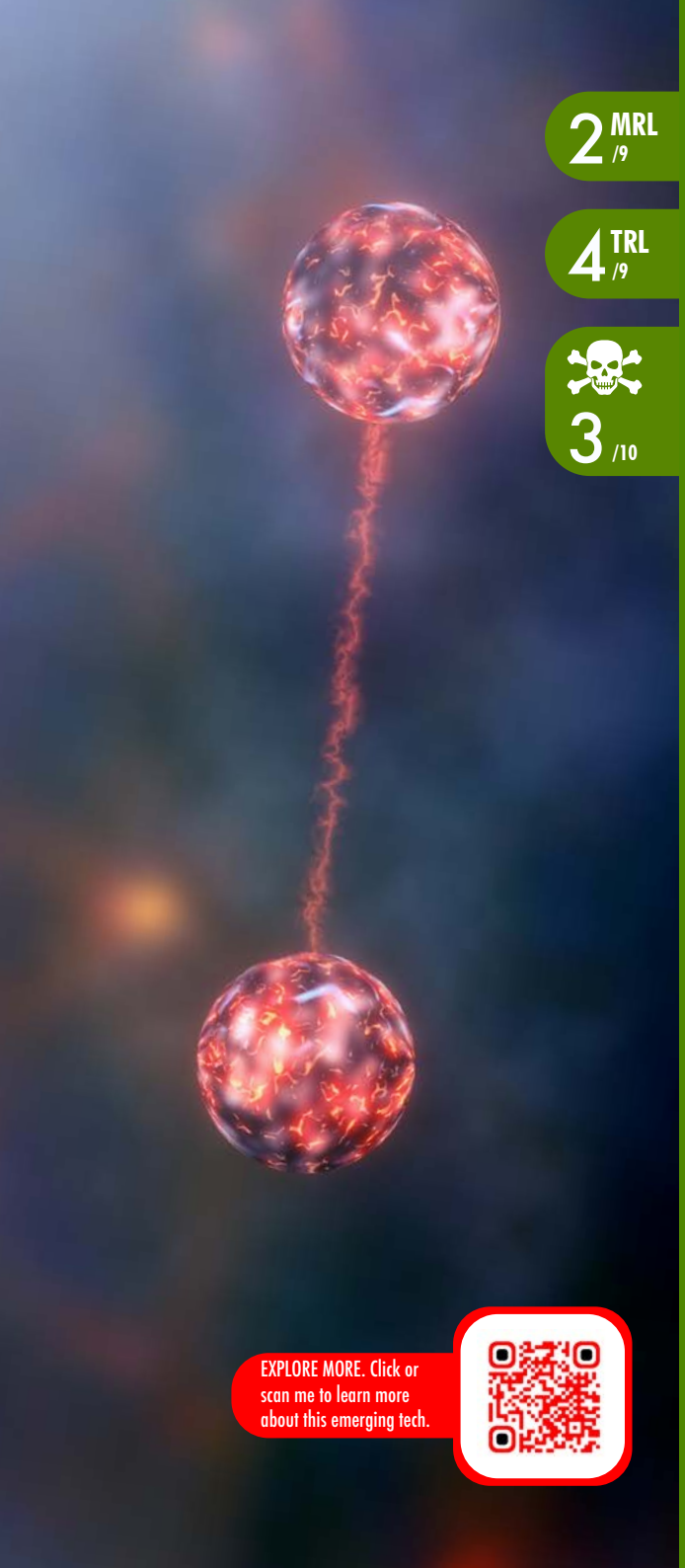
STARBURST APPEARANCES: '19, '20, '21

IMPACT

STATUS

Accessibility	3
Affordability	3
Competition	6
Demonstration	6
Desirability	7
Investment	4
Regulation	2
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



2 MRL /9

4 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

QUANTUM BATTERIES

QUANTUM BATTERIES, which are in the early Prototype Stage, is the field of research concerned with developing a new class of batteries that obey the laws of quantum physics and not classical physics. Recently there have been a number of breakthroughs in the space including the first prototype quantum battery that charges faster the bigger it is, as well as the development of quantum batteries that never run out of charge - something that even more conventional nuclear battery and energy systems can't match.

DEFINITION

Quantum Batteries are a class of energy storage devices that operate according to the principles of quantum physics where the laws of classical physics don't always apply.

EXAMPLE USE CASES

While Quantum Batteries are still a nascent technology their characteristics make them ideal for initially small and then increasingly large energy applications where continuous power and fast or even non-stop charging is attractive.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, albeit from a very low base, primarily led by organisations in the energy and technology sectors, with support from government funding and university grants. In time we will see Quantum Batteries commercialise and mature but it won't be for many decades yet and there is a risk that hey will become a niche technology.

While Quantum Batteries are in the early Prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence and Quantum Materials, however over the long term they face a lot of competition from many other alternative battery and energy types which are likely to mature and commercialise faster and perhaps be orders of magnitude Cost-Performance better.

MATTHEW'S RECOMMENDATION

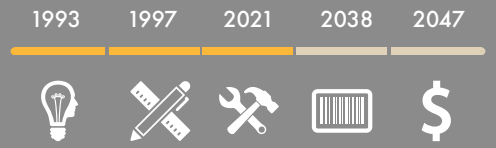
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and re-visit it every few years until progress in this space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	7
Demonstration	5
Desirability	7
Investment	2
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

1 MRL /9

3 TRL /9

5 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

QUANTUM ENERGY TELEPORTATION

QUANTUM ENERGY TELEPORTATION, which is in the Prototype Stage, is the field of research concerned with trying to find new ways to use the weirdness of quantum physics and quantum entanglement to literally teleport energy from one place to another instantly. A truly sci-fi like technology, even for this Codex, recently there have been a few breakthroughs in this field including the first demonstration of energy teleportation using the real hardware of a quantum computer. By using entangled quantum particles researchers were able to teleport energy over distances roughly the size of a computer chip without any energy gain or loss - it was "simply transferred" without the energy travelling across the space in between the two points.

DEFINITION

Quantum Energy Teleportation is the transfer of energy from one point to another without traversing the physical space between them.

EXAMPLE USE CASES

An incredibly sci-fi-like technology the use cases for energy teleportation are vast, after all just imagine being able to teleport energy to anything that needs it anywhere in the universe instantly and there you have your primary use case.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate, albeit from a very very low base, predominantly led by government grants. The ability to teleport and transfer energy across infinite distances instantly is arguably an insanely attractive proposition but because of the uniqueness of it it will take decades to mature let alone commercialise which means it will remain niche for a very long time to come.

While Quantum Energy Teleportation is still in the Prototype Stage it could be enhanced by advances in AI, Materials, and other Quantum technologies, however over the long term it is unclear what it could be replaced by.

MATTHEW'S RECOMMENDATION

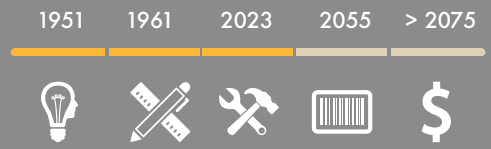
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

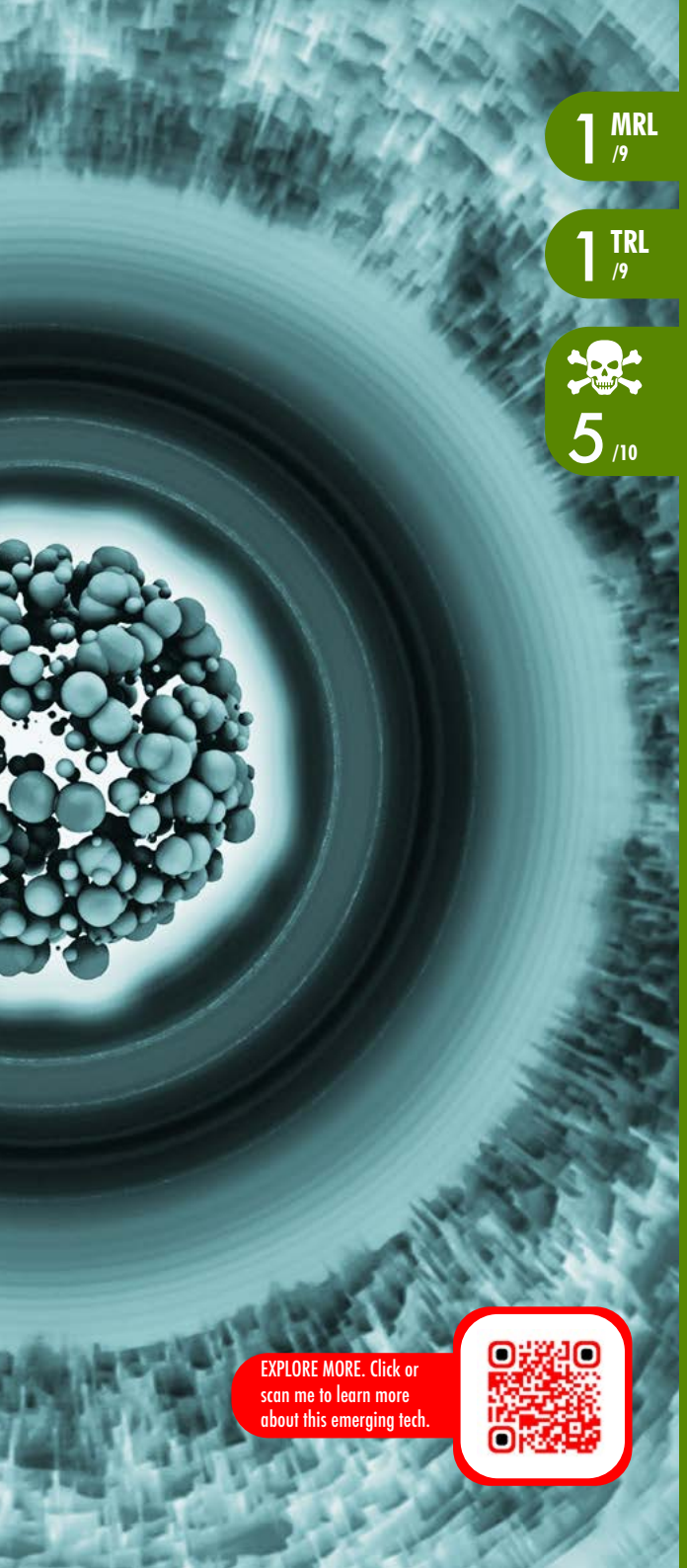
IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	1
Demonstration	4
Desirability	7
Investment	1
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



1 MRL /9

1 TRL /9

5 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

QUARK ENERGY

QUARK ENERGY, which is in the Concept Stage, is the field of research concerned with trying to understand the energy mechanics of quark collisions, and harness them to create the first Quark Energy theories and prototypes. Recently there have been a number of breakthroughs in the field, but none the less it is a very niche field and one that is still largely theoretical with the first quark energy reactions, and the results thereof, only being observed a couple of years ago at the LHC. During those reactions researchers observed energy reactions that outshone those of traditional Fusion reactors by a factor of eight to one, meaning that if, and it is a big if, we were able to harness Quark Energy, then it would be orders of magnitude more powerful than Fusion.

DEFINITION

Quark Energy is a form of energy production that can produce at least eight times more energy that nuclear fusion.

EXAMPLE USE CASES

Today there are no Quark Energy prototypes, only concepts. In the future the primary use cases of this technology will include acting as the primary energy source to the global energy grid.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow but from an incredibly specialist and limited base, primarily led by government funding, industry consortiums and university grants.

While Quark Energy is in the Concept Stage, over the long term it will be enhanced by advances in Dyson Spheres, Dyson Sphere Swarms, Fusion, and Space Based Solar Farms, but at this point in time it is unclear what could replace it.

MATTHEW'S RECOMMENDATION

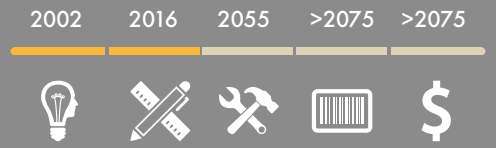
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '19, '20

IMPACT

STATUS



Accessibility	1
Affordability	1
Competition	1
Demonstration	1
Desirability	9
Investment	1
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

4 MRL /9

5 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SEMI-SYNTHETIC ENERGY SYSTEMS

SEMI-SYNTHETIC ENERGY SYSTEMS, which are in the Prototype Stage and very early Productisation Stage, is the field of research concerned with finding new ways to combine biological and inorganic entities, such as chemicals, compounds, and organisms, together to create new energy products. Recently there have been a number of breakthroughs in the space in engineering Semi-Synthetic Cells, that are part inorganic and part organic, where the inorganic elements, which are often engineered into the cells walls, compliment the cell's natural attributes and processes, as well as breakthroughs in our ability to engineer "cyborg" organisms, such as Perscovite cyborg bacteria, whose new attributes allow them to convert solar energy in photovoltaic cells at record breaking levels.

DEFINITION

Semi-Synthetic Energy Systems are batteries that contain both inorganic and organic elements.

EXAMPLE USE CASES

Today we are using Semi-Synthetic Energy Systems to create cyborg bacteria that are capable of merging with Perscovite crystals to create the first generation of advanced, low cost, efficient photovoltaics. In the future the primary use cases for the technology will include being able to use these hybrid energy systems to create perpetual batteries, in a wide range of form factors, that never run out.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Energy and Healthcare sectors, with support from government funding and university grants. In time we will the efficiency and viability of these "hybrid" energy systems increase at a dramatic rate to a point where their potential will start to far out strip those of traditional energy technologies.

While Semi-Synthetic Energy Systems is in the Prototype Stage and very early Productisation Stage, over the long term they will be enhanced by advances in 3D Printing, 3D Bio-Printing, Bio-Batteries, CRISPR Gene Editing, Nano-Photonic Materials, Photovoltaics, Printable Batteries, Structured Batteries, Synthetic Cells, and Wireless Energy, but at this point in time it is unclear what they will be replaced by.

MATTHEW'S RECOMMENDATION

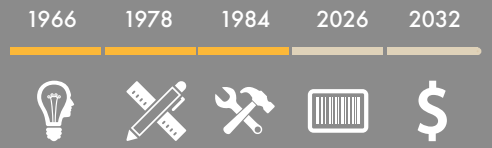
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19

IMPACT

STATUS



Accessibility	4
Affordability	4
Competition	5
Demonstration	4
Desirability	7
Investment	4
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

6 MRL /9

9 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SOLAR FUELS

SOLAR FUELS, which are in the Productisation Stage, is the field of research concerned with finding new and alternative ways to make hydrocarbon based fuels using direct or indirect sunlight, such as via the use of Artificial Photosynthesis, without the need to extract them from the ground and refine them as normally happens with traditional fossil fuels. While this sector has been developing for some time now recent advances in catalysts, harvesters, processes, and other associated fields mean that carbon neutral solar fuels, such as Green Diesel, as well as others, are now commercialised and becoming increasingly affordable.

DEFINITION

Solar Fuels are synthetic chemical fuels produced from solar energy.

EXAMPLE USE CASES

The use cases for this technology are very much the same as the current use case for traditional fossil fuels, except because the way solar fuels are produced unlike their legacy cousins they can be carbon neutral or even carbon negative, which as we look towards a greener and more sustainable future make them an attractive transitional fuel as the world moves away from fossil fuels and as it ramps up the deployment and use of other forms of fuel.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will accelerate fast, from a good base, primarily led by organisations in the government and energy sectors, with support from government funding and university grants. In time we will see Solar Fuels become much more widely available, especially in certain territories, as countries accelerate their flight from fossil fuels and seek energy security. However, it is unlikely that given the current energy transition that they will have a long term future as various sectors focus on electrification rather than merely changing the source of their hydrocarbon based fuels.

While Solar Fuels are in the Productisation Stage, over the long term they will be enhanced by advances in Artificial Photosynthesis, Biofuels, Bio-Manufacturing, Genetic Engineering, and Materials, but in the long term they will likely be replaced by technologies such as Photovoltaics and other renewable energy sources.

MATTHEW'S RECOMMENDATION

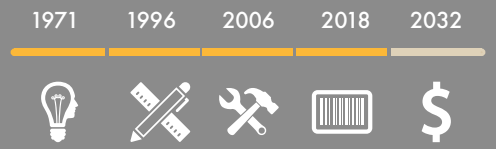
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

IMPACT

STATUS



Accessibility	7
Affordability	6
Competition	9
Demonstration	8
Desirability	7
Investment	6
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

7 MRL /9

9 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SOLAR OVENS

SOLAR OVENS, which are in the early Productisation Stage, is the field of research concerned with developing new ways to replace the need to use fossil fuel powered high temperature industrial processes and systems, such as Blast Furnaces, with clean, green, solar power based alternatives. Recent breakthroughs in the field include the development of the world's first pupose built Solar Oven that uses the principles behind solar concentrators to replace Blast Furnaces and a number of other high energy high temperature industrial processes.

DEFINITION

Solar Ovens are a form of large scale solar concentrators that use the energy of the Sun to heat specific environments and products to extreme temperatures.

EXAMPLE USE CASES

Today we are using small scale prototypes to prove the theory behind the technology and refine it. In the future the primary use case of this technology will be to replace traditional high energy high temperature industrial processes with a cleaner, greener alternative.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Energy sector, with support from univesity grants. In time we will see this technology become refined enough and easy enough to install and implement so that it becomes a truly viable competitor to traditional industrial processes and systems, however, its reliance on solar energy could limit the technology's wide spread use esepcially in less sunny parts of the world.

While Solar Ovens are in the early Productisation Stage, over the long term they will be enhanced by advances in Carbon Nanotubes, Graphene, Photovoltaics, Nano-Photonics, and Superconductors, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

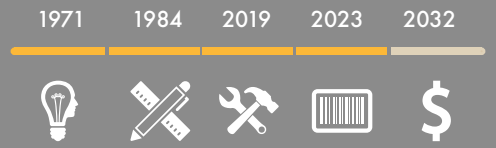
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22

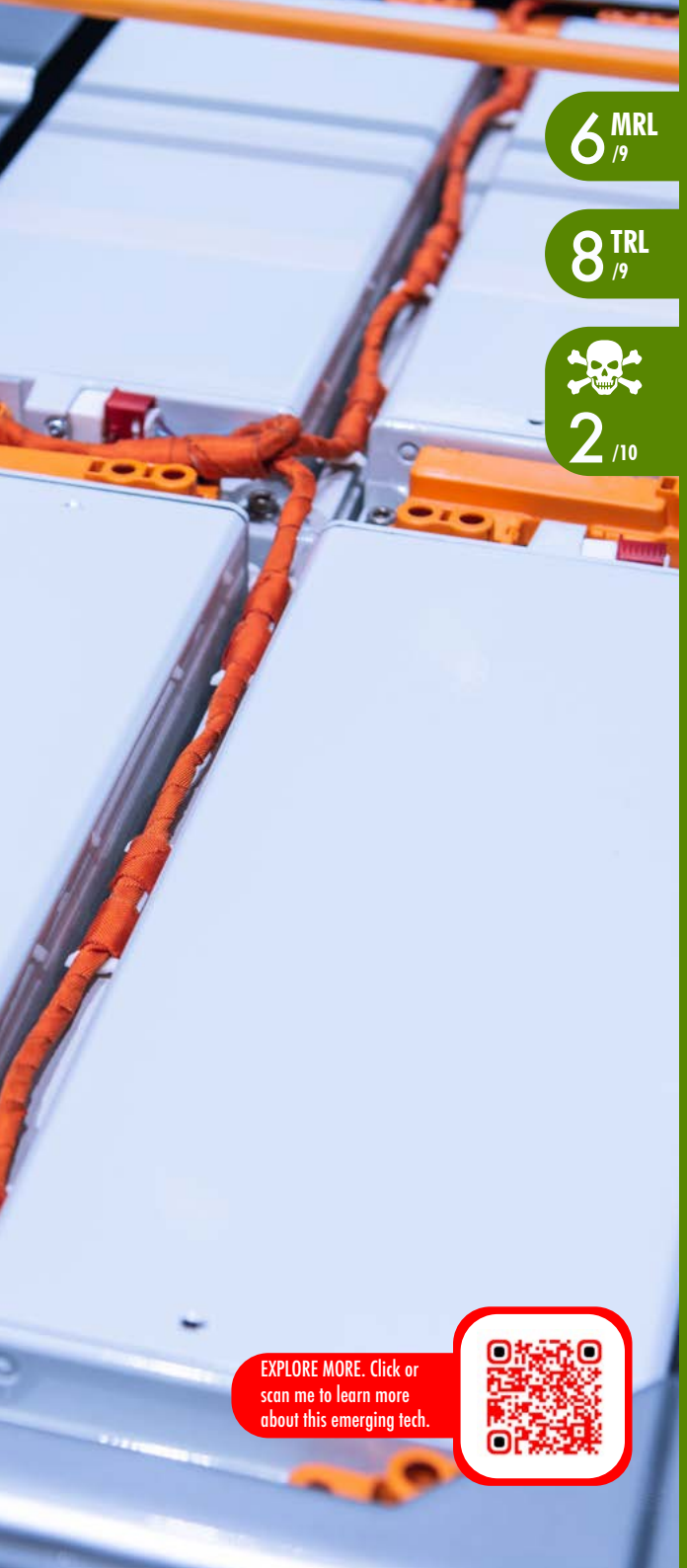
IMPACT

STATUS



Accessibility	5
Affordability	2
Competition	2
Demonstration	8
Desirability	8
Investment	4
Regulation	1
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



6 MRL /9

8 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SOLID STATE BATTERIES

SOLID STATE BATTERIES, which are in the Prototype Stage, is the field of research concerned with finding new alternatives to today's traditional Lithium Ion and Lithium Polymer battery systems which many experts believe are starting to reach their peak. The technology, which has seen a number of breakthroughs recently, has a variety of big benefits over today's LiOn batteries including the ability to create more energy dense, longer lasting, safer and smaller batteries that are inflammable, don't require any cooling elements, and are up to 80 percent cheaper to produce.

DEFINITION

Solid State Batteries are batteries that use solid electrodes and solid electrolytes instead of the liquid or polymer electrolytes found in other battery types.

EXAMPLE USE CASES

Today the first Solid State Battery prototypes are being used to prove the technology before it is eventually refined and productised. In the future the primary use cases of the technology will include Electric Vehicles, including electric aircraft, drones and semi-trucks, gadgets, smartphones, and any other applications where LiOn batteries are used.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Energy and Manufacturing sectors, with support from government funding and university grants.

While Solid State Batteries are in the Prototype Stage, over the long term they will be enhanced by advances in 3D Printing, Nano-Manufacturing, and Printable Batteries, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

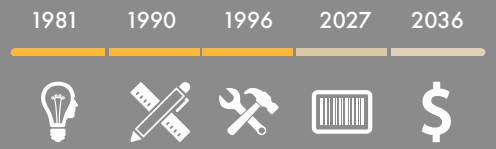
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23, '24

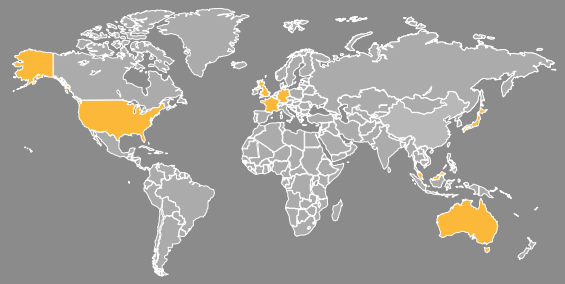
IMPACT

STATUS



Accessibility	4
Affordability	2
Competition	6
Demonstration	4
Desirability	9
Investment	7
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



SPACE BASED ENERGY PLATFORMS

SPACE BASED ENERGY PLATFORMS, which are in the Concept Stage, is the field of research concerned with developing new ways to capture solar radiation from the Sun in space using massive orbiting multi-kilometer wide solar array platforms before most of it's absorped by the Earth's atmosphere, and then use laser energy transmission systems to beam it to ground stations back on Earth's surface before it's distributed via the global energy grid. Recent breakthroughs in the field include the development of the satellite platforms and solar arrays needed to create the large scale orbiting solar platforms that will form the basis of these power stations.

DEFINITION

Space Based Energy Platforms are huge space based arrays that collect solar power and transmit it to Earth using laser transmission systems.

EXAMPLE USE CASES

Today we are using small scale prototypes to prove the theory behind the technology and refine it. In the future the primary use case for the technology will be to replace fossil fuel based energy generation systems here on Earth and provide overall stability to the global energy grid.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by organisations in the Energy and Government sectors. In time we will see the first Gigawatt scale Space Based Energy Platforms being constructed and assembled in orbit with several soverign governments leading the charge to fund and build them, however, that said there are obvious huge logistical challenges still to be overcome and the scale and complexity of these projects should not be underestimated.

While Space Based Energy Systems are in the Concept Stage, over the long term they will be enhanced by advances in 3D Printing, 4D Printing, Laser Energy Transmission, Nano-Photonics, and Photovoltaics, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

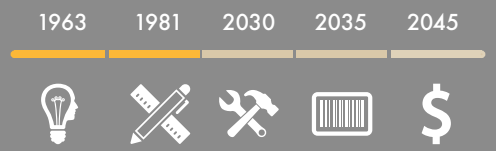
In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22, '23, '24

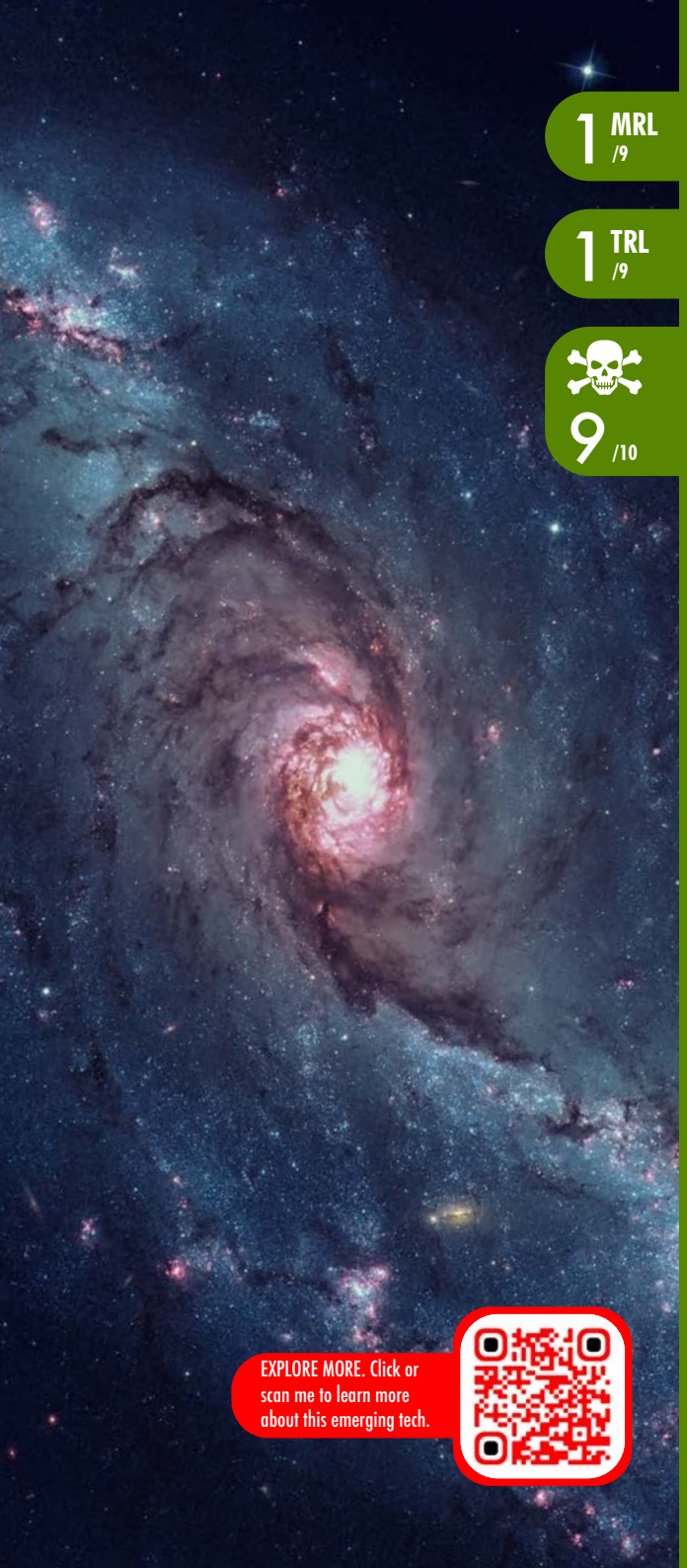
IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	7
Demonstration	2
Desirability	7
Investment	4
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



1 MRL /9

1 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

STELLAR ENGINES

STELLAR ENGINES, which are in the Concept Stage, is the field of research concerned with developing new ways to move our entire galaxy with the ultimate goal of moving it out of the way of an imploding star or a blackhole. Recent breakthroughs in the field include the peer review of several new Stellar Engine theories which look feasible.

DEFINITION

Stellar Engines are hypothetical megastructures that use a star's radiation to create usable energy that can be used to move galaxies.

EXAMPLE USE CASES

Today Stellar Engines are just conceptual. In the future the primary use case for this technology would be to move our solar system out of harms way, or as researchers put it, to another part of our galactic neighbourhood.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate but there will be in specific investment in the concept. In time the theories will be refined further and ultimately one day testes at a small scale, but that is estimated to be many hundreds of years in the future.

While Stellar Engines are in the Concept Stage, over the long term they will be enhanced by advances in Energy and Materials, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

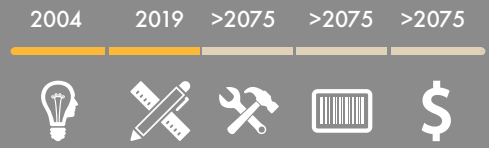
In the short to medium term I suggest companies put the technology on their radars and re-visit it every decade or two.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22

IMPACT

STATUS



Accessibility	1
Affordability	1
Competition	1
Demonstration	1
Desirability	4
Investment	1
Regulation	1
Viability	1

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

5 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

STRUCTURAL BATTERIES

STRUCTURAL BATTERIES, which are in the Prototype Stage, is the field of research concerned with finding new ways to turn fixed structures and materials into batteries. Recently there have been breakthroughs in turning Carbon Fiber and other materials into Structured Batteries using Carbon Nanotubes that can generate and store electricity and then release it when needed, and this, and other breakthroughs mean that one day it will be possible to create so called "battery-less" products where the materials that make up the products are the same materials that power them, thereby eliminating the need to use dedicated, separate battery systems. Today the first structural batteries are being lined up to create the world's first battery-less electric hyper-car, the Lambourghini Terzo Millenio, and in time many more applications will follow.

DEFINITION

Structural Batteries are sheets of composite materials capable of storing and releasing energy that can be moulded into complex 3D shapes to form the actual structure of a device.

EXAMPLE USE CASES

Today the first Structural Battery prototypes are being used to prove the technology's viability, and to refine it before attempts are made to productise it. In the future the primary use cases of this technology will include using it to turn any material or structure into a battery capable of powering anything from entire buildings and cities, to electric aircraft and electric vehicles.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, albeit from a low base, primarily led by organisations in the Aerospace, Energy and Manufacturing sectors, with support from government funding and university grants.

While Structural Batteries are in the Prototype Stage, over the long term they will be enhanced by advances in 3D Printing, 3D Bio-Printing, Bio-Batteries, Carbon Nanotubes, CRISPR Gene Editing, Nano-Manufacturing, Printable Batteries, Semi-Synthetic Cells, Synthetic Cells, and Wireless Energy, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

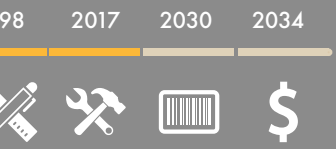
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	4
Affordability	2
Competition	5
Demonstration	3
Desirability	9
Investment	3
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

9 MRL /9

9 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

THERMOELECTRIC GENERATORS

THERMOELECTRIC GENERATORS, which are in the Mass Adoption Stage, is the field of research concerned with finding new ways to efficiently extract energy from the thermal differences in substances. Even though this technology is decades old and generally regarded as mature recent developments in Artificial Intelligence (AI) and Materials now mean that in many respects it's getting a new lease of life. Recently there have been significant developments in merging this technology with other impactful technologies such as Photovoltaics - the unison of which have finally made it possible for solar panels to generate electricy 247 day and night, which is huge, and which also helps drop the cost of water desalination. At a more basic level though the energy energy conversion efficiency of some thermal generators now exceeds 40% which is a major milestone, and we are now seeing the emergence of flexible thermoelectric generation devices which capture even more thermal energy and drive new use cases.

DEFINITION

Thermoelectric Generators are solid state devices that convert temperature differences directly into electrical energy.

EXAMPLE USE CASES

While Thermoelectric Generators have been around of decades their new energy efficiency levels mean that they are increasingly being used to augment other energy generation technologies such as Ocean Thermal Energy and Photovoltaics. At a smaller scale use cases also include using them to power wearable devices, improving ship efficiency, and flexible thermoelectric generators can be wrapped round pipes to capture and convert otherwise lost heat energy.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate, predominantly led by the energy sector. The race to Net Zero and decabonisation has spurred renewed interest in this field and more broadly in "waste" energy capture. While over the long term it will only ever play a small role in the future energy mix the ubiquity of thermal differences means that it's a highly desirable complimentary energy technology which means ergo it has staying power.

While Thermoelectric Generators are in the Mass Adoption Stage they could be enhanced by advances in AI, Materials, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

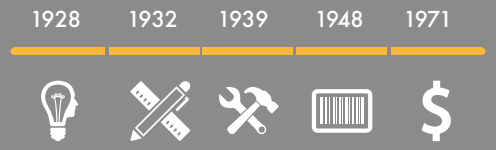
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

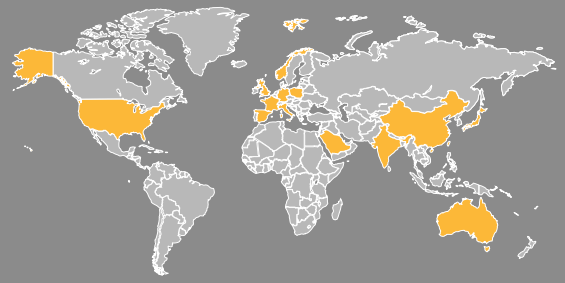
IMPACT

STATUS



Accessibility	6
Affordability	5
Competition	8
Demonstration	8
Desirability	7
Investment	5
Regulation	5
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



6 MRL /9

8 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

THORIUM REACTORS

THORIUM REACTORS, which are in the Prototype Stage, is the field of research concerned with trying to build and commercialise the world's first Thorium reactors which offer the same generation capacity as today's nuclear reactors, without leaving such a damaging, and long lasting nuclear waste problem. While there have recently been developments in the space, with the first new prototype reactor coming online in decades, and a number of countries providing researchers with a boost in funding, the fact of the matter is that progress in the field is still agonisingly slow.

DEFINITION

Thorium Reactors use Thorium a stable Earth isotope that doesn't need enrichment and produce up to 10,000 times less long lived radioactive waste than traditional Nuclear Reactors.

EXAMPLE USE CASES

Today the first prototype Thorium Reactors are being used to test and refine the technology before its eventual productisation. in the future the primary use cases of the technology will be as primary generating capacity to feed energy into the grid.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Energy sector, with support from government grants.

While Thorium Reactors are in the Prototype Stage, over the long term they will be enhanced by advances in Nano-Vascular Composites, and replaced by Fusion Reactors, Space Based Solar Platforms.

MATTHEW'S RECOMMENDATION

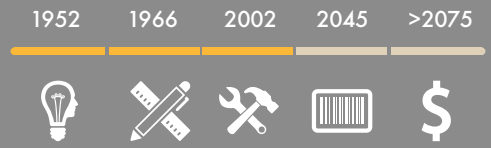
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18

IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	7
Demonstration	2
Desirability	4
Investment	3
Regulation	2
Viability	5

PRIMARY GLOBAL DEVELOPMENT AREAS

9 MRL /9

9 TRL /9

5 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

WIRELESS ENERGY

WIRELESS ENERGY, which is in the Prototype Stage and Productisation Stage, is the field of research concerned with trying to create long range, high capacity wireless charging systems that can be used to charge everything from sensors and smartphones, to televisions and vehicles. Recently there have been substantial breakthroughs in the field with the maximum range and the amount of energy that can be transmitted wirelessly increasing by orders of magnitude, and now that the regulators have approved the technology for wide spread commercial use, for distances of up to 15 feet, the technology will soon go mainstream.

DEFINITION

Wireless Energy is the transfer electromagnetic power to another device without the need to use wires.

EXAMPLE USE CASES

Today we are using Wireless Energy to charge our smartphones, and small cars and drones. In the future the primary use cases of this technology will be to charge a wide variety of devices and products, from sensors to vehicles, including aircraft and semi-trucks, and everything in between.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Defence, Energy and Manufacturing sector, with support from government funding, and university grants. In time we will see the range of the technology, and the amount of energy that can be transmitted increase substantially, which will have a dramatic impact on its wide spread adoption.

While Wireless Energy is in the Prototype Stage and Productisation Stage, over the long term it will be enhanced by advances in Bio-Batteries, Piezoelectric Energy Systems, Triboelectric Materials, and Photovoltaics, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

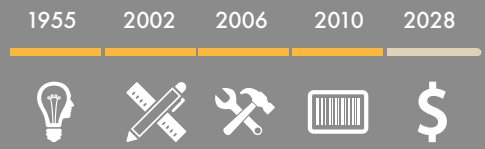
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

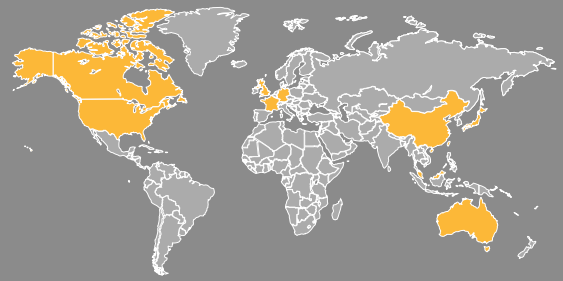
IMPACT

STATUS



Accessibility	8
Affordability	7
Competition	6
Demonstration	9
Desirability	9
Investment	7
Regulation	8
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



GEOENGINEERING

HUMANITY IS using geoengineering as a means to fulfil two fundamental requirements. The first of which is to help us reign in, and re-engineer the climate of our own planet, and the second of which is to help us colonise new worlds, such as Mars, an endeavour which will get underway in the next few years.

Once seen as a way to bring rain to drought stricken areas geoengineering is now being seen by many in the global scientific community as our "Plan B" if our "Plan A" to tackle climate change fails, and today countries around the world, such as China, are investing hundreds of millions of dollars to develop and roll out "monster" climate engineering schemes that cover millions of square miles of territory.

Today this category is being driven, primarily, by advances in two significant and ascending technology fields, namely Carbon Sequestration and Climate Engineering.

In this section you will find details of the emerging technologies that made it into this years Griffin Emerging Technology Starburst along with details of other impactful emerging technologies:

1. Archologies
2. Carbon Sequestration
3. Climate Engineering
4. Solar Geo-Engineering
5. Terraforming

In addition to these emerging technologies there are many others that have yet to get an entry in this codex. These include, but are not limited to:

6. High Frequency Atmospheric Manipulation
7. Single Step Desalination Systems
8. Solid State Greenhouse Effects

5 MRL /9

8 TRL /9

2 /10

ARCHOLOGIES

ARCOLOGIES WERE first bought to life in the 1980's and, arguably, they're an architectural concept that won't die, perhaps on the one hand it's because architects and designers aren't certain that the world that we're going to be leaving for our children will be habitable. However, that said, as a range of complimentary manufacturing technologies, such as 3D Printing continue to mature, and as humankind continues to strive to become an inter-planetary species it's highly likely that these large, self contained "smart cities in a jar"will one day become a reality.

DEFINITION

Archologies are integrated self sustaining cities contained within massive vertical structures.

EXAMPLE USE CASES

While the future use cases for the technology show great potential, such as the ability to build fully self contained cities on, initially the Moon and Mars, the current use cases here on Earth are limited only by companies and individuals willingness to invest in the technology, and the concept.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade, the technology will continue to languish in the realms of science fiction because today on Earth few people see the need, or have the desire to build self-sustaining self-contained cities, however, if we did want to build such monoliths today, both on land and at sea, we could do it very easily and incorporate a variety of different technologies, such as 3D Printing, renewable energy systems, smart city and smart home technologies, and vertical farms into the design.

While Archologies are still in the ascending phase today it isn't clear that anything could replace them.

MATTHEW'S RECOMMENDATION

Archologies are a moderately disruptive technology that is still at the concept stage. As a result, in the long term, I suggest companies put it onto their radars and keep an eye on it while at the same time paying more attention to the technologies that underpin the concept.

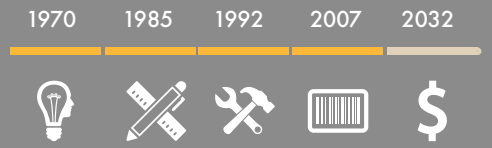
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19

IMPACT

STATUS



Accessibility	3
Affordability	3
Competition	2
Demonstration	7
Desirability	9
Investment	5
Regulation	2
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

8 MRL /9

9 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

CARBON SEQUESTRATION

CARBON SEQUESTRATION has been on the ascent for the past couple of decades but the cost and complexity of bringing these technologies, which need to operate at scale, to market has been prohibitive. As a consequence many of the companies involved in the sector have been forced to either reign in their ambitions, or focus on niche markets. That said though, as costs continue to fall and these programs become increasingly cost effective the technology is now starting to make some headway, albeit slowly.

DEFINITION

Carbon Sequestration is the natural or artificial process by which carbon dioxide is removed from the atmosphere and held in solid or liquid form.

EXAMPLE USE CASES

While many of the future use cases for the technology will rely on it being able to be absorb and convert Carbon at scale and store it safely, as demonstrated by the huge city sized carbon capture facilities shown off in the movies, recent technology breakthroughs have shown us that it is possible to create zero emission fossil fuel power stations, as well as a new "Carbon Farming" industry that draws Carbon out of the environment using genetically modified bacteria.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade the technology will continue to gain traction and diversify, especially as many climate scientists warn that sovereign nations attempts to slow climate change are not enough, and today I am seeing an increase in the rate of investment, the size and diversity of the projects, and the efficiency of the carbon capture platforms being deployed. However, whereas in the past companies rallied around chemical capture technology solutions now they are increasingly focusing on the benefits of genetic engineering and investing in biological platforms, as a result there is the chance that they could face new regulatory hurdles and be embroiled in debates about Genetically Modified Organisms (GMO).

While Carbon Sequestration technology is still an ascending technology, as it diversifies from chemical to biological based platforms, it is not yet clear what these new platforms will be replaced by.

MATTHEW'S RECOMMENDATION

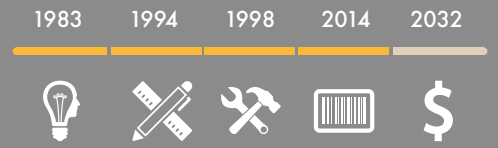
Carbon Sequestration is a moderately disruptive technology that can help companies lower their tax liabilities and improve their eco credentials. As a result in the short to medium term I suggest companies put it on their radars and keep an eye on it.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

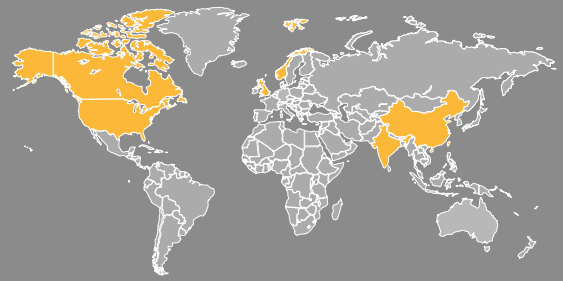
IMPACT

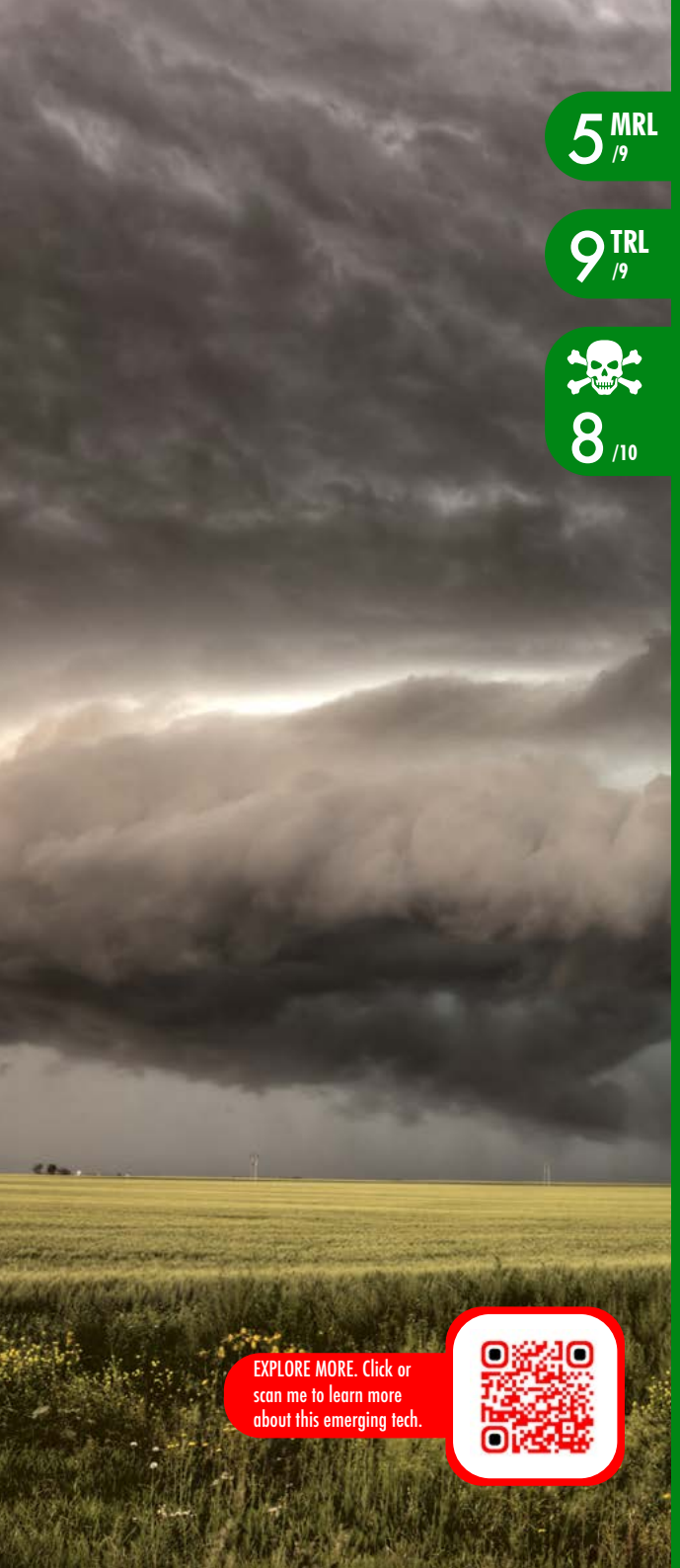
STATUS



Accessibility	7
Affordability	4
Competition	4
Demonstration	6
Desirability	7
Investment	6
Regulation	4
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS





5 MRL /9

9 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

CLIMATE ENGINEERING

CLIMATE ENGINEERING continues to be a contentious issue, but one nevertheless that several governments and research institutes are ploughing huge sums of money into. While the overall impact that local climate engineering projects have on the global climate still hasn't been quantified there are many that suspect that some of the recent projects, for example, those in China, which in some cases have increased regional rainfall by over 50 billion cubic meters, must have an effect elsewhere.

DEFINITION

Climate Engineering is the deliberate and large scale intervention and manipulation of a planets climatic system.

EXAMPLE USE CASES

While many of the future use cases of this technology will involve both large planetary scale, as well as smaller, more local deployments, what will change over time is the precision of the technology, and the quality of the results it produces. Today's use cases in the main are still restricted to local and regional climate engineering projects that spur rainfall, or help create the right conditions for specific public events, however China is now taking the lead when it comes to large, national scale projects with some of the latest projects covering over a quarter of the nation.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade, as researchers continue to experiment with new techniques and tools that include new materials and chemicals, as well as new, smart autonomous delivery and deployment platforms, we will continue to see an increase in the size of the ecosystem and the amount of investment being poured into the areas. We will also continue to see an improvement in the precision and the results these projects deliver, and as many experts around the world continue to believe that climate change is either nearing, or very near to its global tipping point, we will continue to see an increase in the number of institutions who develop and promote their new platforms as "Plan B" in case governments "Plan A" fails.

While Climate Engineering technology is still in the ascending phase one day it is highly likely that it will be wrapped into new Terraforming platforms.

MATTHEW'S RECOMMENDATION

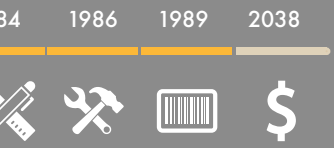
Climate Engineering is a highly disruptive technology that has already been productised, albeit at an early stage. Companies should perform a thorough assessment of its medium to long term impact on their business.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

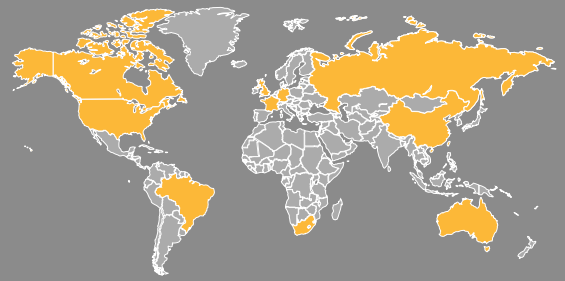
IMPACT

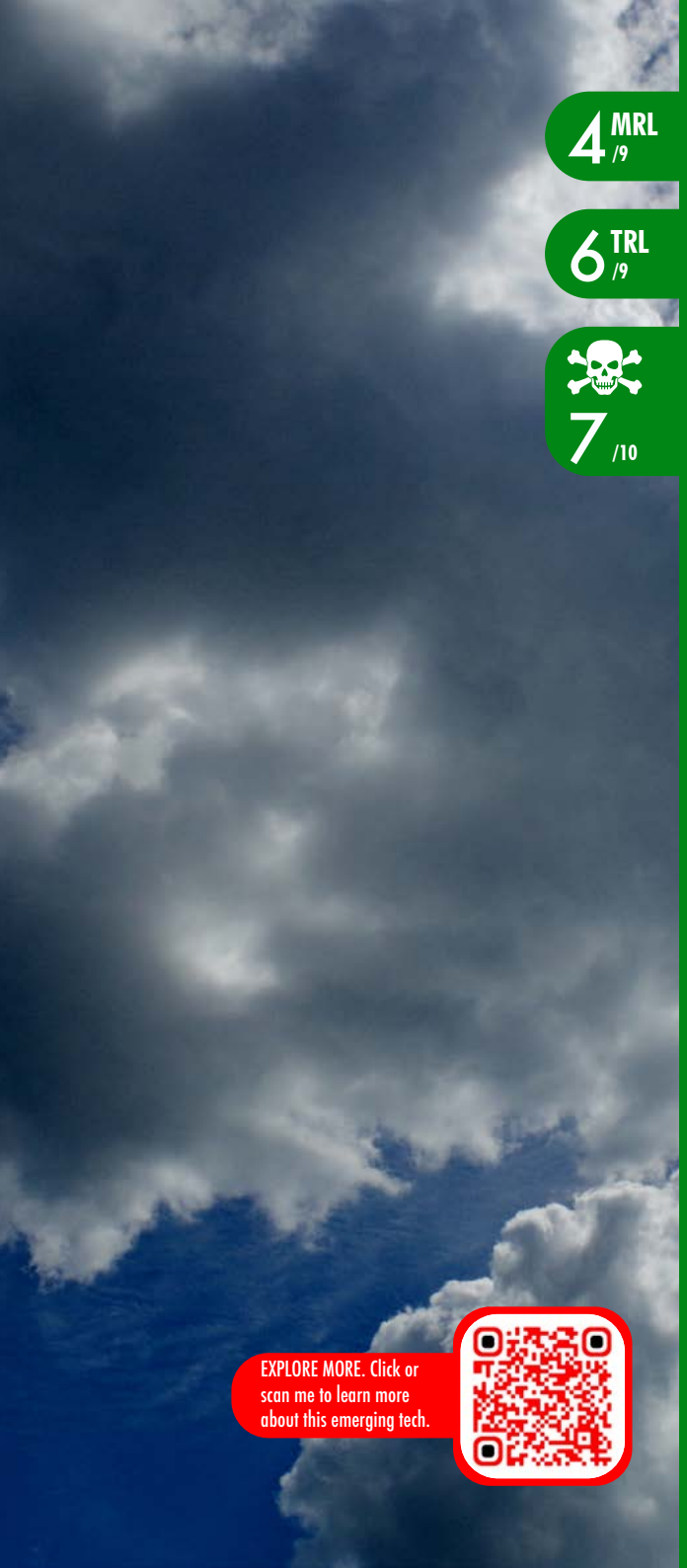
STATUS



Accessibility	9
Affordability	6
Competition	4
Demonstration	8
Desirability	7
Investment	6
Regulation	5
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





4 MRL /9

6 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SOLAR GEO-ENGINEERING

SOLAR GEO-ENGINEERING, which is in the Prototype Stage, is the field of research concerned with developing new ways to block or deflect the Sun's rays away from reaching the Earth's surface and lower atmosphere in order to limit and or reduce the amount of global warming the planet experiences. Recent breakthroughs in the field have managed to demonstrate that medium scale Solar Geo-Engineering projects that could lower local or global temperatures by a few degrees are technologically feasible. Furthermore, as the climate crisis deepens many scientists are now also proposing that we consider going one step further and, rather than simply using the technology to blanket one or more specific areas or regions, we scale the it up to a size where it has the blanketing impact equivalent to a Supervolcano eruption.

DEFINITION

Solar Geo-Engineering technologies counteract climatic temperature increases by reflecting more sunlight away from the Earth's surface.

EXAMPLE USE CASES

Today we are using small scale prototypes to prove the theory behind the technology and refine it. In the future the primary use case for this technology will be as a Plan B to reduce the impact of climate change and global warming in the event that the world reaches a catastrophic point of no return by reflecting the majority of the Sun's energy back into space.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by univesity grants. In time as the technology is refined and as global temperatures continue to rise we will inevitably see an increase in the number of voices demanding that organisations begin trials of the technology to evaluate its efficacy.

While Solar Geo-Engineering is in the Prototype Stage, over the long term it will be enhanced by advances in Materials, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

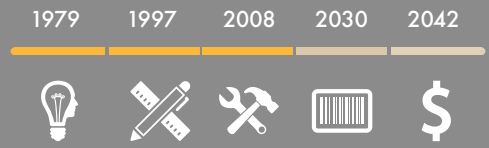
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22, '23, '24

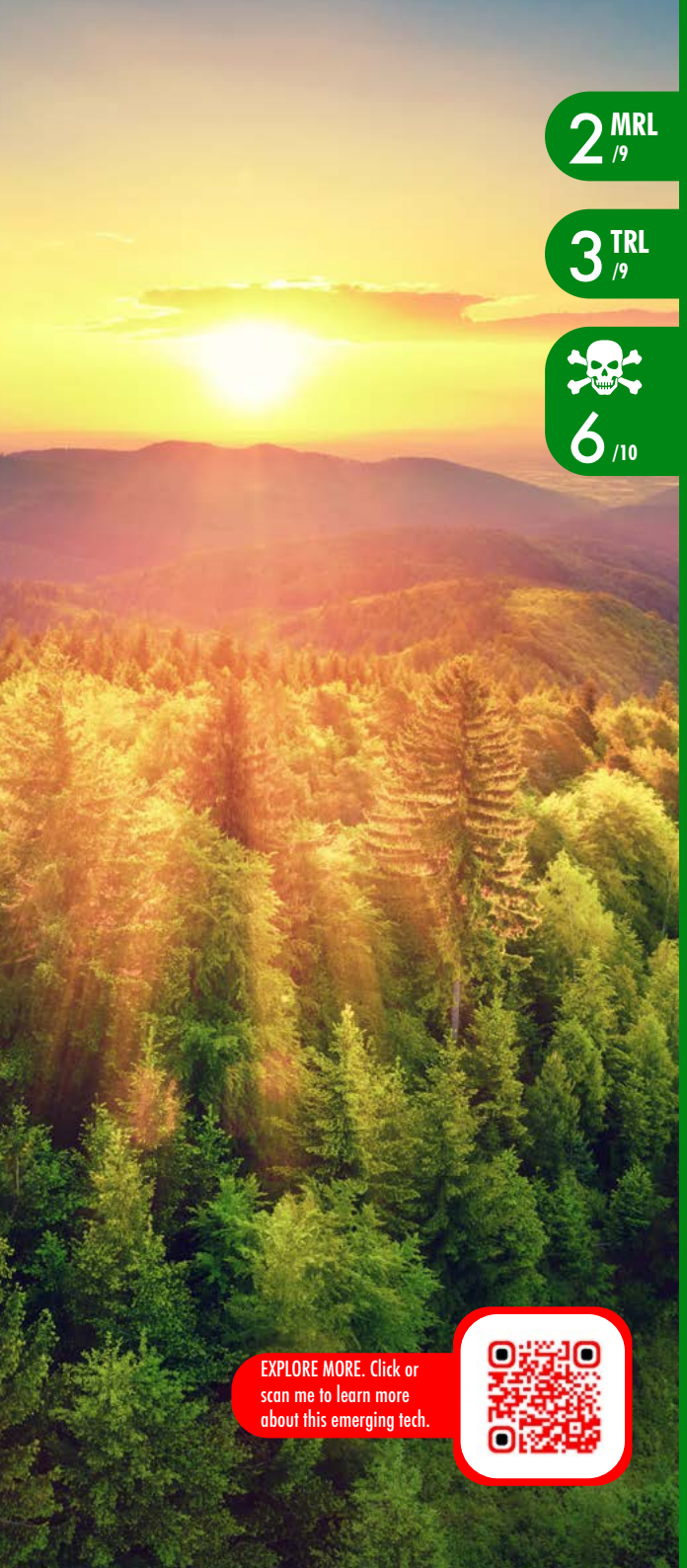
IMPACT

STATUS



Accessibility	6
Affordability	6
Competition	4
Demonstration	8
Desirability	7
Investment	4
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



2 MRL /9

3 TRL /9

6 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

TERRAFORMING

TERRAFORMING HAS long been a staple of the science fiction community who continually show off its power to transform planets and space stations alike into vibrant, habitable green spaces, but the fact remains that there is little to no need for the technology on Earth. As a consequence, as humanity continues to reach for the stars and looks to build the first human inter-planetary outposts on the Moon and Mars by 2050 it is inevitable that it will become an increasingly important tool to help humans colonise the universe.

DEFINITION

Terraforming is the transformation of an ecosystem or a planet so that it resembles Earth.

EXAMPLE USE CASES

While many of the future use cases for the technology are extreme and vary in scale, from the ability to terraform large orbiting cities to being able to transform entire planets today's uses are limited to small lab scale experiments.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research institutions will continue to work on developing and experimenting with the technology, and it is inevitable that it will require a "Technology in depth" approach that will include researchers increasingly turning to Synthetic Biology technologies, as well as more boutique technologies such as Magnetic Shields, like the ones NASA are proposing for Mars, that will prevent a planets new atmosphere from being blown away by solar flares and radiation.

While Terraforming technology is still very nascent at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

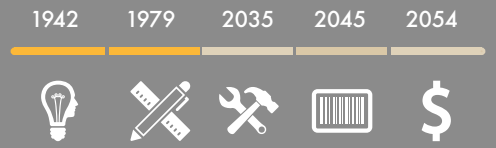
Terraforming is a highly disruptive and potentially very valuable technology but it is still at the concept and prototype stage. As a result, in the medium to long term, I suggest companies put it onto their radars and keep an eye on it.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22

IMPACT

STATUS



Accessibility	2
Affordability	1
Competition	2
Demonstration	2
Desirability	3
Investment	2
Regulation	1
Viability	5

PRIMARY GLOBAL DEVELOPMENT AREAS

INTELLIGENCE

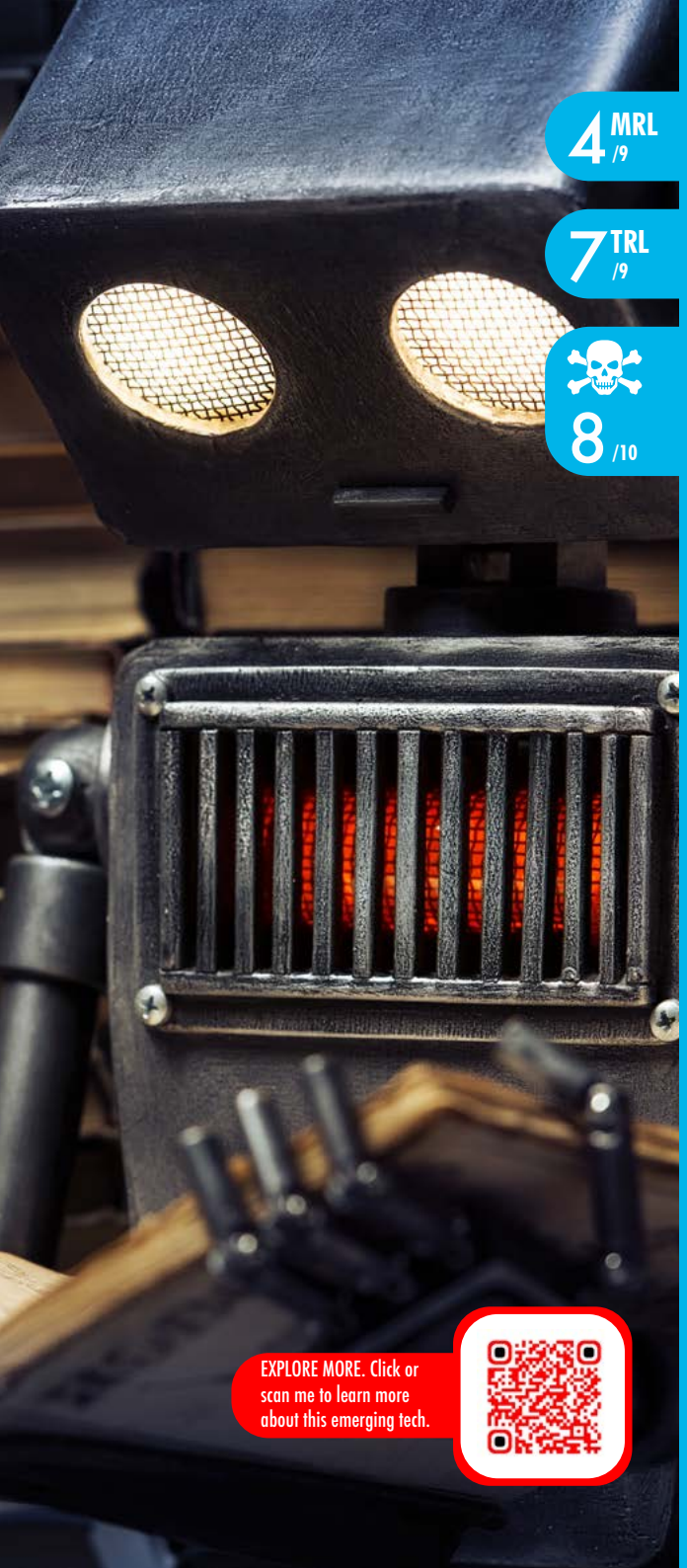
HUMANS HAVE long thought we're special because of our superior intelligence, but as we use that intelligence to build new forms of intelligence, whether it's machine, mechanical, or even new forms of synthetic biological intelligence, our position at the apex of the tree will become increasingly threatened.

In this section you will find details of the emerging technologies that made it into this years Griffin Emerging Technology Starburst along with details of other impactful emerging technologies:

1. Analogue Artificial Intelligence
2. Artificial General Intelligence
3. Artificial Narrow Intelligence
4. Artificial Super Intelligence
5. Cognitive Computing
6. Creative Machines
7. Diffractive Neural Networks
8. DNA Neural Networks
9. Evolutionary Artificial Intelligence
10. Explainable Artificial Intelligence
11. Federated Artificial Intelligence
12. Liquid Artificial Intelligence
13. Machine Vision
14. Mechanical Artificial Intelligence
15. Meta Artificial Intelligence
16. Natural Language Processing
17. Open Ended Artificial Intelligence
18. Quantum Artificial Intelligence
19. Quantum Language Processing
20. Shallow Neural Networks
21. Simulation Engines
22. Swarm Artificial Intelligence
23. Synthetic Biological Intelligence

In addition to these emerging technologies there are many others that have yet to get an entry in this codex. These include, but are not limited to:

24. Adversarial Artificial Intelligence
25. Artificial Quantum Life
26. Augmented Intelligence
27. Conversational Artificial Intelligence
28. Procedural Content Generation
29. Quantum Deep Learning
30. Self-Learning Artificial Intelligence
31. Sentient Artificial Intelligence
32. Smart Data



4 MRL /9

7 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ANALOGUE ARTIFICIAL INTELLIGENCE

ANALOGUE ARTIFICIAL INTELLIGENCE, a General Purpose Technology, which is in the early Commercialisation Stage, is the field of research concerned with trying to develop new kinds of AI systems that are compact, robust to noise, and capable of running parallel computations at very low power. Recently there have been several breakthroughs in the field with companies such as IBM and Microsoft who have not only developed new Analogue AI models and training methods but also the new generation of Analogue Computing platforms to support those AI's. Seen as a potential paradigm shift in the field of AI one of the most interesting aspects of these AIs is the ability to process huge volumes of data with exceptionally low power requirements that are magnitudes smaller than the energy requirements of traditional Artificial Narrow Intelligence and Artificial General Intelligence systems which, as we see on a daily basis are only getting more huge.

DEFINITION

Analogue Artificial Intelligence mimics the human cognitive process by processing information in a continuous non-digital manner.

EXAMPLE USE CASES

While Analogue AI has been around for decades in one form or another today they can be used to accelerate AI hardware, and do signal filtering, as well as being used to perform analogue pattern matching and anomaly detection in continuous analogue data streams such as those found in biomedical applications, environmental monitoring, and industrial processes. They are also increasingly effective at helping solve continuous optimisation problems.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Analogue AI increase and accelerate, primarily driven by organisations in the Technology sector. While this technology has many interesting attributes the key one is its ability to drop the power consumption of large AI models by magnitudes, which means it could have longevity.

While Analogue AI is still in the early Commercialisation Stage it could be enhanced by advances in Analogue Computing, Artificial Intelligence, Materials, Memristors, Nanotechnology, Neuromorphic Computing, Quantum Computing, Sensors, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

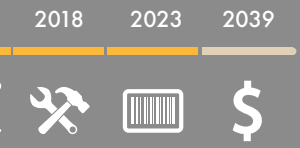
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

IMPACT

STATUS



Accessibility	3
Affordability	5
Competition	9
Demonstration	7
Desirability	7
Investment	5
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

ARTIFICIAL GENERAL INTELLIGENCE

ARTIFICIAL GENERAL INTELLIGENCE, a GENERAL PURPOSE TECHNOLOGY, which is in the very early Prototype Stage, is the field of research concerned with developing intelligent machines capable of performing any intellectual task that a human can, and when that even takes place many experts already agree that it will signal nothing less than a paradigm shift for human society with significant ripple effects and impacts. Recently there have been a couple of early stage breakthroughs in the space with the development of the world's first AGI blueprint architecture, and then the unveiling of the world's first nascent AGI that unlike it's more traditional Artificial Narrow Intelligence cousins is capable of performing thirty tasks at once.

DEFINITION

Artificial General Intelligence is the point at which a machine can successfully perform any intellectual task that a human can.

EXAMPLE USE CASES

Today the first Artificial General Intelligence prototype is being used to test the viability of the initial blueprint architecture, test it and refine it, before iterating it further. In the future the primary use cases of this technology will be almost limitless.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Defence and Technology sector, with support from government funding, and university grants. In time we will see the technology approach take off as the first viable examples emerge, after which the genie will then be out of the bottle, and as the global AI arms race continues to accelerate it is firmly my expectation that we will see the first true AGI platforms emerge by 2030, years earlier than currently predicted.

While Artificial General Intelligence is in the very early Prototype Stage, over the long term it will be enhanced by advances in Artificial Narrow Intelligence, Cognitive Computing, Creative Machines, Exascale Computing, Federated Artificial Intelligence, Intelligence Processing Units, Natural Language Processing, Neuromorphic Computing, Photonic Computing, Quantum Computing, Simulation Engines, and Terahertz Computer Chips, and eventually replaced by Artificial Super Intelligence.

MATTHEW'S RECOMMENDATION

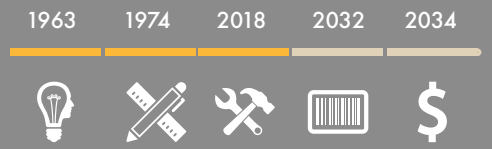
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23, '24

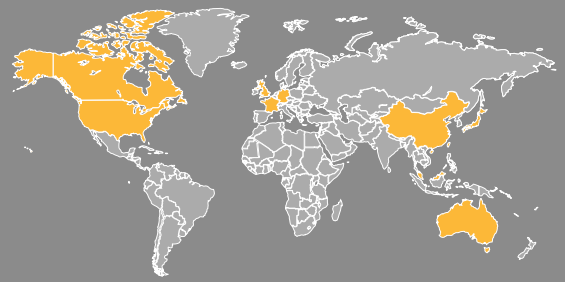
IMPACT

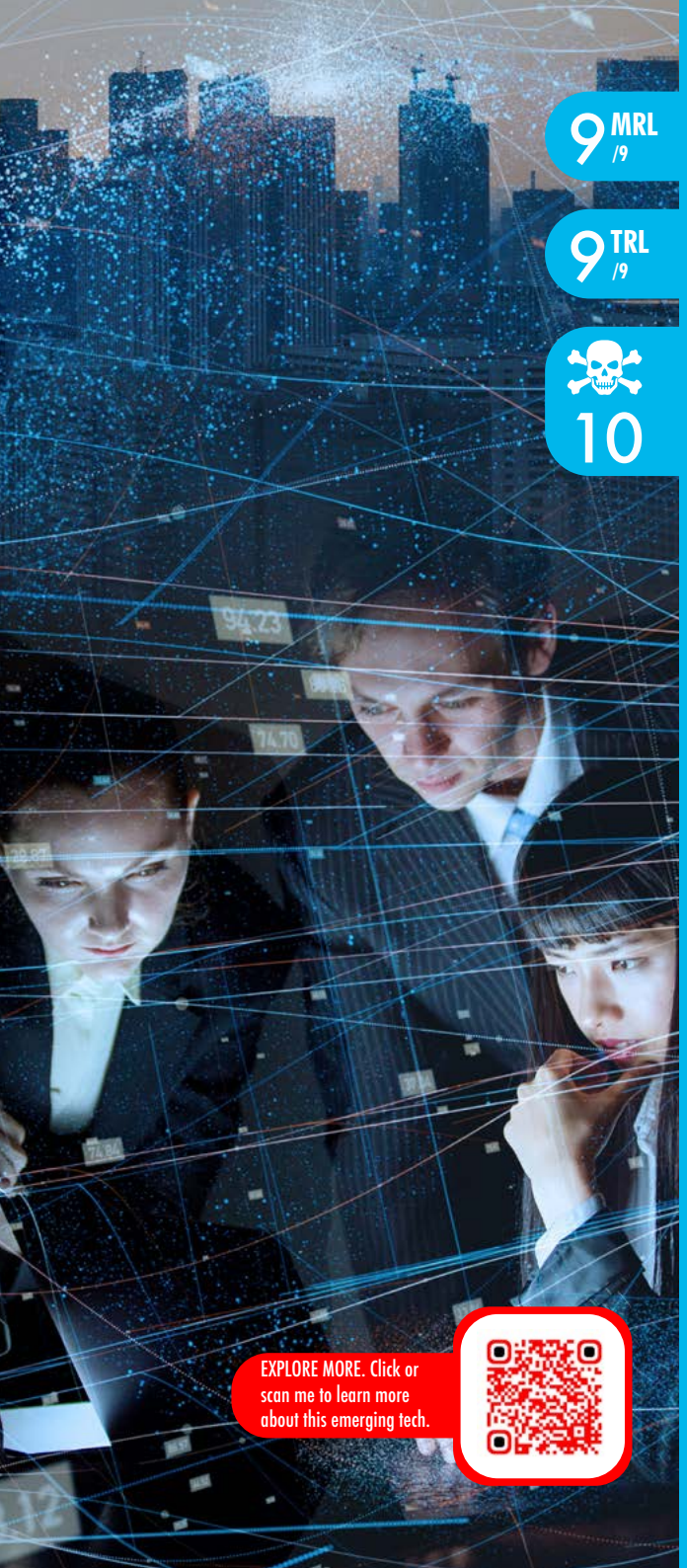
STATUS



Accessibility	1
Affordability	2
Competition	5
Demonstration	3
Desirability	9
Investment	4
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





9 MRL /9

9 TRL /9

10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ARTIFICIAL NARROW INTELLIGENCE

ARTIFICIAL NARROW INTELLIGENCE, a GENERAL PURPOSE TECHNOLOGY, which is in the Mass Adoption Stage, is the field of research concerned with developing intelligent machines that are as capable, or more capable, than humans at performing certain specific tasks. Recently the number of breakthroughs, the rate of development, and the level of interest in the field has exploded the technology is now achieving lift off and going mainstream, being embedded into almost every corner of the world's digital fabric.

DEFINITION

Artificial Narrow Intelligence is a form of machine intelligence that is focused on accomplishing one narrow task.

EXAMPLE USE CASES

Today the use of Artificial Narrow Intelligence is growing at an unprecedented rate, including in healthcare diagnostics, personalised advertising and targeting, government policy making, internet search and services, manufacturing, quantitative trading, Robo-"X" services, security and surveillance, and millions more. In the future the primary use cases of this technology will be almost limitless.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at a highly accelerated rate, led by organisations across all sectors, with support from government funding, industry consortiums, and university grants. In time we will see the technology reach a point where its use is ubiquitous and it will be rare to find products and services that do not leverage it in one way or another.

While Artificial Narrow Intelligence is in the Mass Spread Adoption Stage, over the long term it will be enhanced by advances in enhanced by advances in Cognitive Computing, Creative Machines, Federated Artificial Intelligence, Intelligence Processing Units, Natural Language Processing, Photonic Computing, Quantum Computing, Simulation Engines, and Terahertz Computer Chips, and eventually replaced by Artificial General Intelligence.

MATTHEW'S RECOMMENDATION

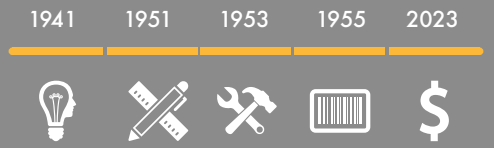
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23

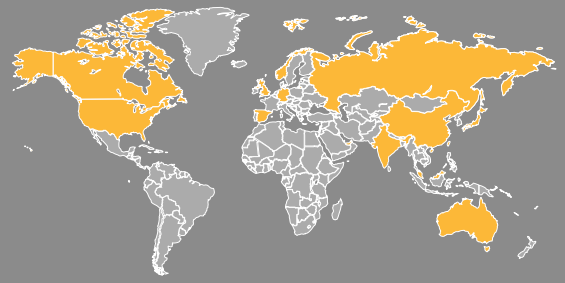
IMPACT

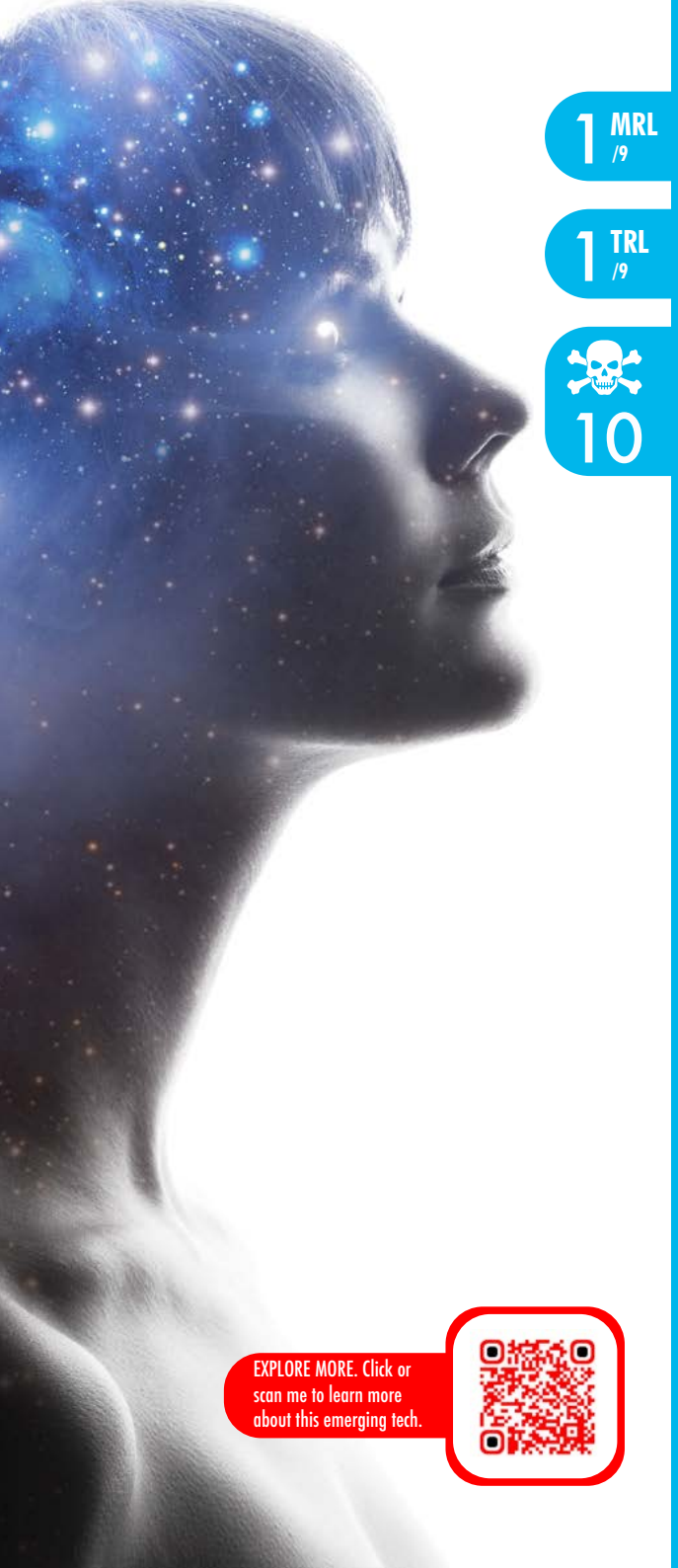
STATUS



Accessibility	9
Affordability	6
Competition	7
Demonstration	9
Desirability	9
Investment	9
Regulation	5
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





1 MRL /9

1 TRL /9

10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ARTIFICIAL SUPER INTELLIGENCE

ARTIFICIAL SUPER INTELLIGENCE, a GENERAL PURPOSE TECHNOLOGY, which is still in the Concept Stage, is the field of research concerned with developing the first generation of super intelligent machines whose intellectual capabilities and performance far outstrip those of humans. As a consequence many experts agree that the emergence of ASI will have a greater impact on human evolution and society as the discovery of electricity and fire. Similarly, given the capability of the technology there are many experts that view its emergence with extreme caution, going so far as painting apocalyptic visions of the future, but, whatever the reality only time will tell whether the same technology that could potentially help humans discover new ways to live forever, and take us into inter-stellar space, will also annihilate us.

DEFINITION

Artificial Super Intelligence is the point at which a machine is capable of exceeding the intellectual capabilities and performance of humans.

EXAMPLE USE CASES

Today Artificial Super Intelligence is just a concept, but there are many experts who believe its emergence will help us unlock the secrets to eternal life, inter-stellar space travel, and new powerful energy sources, among many other potential benefits.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow albeit from a very low base, primarily led by organisations in the Technology sector, with support from government funding, and university grants. In time we will see the emergence of the first Artificial General Intelligence platforms and then, a decade or so later, by 2045, the emergence of the first ASI, and both events will be defining moments for the future of humanity.

While Artificial Super Intelligence is in the Concept Stage, over the long term it will be enhanced by advances in Artificial General Intelligence, Biological Computing, Chemical Computing, DNA Computing, Federated Artificial Intelligence, Liquid Computing, Neuromorphic Computing, Photonic Computing, and Quantum Computing, and it could potentially be replaced by a new form of Biological-Hybrid Artificial Super Intelligence, the result of multiple advances in multiple complimentary technology fields.

MATTHEW'S RECOMMENDATION

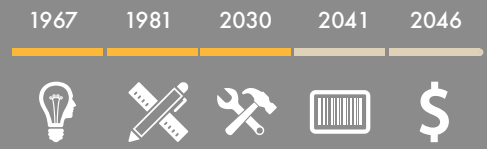
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '24

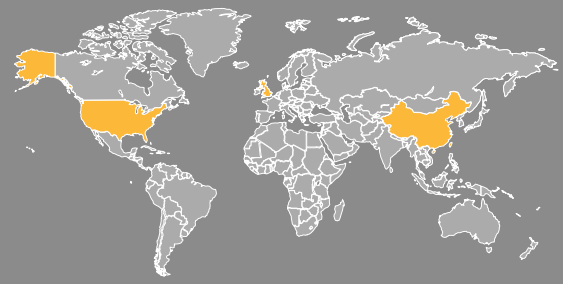
IMPACT

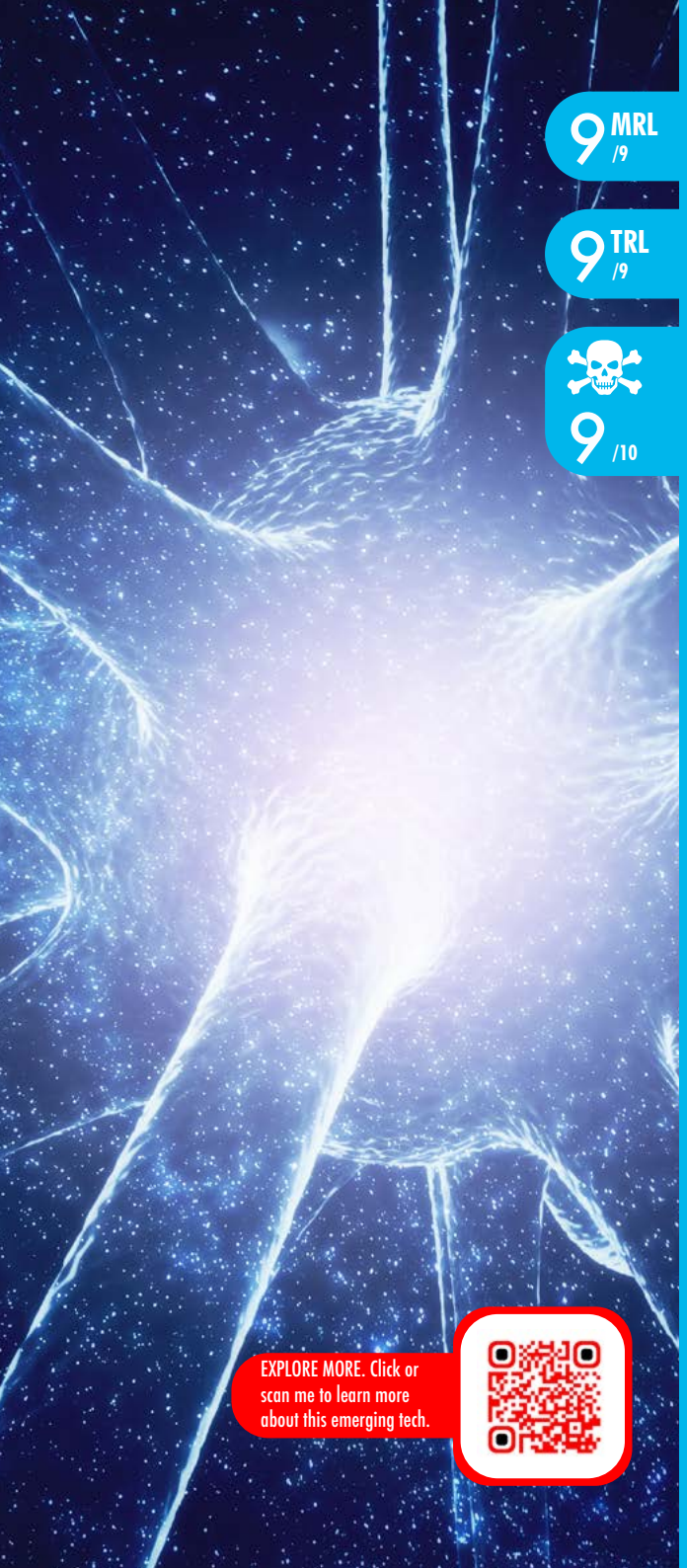
STATUS



Accessibility	1
Affordability	1
Competition	2
Demonstration	1
Desirability	9
Investment	2
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





9 MRL /9

9 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

COGNITIVE COMPUTING

COGNITIVE COMPUTING, a GENERAL PURPOSE TECHNOLOGY, which is in the Productisation Stage, is the field of research concerned with developing machines with human-like decision, intelligence, and reasoning capabilities that can be interacted with in natural ways. In short one analogy would be to compare them to the Star Trek Enterprise computer platform, where the computer takes on the task of processing and making sense of huge volumes of information before presenting it to the human crew in a human-like manner. As a result Cognitive Computing platforms combine a variety of different fields together, including Artificial Intelligence and Natural Language Processing, and recent breakthroughs in all these fields mean they are now more capable than ever.

DEFINITION

Cognitive Computing is the simulation of Human thought processes in a computerised model or system.

EXAMPLE USE CASES

Today we are using Cognitive Computing in a myriad of ways, including creating adverts and to cook up new food recipes, as well as to augment human decision making, and as a debating, healthcare diagnostics, and investment tool. In the future the primary use of the technology will be in helping augment human decision making.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at a highly accelerated rate, primarily led by organisations in the Technology sector. In time we will see the technology's capabilities grow and its ease of use, and usefulness, increase to a point where it, and its close relatives, will be able to augment human decision making in a wide range of fields and use cases.

While Cognitive Computing is in the Productisation Stage, over the long term it will be enhanced by advances in Creative Machines, Exascale Computing, Federated Artificial Intelligence, Intelligence Processing Units, Neuromorphic Computing, Simulation Engines, and Terahertz Computer Chips, and in time it will be replaced by Artificial General Intelligence.

MATTHEW'S RECOMMENDATION

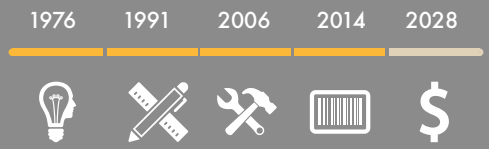
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20

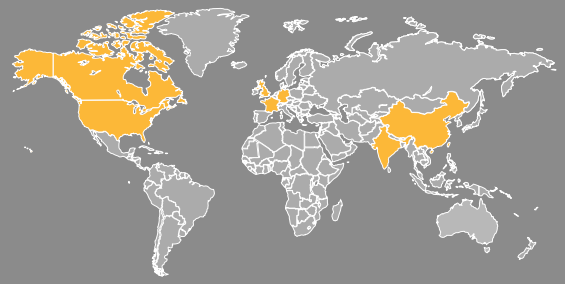
IMPACT

STATUS



Accessibility	8
Affordability	6
Competition	5
Demonstration	7
Desirability	9
Investment	7
Regulation	4
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



CREATIVE MACHINES

CREATIVE MACHINES, a GENERAL PURPOSE TECHNOLOGY, which is in the Prototype Stage and early Productisation Stage, is the field of research concerned with using Adversarial Artificial Intelligence and other complimentary technologies to build machines capable of matching and exceeding human creativity and ingenuity. In short, it is the effort to create machines that can create, imagine and innovate by themselves, without the need for human intervention, at speeds that are tens to hundreds of thousands times faster than humans. Recently there have been a spate of breakthroughs, from the creation of machines that can dynamically create art, literature, music, photos, scripts and videos, through to machines capable of performing iterative innovation, and creating new hardware and software products.

DEFINITION

Creative Machines are intelligent machines that are capable of emulating and simulating human ingenuity and the creative process.

EXAMPLE USE CASES

Today we are using Creative Machines to help us design new products, including aircraft, clothes, furniture, lunar landers, robots, and vehicles, as well as create adverts, art, literature, movies, and music, and to design, compile, and evolve new Artificial Intelligence software, and computer programs. In the future the primary use case of this technology will be limitless.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Construction, Entertainment, Manufacturing, Retail, and Technology sector, with support from government funding, and university grants. In time we will see the technology move from a point where it is capable of basic design and iteration to a point where it is capable of producing its own disruptive, primary innovations and creations.

While Creative Machines are in the Prototype Stage and Productisation early Stage, over the long term it will be enhanced by advances in Adversarial Artificial Intelligence, Artificial General Intelligence, Artificial Narrow Intelligence, Artificial Super Intelligence, Intelligence Processing Units, and Simulation Engines, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

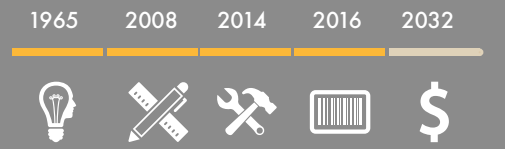
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '19, '20, '21, '22, '23, '24

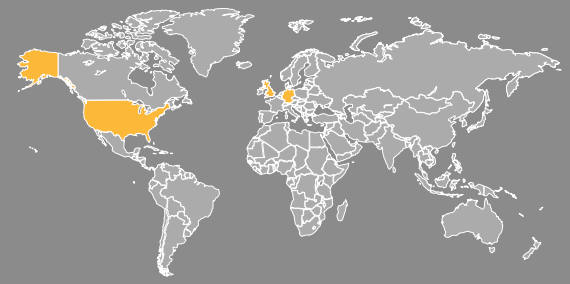
IMPACT

STATUS



Accessibility	6
Affordability	6
Competition	3
Demonstration	5
Desirability	9
Investment	6
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

5 TRL /9

2 /10

DIFFRACTIVE NEURAL NETWORKS

DIFFRACTIVE NEURAL NETWORKS, which are in the early Prototype Stage, is the field of research concerned with creating the world's first physical passive neural networks by 3D Printing them, rather than programming them, and using light waves, not electrons, to perform machine learning tasks, such as image analysis, feature detection and object classification, at the speed of light without the need to rely on any external compute or power source. Recently there have been a couple of interesting breakthroughs in the space, in the automated production of these types of neural networks, and their low cost, and ease of deployment, which makes them potentially a very interesting twist on a popular technology.

DEFINITION

Diffractive Neural Networks is a form of physical Artificial Intelligence that is printed and encoded into physical objects rather than being manifested in machine code.

EXAMPLE USE CASES

Today the first prototype Diffractive Neural Networks are being used in image detection, image analysis, and object classification to test the theory and refine the technology. In the future the primary use case of the technology will be passive neural network applications where speed is useful or important.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by university grants. In time the technology will continue to be refined and proven with researchers looking into new ways to produce and manufacture these kinds of networks automatically and at speed.

While Diffractive Neural Networks are in the early Prototype Stage, over the long term it will be enhanced by advances in 3D Printing and Nano-Manufacturing, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

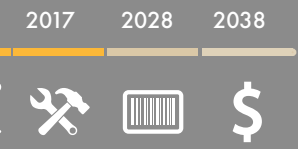
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23, '24

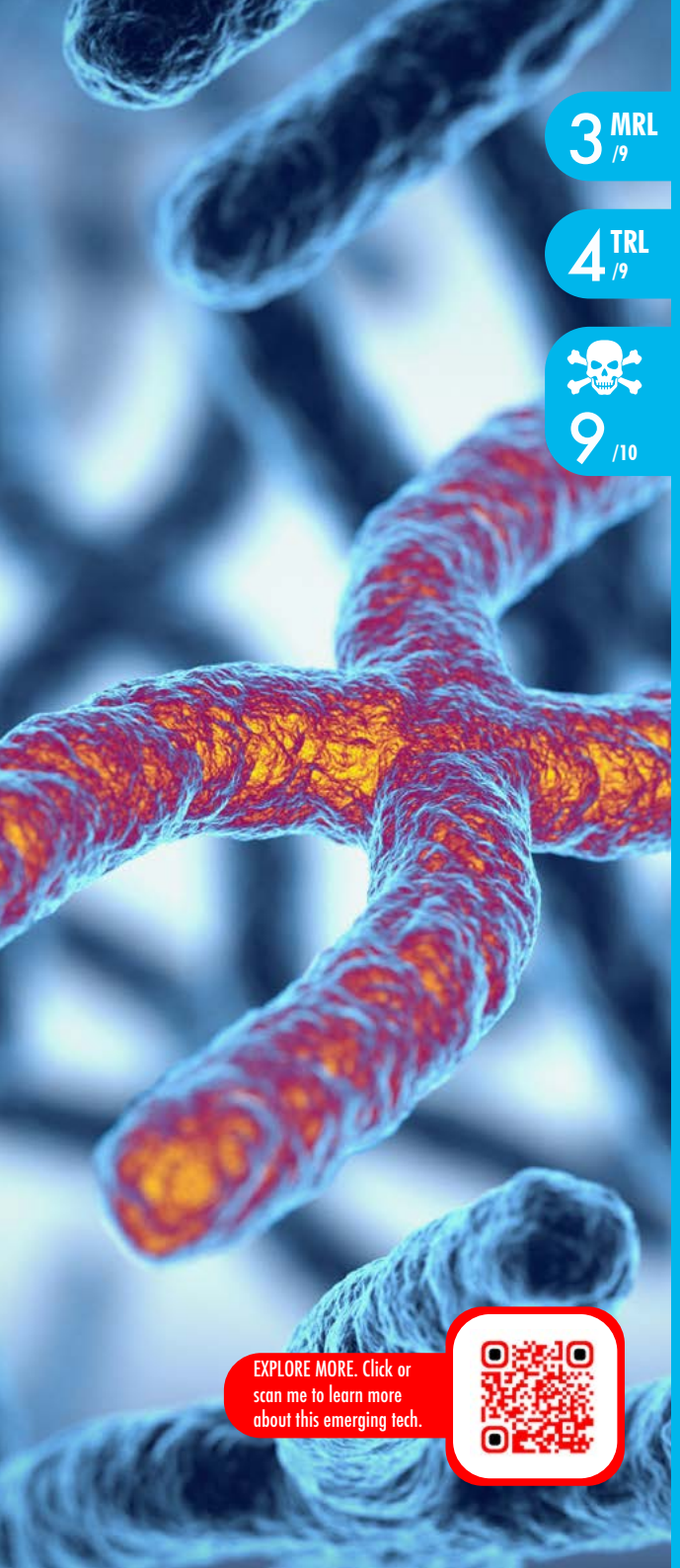
IMPACT

STATUS



Accessibility	3
Affordability	6
Competition	5
Demonstration	4
Desirability	5
Investment	2
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

4 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

DNA NEURAL NETWORKS

DNA NEURAL NETWORKS, which is in the early Prototype Stage, is the field of research concerned with creating a new so called "Wet Artificial Intelligence" technologies using nothing more than biological components, in the first case, DNA, to create complex neural networks that one day could be integrated with and programmed into molecular machines, and even the molecular machinery of the human body, in essence, helping turn the human body into a biological supercomputer.

DEFINITION

DNA Neural Networks is a form of Artificial Intelligence, also known as Wet AI, that is built from DNA rather than machine code.

EXAMPLE USE CASES

Today the first DNA Neural Network prototypes are being used to train the networks to identify handwriting before being refined. In the future the primary applications of the technology will be to bring the power of Artificial Intelligence to new environments, such as liquids, where their use cases will be as numerous as their digital counterparts.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow albeit from a very low base, primarily led by organisations in the healthcare sector, with support from government funding, and university grants. In time we will see researchers become increasingly capable at building and deploying increasingly complex DNA Neural Networks that have a wide variety of applications, but it is also likely that productising the technology will be hampered by regulation.

While DNA Neural Networks are in the early Prototype Stage, over the long term they will be enhanced by advances in 3D Bio-Printing, Biological Computing, Bio-Manufacturing, CRISPR Gene Editing, DNA Computing, DNA Nanoscience, DNA Synthesis, Nano-Machines, Nano-Manufacturing, and Semi-Synthetic Cells, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

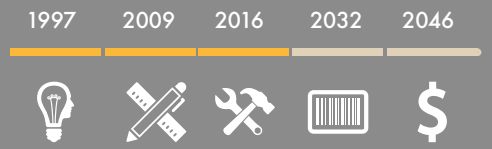
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23, '24

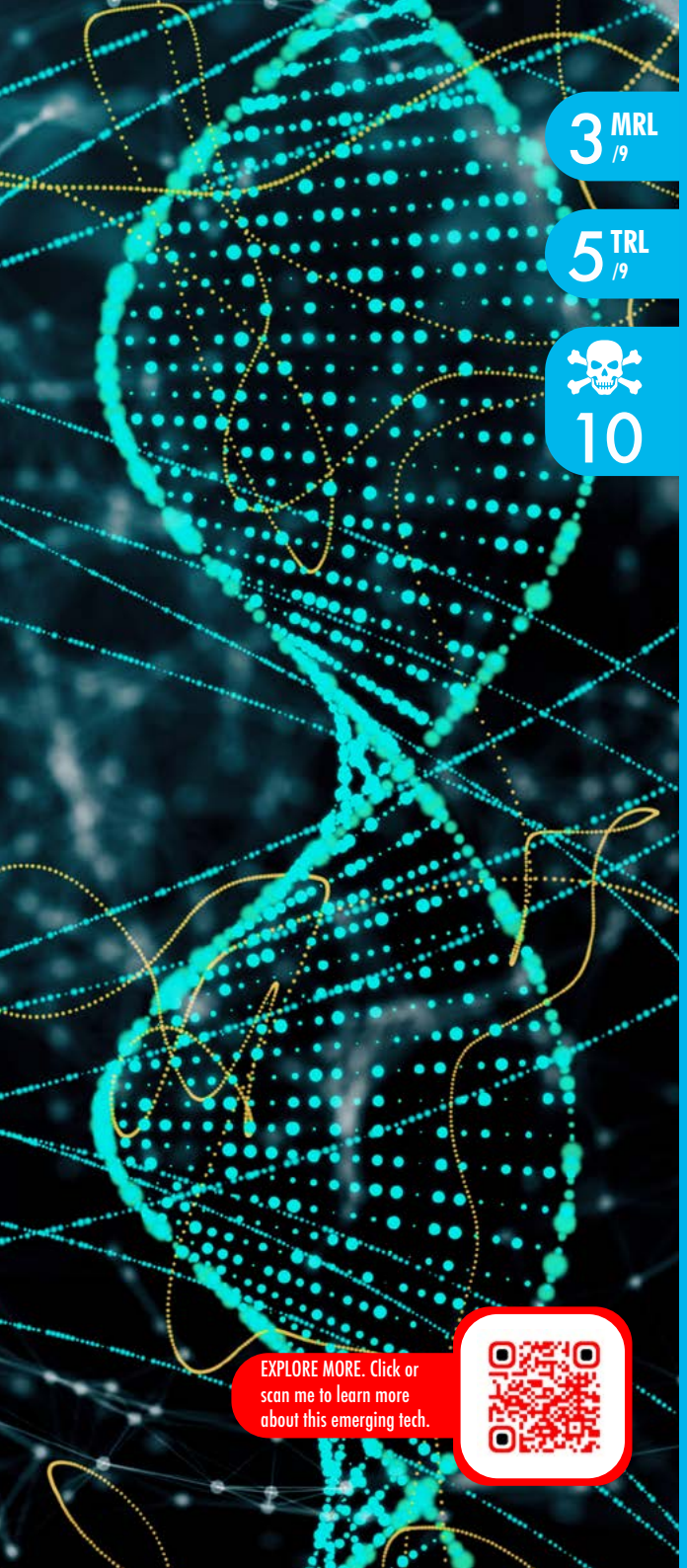
IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	4
Demonstration	3
Desirability	8
Investment	2
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

5 TRL /9

10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

EVOLUTIONARY AI

EVOLUTIONARY ARTIFICIAL INTELLIGENCE, which is in the Prototype Stage, is the field of research concerned with developing AI's that are capable of evolving their own code in much the same way that animals combine together different DNA strands to create new lifeforms and evolutionary alternatives. While this is a highly promising technology that could yield a great number of interesting and surprising results it has to be said it's also highly likely that it will produce all manner of unpredictable outcomes none of which might be controllable or favourable. Recently there have been a number of breakthroughs in this field from companies including Google who have created AI's capable of mutating and evolving their "programming and code" autonomously.

DEFINITION

Evolutionary Artificial Intelligence are unsupervised neural networks that rely on fitness functions rather than training to improve and solve problems.

EXAMPLE USE CASES

With examples such as AutoML-Zero which resembles natural evolution with the AI code improving every generation with little or no human interaction by evaluating the top performing candidate algorithms for a particular task and then mathematically combining them together and "evolving" them this is an interesting field with many applications including the development of better Generalised Robots and superior AI's - especially if it's combined with Open Ended AI systems.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the technology sector, with support from government funding and university grants. In time we will see Evolutionary AI become common place and see evolution taking place at digital speed at which point it's highly unlikely that these systems or their outcomes will be fully controllable. Furthermore, as AI gets better at designing and generating its own algorithms this is literally a technology that could take on a life all of its own which is both fascinating and dangerous.

While Evolutionary AI is in the Prototype Stage, over the long term it will be enhanced by advances in Artificial Intelligence, Explainable AI, Open Ended AI, Quantum Computing, and many other complimentary fields, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '22, '23, '24

IMPACT

STATUS

Accessibility	3
Affordability	3
Competition	2
Demonstration	7
Desirability	9
Investment	6
Regulation	2
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

EXPLAINABLE AI

EXPLAINABLE AI (XAI), which is in the early Productisation Stage, is the field of research concerned with developing new AI tools and techniques that enable AI's to explain their decision making processes to humans using natural language, visualisations, or in other formats. Recently there have been a variety of breakthroughs in the field when it comes to "reading the mind" of so called neural Black Box AI's which include the ability to visualise decision trees, as well as use natural language to ask AI's clarifying questions, but despite these developments there is still a long way to go before these systems are robust and trustworthy enough to be incorporated into high risk and high stakes applications.

DEFINITION

Explainable AI is a set of tools and techniques that allow humans to comprehend, query, and thereby trust the outputs of AIs.

EXAMPLE USE CASES

As AI becomes more embedded into the digital fabric of society there are an increasing number of examples and reasons why it needs to be able to explain its actions and decisions, such as in the defense, healthcare, financial, legal, and transportation sectors especially, whether it's military personnel understanding AI target selections or doctors understanding the reasoning behind suggesting specific medical treatments, and many other examples.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the technology sector, with support from government funding and university grants. In time we will see the vast majority of both enterprise and consumer, private and public, AI's become embodied with this capability but with Explainable AI development and investment massively lagging behind conventional AI development it will be a while before researchers develop robust models and incorporate them into the majority of AI models.

While Explainable AI is in the early Productisation Stage at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

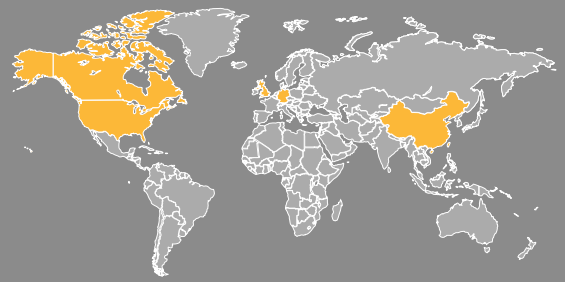
STARBURST APPEARANCES: '22, '23, '24

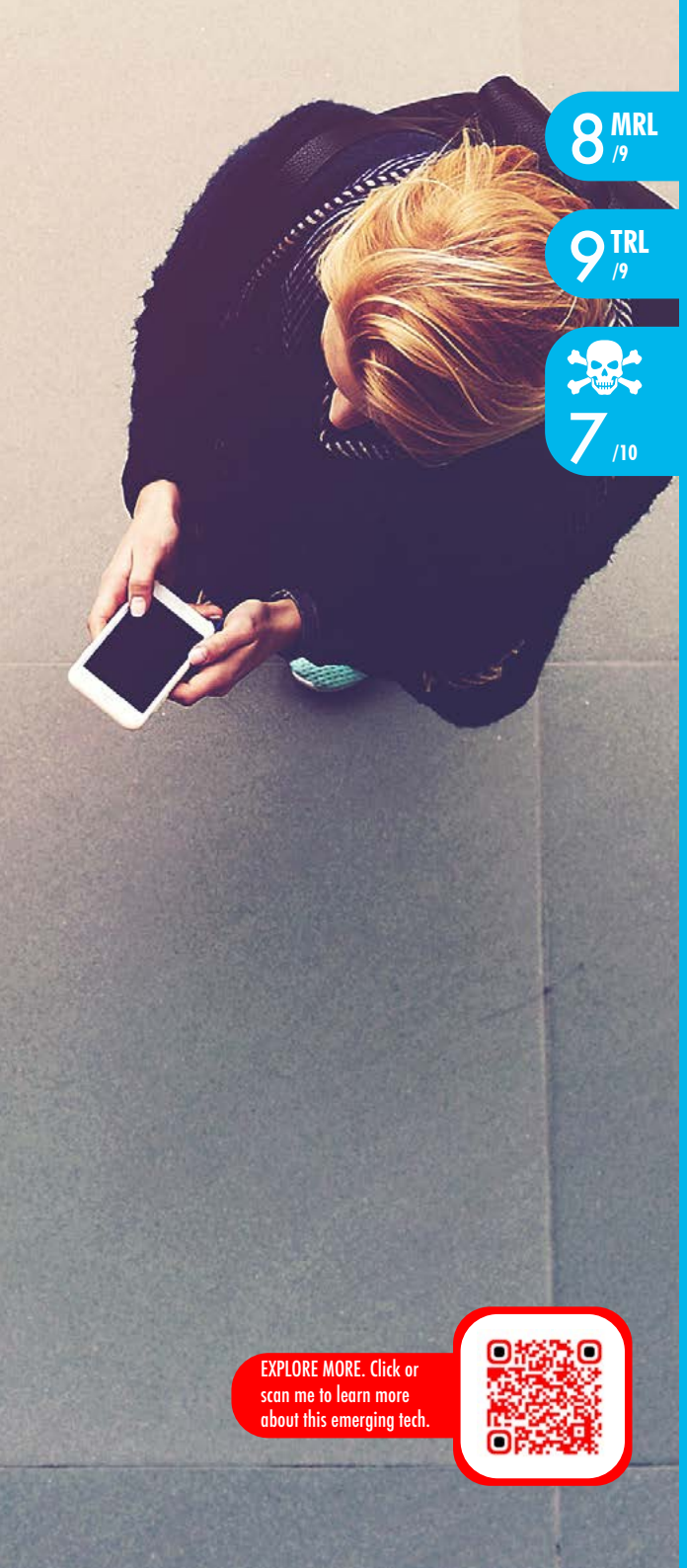
IMPACT

STATUS

Accessibility	4
Affordability	3
Competition	3
Demonstration	6
Desirability	9
Investment	4
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





8 MRL /9

9 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

FEDERATED ARTIFICIAL INTELLIGENCE

FEDERATED ARTIFICIAL INTELLIGENCE, which is in the Prototype Stage and early Productisation Stage, is the field of research concerned with finding new ways to train and develop Artificial Intelligence models without the need to rely on capturing and transporting vast volumes of data back to centralised cloud datacenters for processing, instead pushing those tasks to the devices at the edges of the network, which has the added benefit of not compromising user privacy, dramatically reducing network latency, and creating smarter models that consumers can leverage immediately. Currently one of the biggest issues that organisations developing Artificial Intelligence platforms have is capturing enough training data to train their models, and as a result this technology is potentially invaluable.

DEFINITION

Federated Artificial Intelligence allows disparate devices to collaboratively learn a shared prediction model while keeping all the training data on device, decoupling the need to store data in centralised data centers.

EXAMPLE USE CASES

Today we are using Federated Artificial Intelligence to learn about, and then improve, the usability of smartphones, and messaging systems. In the future the primary use case for this technology will be to use it to tap into the data and powerful devices at the edge of the network to create smarter models.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Technology sector. In time we will see this technology become one of the primary methods organisations use to train their models, and as the devices at the edge become more capable, powerful, and smart, whether those devices are drones and robots, smartphones or vehicles, and everything and anything in between, it is inevitable that they will assume more of the training workload.

While Federated Artificial intelligence is in the Prototype Stage and early Productisation Stage, over the long term it will be enhanced by advances in Artificial Narrow Intelligence, Artificial General Intelligence, Distributed Computing, Neural Processing Units, and Sensor Technology, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

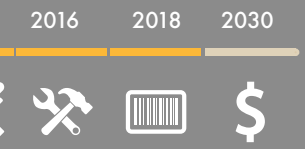
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19

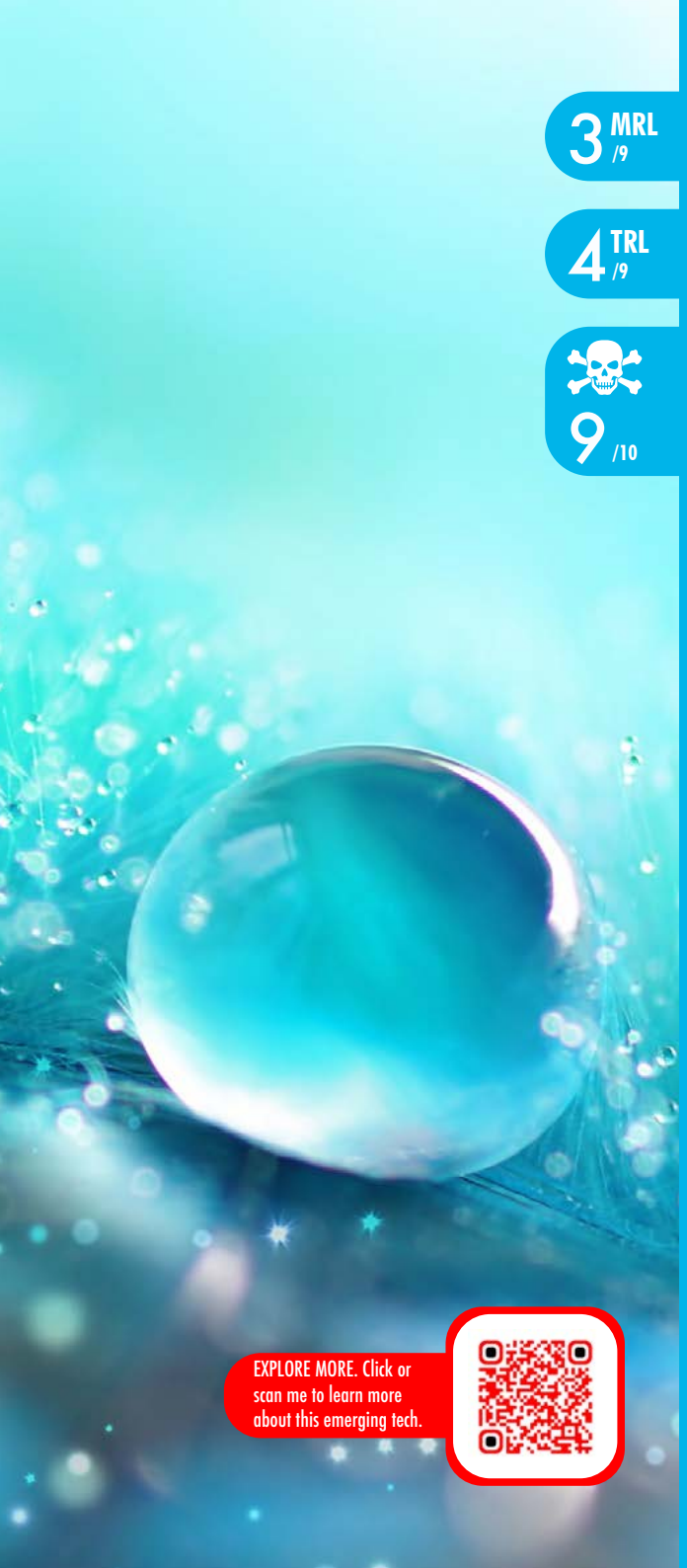
IMPACT

STATUS



Accessibility	7
Affordability	7
Competition	6
Demonstration	7
Desirability	8
Investment	4
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

4 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

LIQUID ARTIFICIAL INTELLIGENCE

LIQUID ARTIFICIAL INTELLIGENCE, a General Purpose Technology, which is in the Prototype Stage, is the field of research concerned with trying to develop liquid neural networks, which work in a similar way to the human brain, that can match or exceed the efficiency and performance of their more traditional Artificial Narrow Intelligence (ANI) counterparts. While this technology is very young recent breakthroughs include the development of the first Water-Ion based liquid AI's which were able to perform simple calculations and computations. As research across multiple complimentary "aqueous" technology fields progresses this will be an interesting technology to watch, but that said it has a significant way to go before it's productised.

DEFINITION

Liquid Artificial Intelligence is the use of aqueous liquids and their properties to perform neural network-like calculations and computations.

EXAMPLE USE CASES

While the future use cases of this technology could be diverse, from using it to perform healthcare related compute tasks within the human body, as well as any other kind of compute tasks in any manner of suitable aqueous solutions, its sweet spot is as yet are unclear. Given the trajectory of its development though and its similarity to biological intelligence there is a high likelihood that it could have extreme utility.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in this space accelerate, predominantly led by government grants. While the usefulness of this technology is without question the pace and trajectory of its future development will rely heavily on developments in other complimentary technology fields which could help or hinder its progress. As such it has a fuzzy future but an interesting one nonetheless.

While Liquid Artificial Intelligence is still in the Prototype Stage it could be enhanced by advances in other aqueous technology fields including Liquid Computing and Electronics, as well as 3D Bio-Printing, Organoids, Nanotechnology, Quantum Computing, Synthetic Biological Intelligence, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

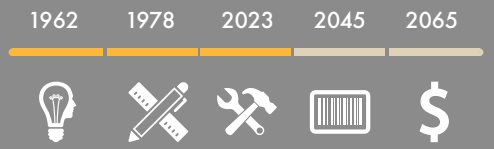
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

IMPACT

STATUS



Accessibility	2
Affordability	4
Competition	4
Demonstration	8
Desirability	9
Investment	2
Regulation	2
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

9 MRL /9

9 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

MACHINE VISION

MACHINE VISION, which is in the Mass Adoption Stage, is the area of research concerned with developing the systems and tools that allow machines to see and understand the world around them. Recently there have been numerous breakthroughs in the field thanks to dramatic advances in Artificial Intelligence, which now means that machines are increasingly adept at understanding, sensing, and interacting with the world around them. Whether it's autonomous vehicles, security, or robotics, and many other applications besides, arguably developing more advanced AI models has been the breakthrough the technology needed in order to really come to life and live up to its promise of not just helping machines see the world around them, but also interact with it in new and bold ways.

DEFINITION

Machine Vision harnesses Deep Learning algorithms to automatically analyse, interpret and inspect still images and streaming video.

EXAMPLE USE CASES

Today we are using Machine Vision across a wide range of areas, from using smartphones to diagnose cancers, and create better manufacturing and warehouse robots, to safer autonomous vehicles, and more capable surveillance systems capable of detecting criminal intent, and many more. In the future the primary use case of the technology will be as it is today, giving machines the ability to see, interpret and interact with the world around them in improved ways.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Defence and Technology sector, with support from government funding, and university grants. In time we will see the technology evolve to include the analysis of the entire electromagnetic spectrum, and see it combined with other sensing technologies that provide intelligent machines with even deeper insights into the world around them.

While Machine Vision is in the Mass Adoption Stage, over the long term it will be enhanced by advances in Artificial General Intelligence, CRISPR Gene Editing, Diffractive Neural Networks, Artificial Narrow Intelligence, Lensless Cameras, Optics, and Sensor technology, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

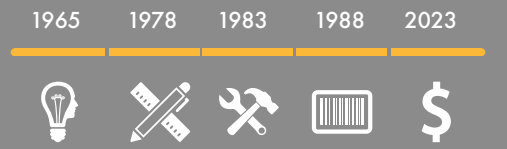
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

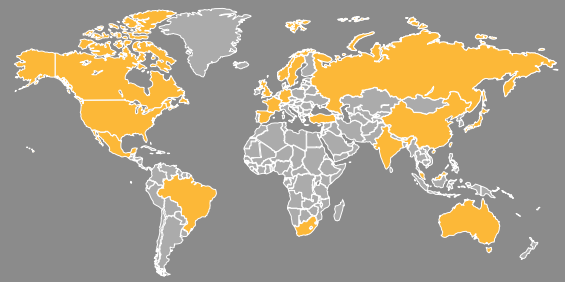
IMPACT

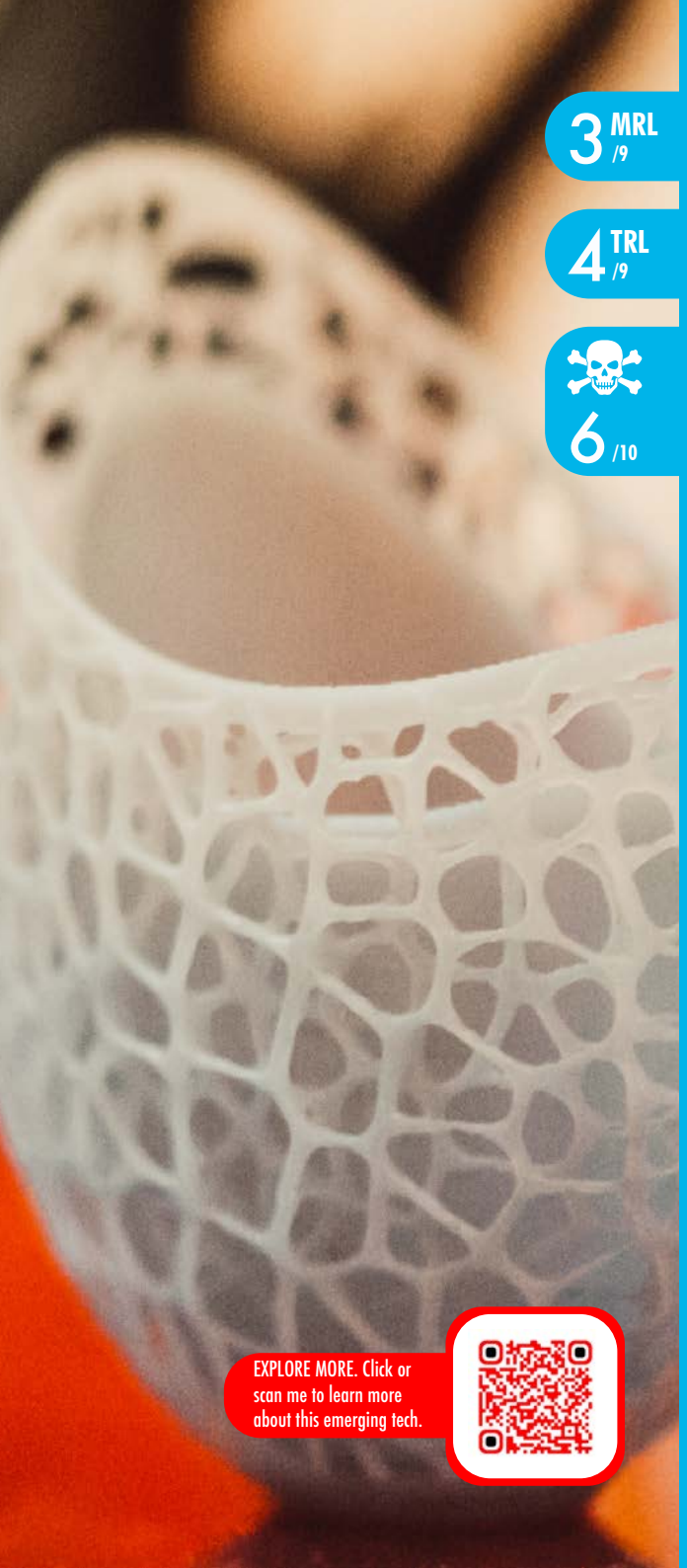
STATUS



Accessibility	9
Affordability	9
Competition	5
Demonstration	9
Desirability	9
Investment	8
Regulation	5
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





3 MRL /9

4 TRL /9

6 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

MECHANICAL ARTIFICIAL INTELLIGENCE

MECHANICAL ARTIFICIAL INTELLIGENCE, which is in the Prototype Stage, is the field of research concerned with developing physical forms of Artificial Intelligence (AI) that can be embedded into materials and objects to give them AI-like adaptable, reactive, and tunable properties. Recently there have been a few breakthroughs in the field including the development of a solid "Architected Material" by an algorithm whose entire structure resembles that of a neural network that can adapt its physical and mechanical properties according to the environment it's in and the stimulii it's subjected to. While this field is still young it potentially opens the door to an exciting class of new materials that could also compliment other classes of materials including Metamaterials and Reactive Materials.

DEFINITION

Mechanical Artificial Intelligence is the embodyment of neural network-like technologies and schema within the physical structures of materials and objects.

EXAMPLE USE CASES

Today the primary use cases for Mechanical Artificial Intelligence is in materials that have to adapt and react to different loads and stresses on the fly, such as aircraft airframes, but over the longer term it could also be used to develop new shape shifting materials and possibly smart materials.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate, albeit from a very low base, led by government grants. While the concept of Mechanical Artificial Intelligence is still young as we continue to see exponential advances across different technology categories this could be a dark horse technology to watch. It's potential could also be multiplied when combined with other technological advancements.

While Mechanical Artificial Intelligence is still in the early Prototype Stage over the longer term it could be enhanced by advances in AI including 3D and 4D Printing, Diffractive Neural Networks and DNA Neural Networks, Electronics, Energy, Materials, Metamaterials, Quantum Computing, Robotics, Sensors, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

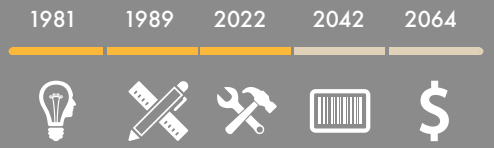
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23

IMPACT

STATUS



Accessibility	3
Affordability	5
Competition	5
Demonstration	5
Desirability	7
Investment	2
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

2 MRL /9

4 TRL /9

10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

META ARTIFICIAL INTELLIGENCE

META ARTIFICIAL INTELLIGENCE, which is in the Prototype Stage, is the field of research concerned with creating AI's that are capable of creating computers and computer-like resources that run within the same AI in simulation which themselves can then, in turn, run other AI's and code - thereby in effect creating a "multi-dimensional" software construct where, provided there is enough real world compute resource one single AI can run and "play host to" an infinite number of other AI's and compute-like systems within itself. Not only is this technology revolutionary but as AI's get better at designing and evolving their own code and programming it could spawn all manner of new compute and intelligence paradigms with almost limitless possibilities that today are difficult to comprehend.

DEFINITION

Meta Artificial Intelligence is the practise of creating computers and compute-like systems within virtual neural networks that can run code.

EXAMPLE USE CASES

Today this is a very nascent field but so far the AI's that have been able to create computers within themselves that have then, in turn, been able to run other AI's and code, have been used to split up incredibly complicated tasks, spread the workload among different virtual "AI Cores" and then re-combine them.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, primarily led by organisations in the technology sector, albeit from a very low base, with limited support from government funding and university grants. In time we could see Meta Artificial Intelligence become ubiquitous in much the same way that today "dumb" virtual servers that run on physical servers are ubiquitous in today's modern datacenters, except in this case the systems won't just be dumb they will be intelligent, self-designing, self-evolving, and self-improving at digital speed.

While Meta Artificial Intelligence is in the Prototype Stage, over the long term it will be enhanced by advances in Artificial Intelligence, Meta Computing, and Neuromorphic Computing, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

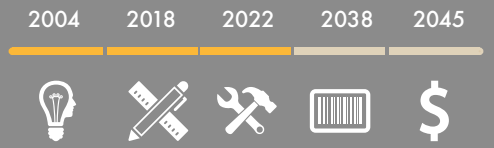
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it where possible, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23, '24

IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	2
Demonstration	7
Desirability	8
Investment	2
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

9 MRL /9

9 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

NATURAL LANGUAGE PROCESSING

NATURAL LANGUAGE PROCESSING, a GENERAL PURPOSE TECHNOLOGY, which is in the Mass Adoption Stage, is the field of research concerned with helping machines analyse and synthesise natural language, whether that language is in speech or written form. Recently there have been significant breakthroughs in the technology, including the ability for machines to translate between hundreds of different languages on the fly, as well as their ability to understand subtle variations in context and tone, as well as their ability to synthesise speech at such a high level it fools humans.

DEFINITION

Natural Language Processing is the application of computational techniques to the analysis and synthesis of natural language and speech.

EXAMPLE USE CASES

Today we are using Natural Language Processing in a number of ways including behavioural computing, natural language translation, speech to text and vice versa, and semantic analysis of literary works. In the future the primary uses of the technology will include breaking down translation barriers, enabling frictionless human-machine communication, and using AI to analyse and unlock the information contained within text and voice based content.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Defence and Technology sector, with support from government funding. In time we will see machines become increasingly adept at understanding natural human language, with their accuracy edging towards 100 percent in all fields, and they will become increasingly adept at communication with us in natural language that is imperceivable from a real person.

While Natural Language Processing is in the Mass Adoption Stage, over the long term it will be enhanced by advances in Artificial Intelligence, Behavioural Computing, Federated Artificial Intelligence, and Intelligence Processing Units, but at this point it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

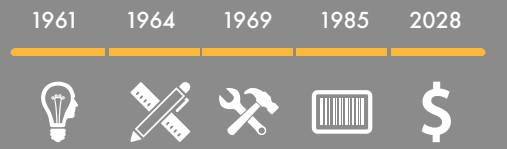
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19

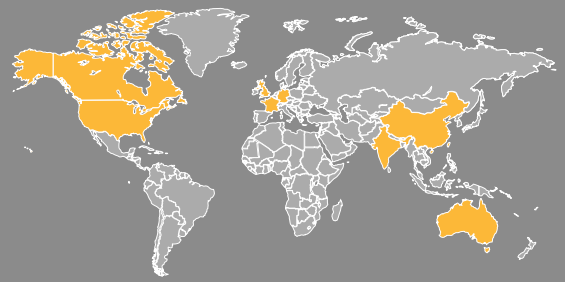
IMPACT

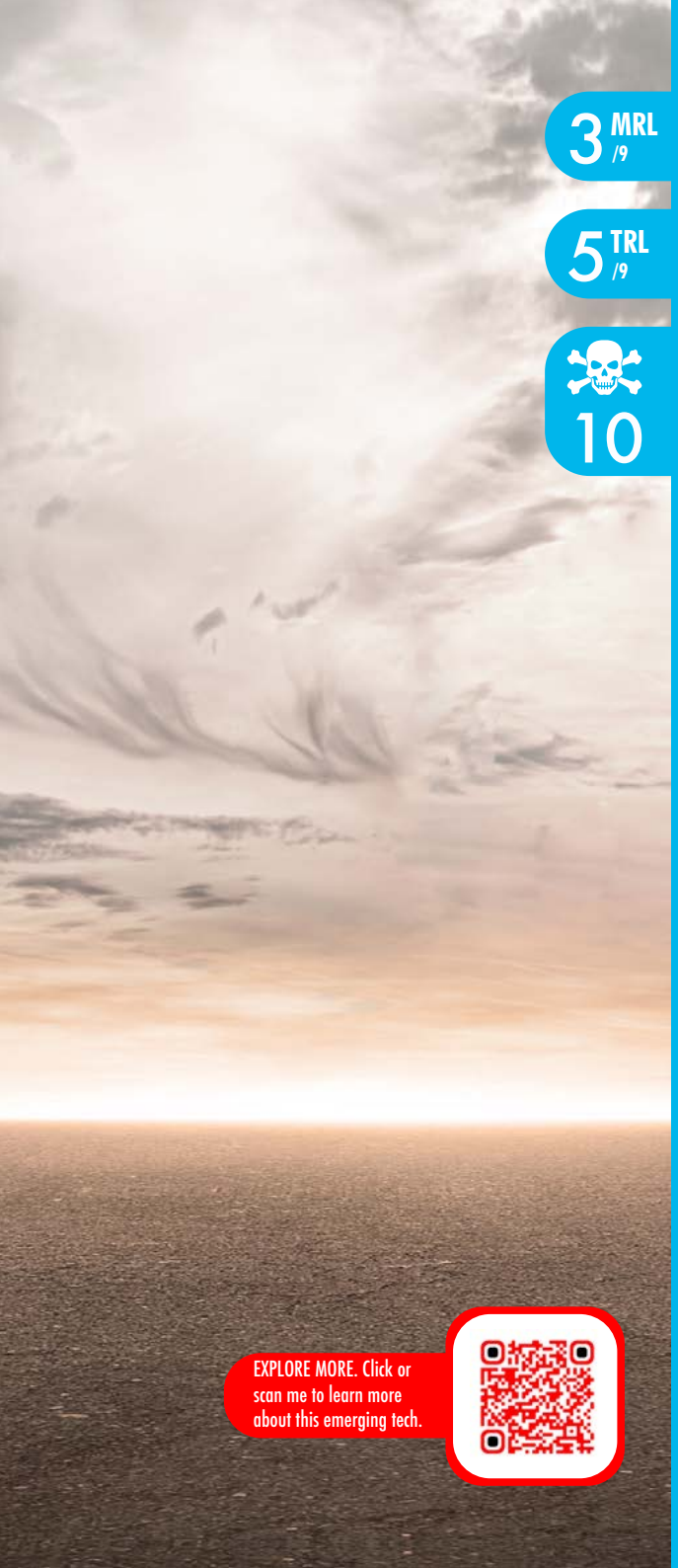
STATUS



Accessibility	9
Affordability	7
Competition	4
Demonstration	9
Desirability	9
Investment	8
Regulation	5
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





3 MRL /9

5 TRL /9

10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

OPEN ENDED AI

OPEN ENDED ARTIFICIAL INTELLIGENCE, which is in the Prototype Stage, is the area of research concerned with building a new form of AI's that are able to generate their own problems in order to discover new ways to solve them and thereby evolve to be more than the sum of their training or parts. Ultimately researchers want to imbue AI's with their own "critical skills and thinking" which, like humans, they can tap into to help them overcome and solve problems that they haven't encountered before or been specifically trained to solve. Recent breakthroughs include the use of simulated environments to give these AI's free reign to create their own problems and increase the complexity of tasks, and then find new ways to solve and overcome them, and so far the results have been ground breaking.

DEFINITION

Open Ended Artificial Intelligence is a form of autonomous AI that is capable of designing and then solving its own problems.

EXAMPLE USE CASES

Today Open Ended AI is still constrained, for the most part, to the labs, but it is already easy to see why an AI which can see, assess, and then find new ways to solve a myriad of problems both at global scale and potentially millions or even billions of times faster than humans can would be an advantage - whether it's in the cyber arena to find new ways to attack and defend systems, create new products, discover new medical treatments, or a billion other things. This is a technology whose uses are literally limitless.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Technology sector. Eventually these AI's will reach a point where they have the independent human-like ability to see, assess, and solve problems without needing training, which will bring about a new AI era and give regulators nightmares.

While Open Ended AI is in the Prototype Stage, over the long term it will be enhanced by advances in Artificial Intelligence, Artificial General Intelligence, Artificial Super intelligence, Containment Algorithms, Explainable AI, Evolutionary Robotics, Simulation Engines, as well as Compute and Intelligence, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

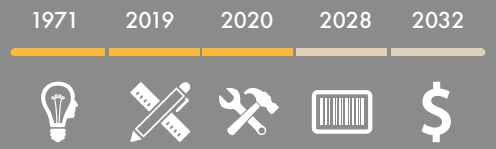
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '22, '23, '24

IMPACT

STATUS



Accessibility	6
Affordability	7
Competition	4
Demonstration	8
Desirability	9
Investment	7
Regulation	4
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

2 MRL /9

6 TRL /9

10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

QUANTUM ARTIFICIAL INTELLIGENCE

QUANTUM ARTIFICIAL INTELLIGENCE, a GENERAL PURPOSE TECHNOLOGY, which is in the Concept Stage and very early Prototype Stage, is the field of research concerned with trying to merge the power of Quantum Computers with the power of Machine Learning and Neural Networks. Recently there have been a number of breakthroughs using Quantum Simulators to develop the first generations of powerful Quantum AI algorithms that, when Quantum Computers become powerful enough, will let researchers run massive matrix analyses, and create an on ramp to create the world's first Artificial Super Intelligence machines.

DEFINITION

Quantum Artificial Intelligence is the marriage of traditional and new purpose built Artificial Intelligence methods and techniques with ultra-powerful Quantum Computers.

EXAMPLE USE CASES

Today we are using the first Quantum Artificial Intelligence prototypes to test the viability of new financial matrix and optimisation models, and refine them. In the future the primary use case for the technology will include any use case that is too large or complex for traditional computers to manage efficiently, including the processing of new cyber security models, drugs, financial risk models, optimisation models, and many more besides.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Financial Services and Technology sector, with support from government funding, and university grants. In time we will see more organisations develop and test Quantum AI, and while it will be some time before it becomes widely adopted it is likely that the sheer performance of the technology will help accelerate its adoption.

While Quantum Artificial Intelligence is in the Concept Stage and very early Prototype Stage, over the long term it will be enhanced by advances in Artificial Intelligence, Creative Machines, and Quantum Computers, but at this point in time it is not clear what will replace it.

MATTHEW'S RECOMMENDATION

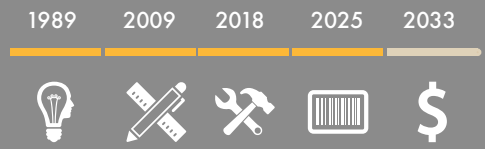
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23, '24

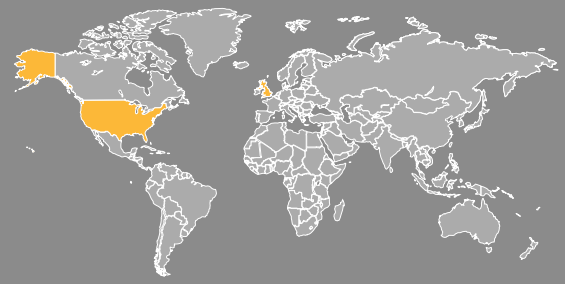
IMPACT

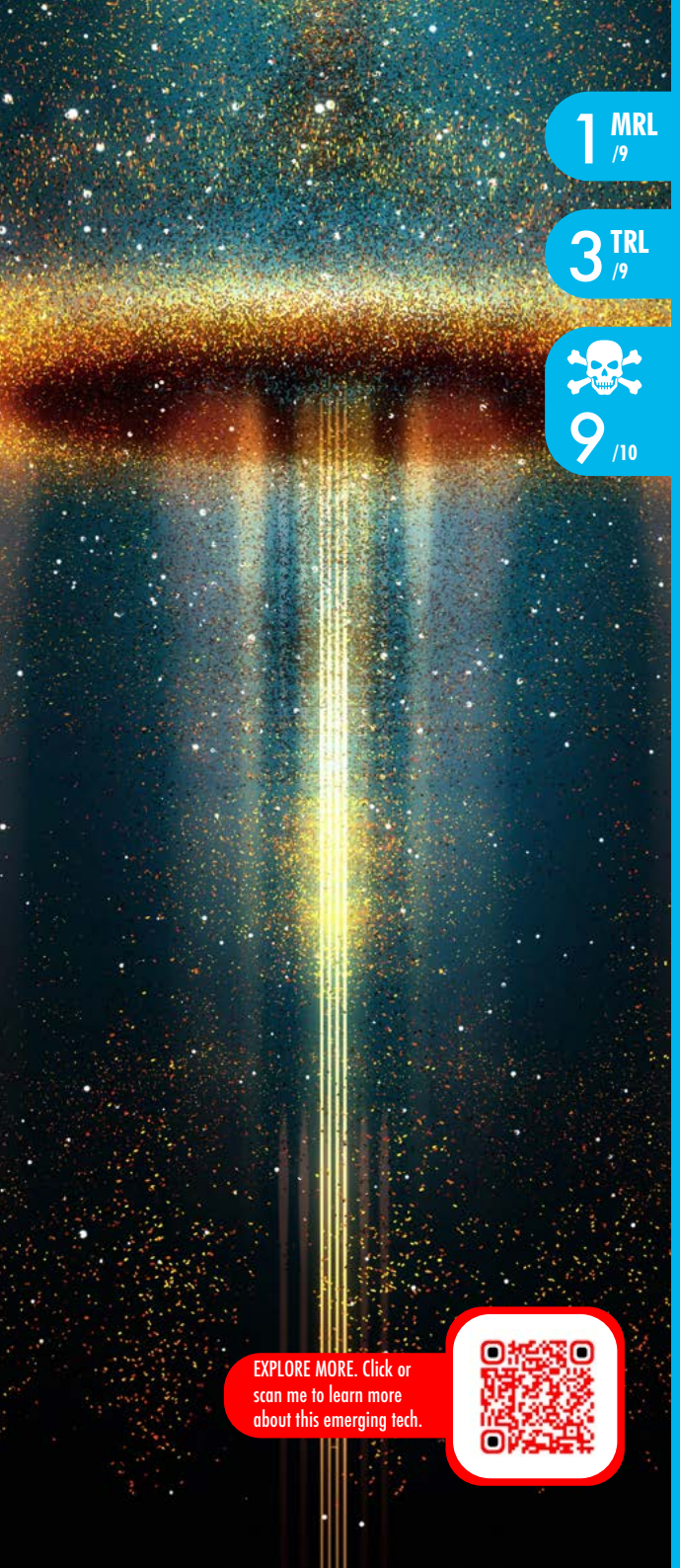
STATUS



Accessibility	6
Affordability	2
Competition	2
Demonstration	4
Desirability	9
Investment	3
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





1 MRL /9

3 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

QUANTUM LANGUAGE PROCESSING

QUANTUM LANGUAGE PROCESSING, which is in the Concept Stage, is the field of research concerned with using the vast power of Quantum Computers and Quantum Artificial Intelligence to create new and massive Natural Language Processing models that are so deep and vast that they are not only able to converse with anyone in any language on any topic but they can do it with genuine human-like emotions and behaviours. Recently researchers in the field have created first generation models which show the promise of the technology to be far superior to anything that the world's best bots, digital humans, and NLP models are able to produce.

DEFINITION

Quantum Language Processing is the use of Quantum Computers and Quantum AI to create emotional and sophisticated NLP models.

EXAMPLE USE CASES

Today researchers have been developing basic models using theory. In the future though the power of quantum computers, which are hundreds of millions of times more powerful that today's computer systems, will be able to let AI have natural language conversations at massive scale in parallel that are indistinguishable from human conversations - including their emotional context, intonation, and tone.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Technology sector. In time we will see the space mature to the point where it becomes the defacto technology and conversational Human-Machine interface which will then, naturally, lead to questions concerning privacy and its influence and role on society, especially as it will also help improve the quality of Synthetic Content.

While Quantum Language Processing is in the Concept Stage, over the long term it will be enhanced by advances in Natural Language Processing, Quantum Artificial intelligence, Quantum Computing, Shallow Neural Networks, as well as Compute, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

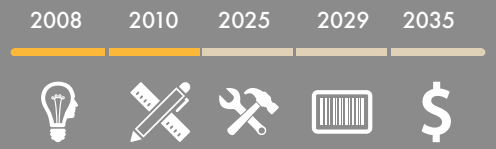
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and re-visit it every few years until progress in this space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '21

IMPACT

STATUS



Accessibility	4
Affordability	4
Competition	3
Demonstration	6
Desirability	9
Investment	6
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

5 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SHALLOW NEURAL NETWORKS

SHALLOW NEURAL NETWORKS, which are in the Prototype Stage, is the field of research concerned with trying to create functional, small, and lean Artificial Intelligence (AI) models that are able to perform their tasks using minimal compute, memory, and network resources. Recently there have been a number of developments in the field including the development of biologically inspired AI models that are able to control and drive autonomous cars using neural networks that have only 19 neurons. While there are many research directions being explored at the moment it is not lost on researchers that biological organisms, unlike their modern AI equivalents, are often able to perform very complex tasks with minimal brain power or energy consumption. Also, when coupled with new AI and Neural Processing Units at the edges of the network the use cases and potential of the technology multiplies.

DEFINITION

Shallow Neural Networks are neural networks that only have one, or a very small number, of hidden layers.

EXAMPLE USE CASES

Today Shallow Neural Networks are being used at the edge of the networks to perform Deep Learning tasks such as processing different sensory inputs, including imagery and environmental data, which can then be analysed and actioned instantaneously without having to use or rely on networks or datacenters. The technology's potential is almost limitless and in the future use cases will span every sector, from enabling Implanted Medical Devices and healthcare diagnostic tools to monitor patient well being and enable interventions when needed, all the way through to being used for entertainment purposes to create, for example, Synthetic Content.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Defence, and Technology sectors. In time we will see Shallow Neural Networks embedded at the edge of every network and become ubiquitous, and regulators will have to work hard to understand the implications of AI everywhere.

While Shallow Neural Networks are in the Prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence, as well as Compute, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

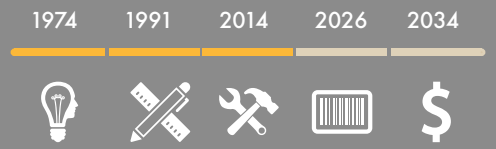
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and re-visit it every few years until progress in this space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '22, '23, '24

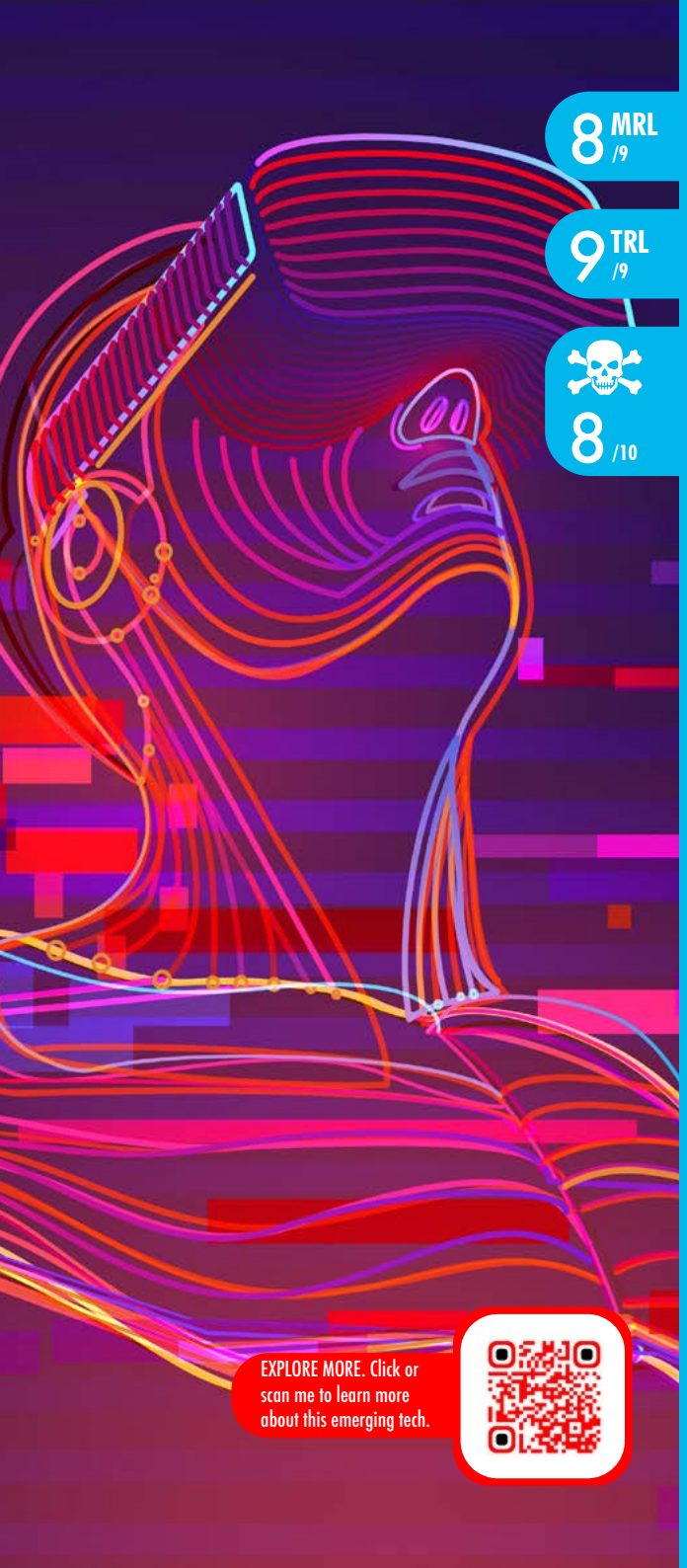
IMPACT

STATUS



Accessibility	4
Affordability	6
Competition	4
Demonstration	7
Desirability	9
Investment	6
Regulation	2
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



SIMULATION ENGINES

SIMULATION ENGINES, a GENERAL PURPOSE TECHNOLOGY, which is in the Productisation Stage, is the field of research concerned with finding new ways to develop better and more realistic simulations, cheaper and faster, which can then be used for a variety of use cases. recently there have been a number of breakthroughs in the space with the development of new Virtual Reality simulation engines that allow machines to render virtual worlds in real time, and dramatic improvements in the reality, both scientific and visual, of those environments.

DEFINITION

Simulation Engines are virtual platforms capable of dynamically modelling environments and events at high speed to accelerate learning and the development of new products.

EXAMPLE USE CASES

Today we are using Simulation Engines in a myriad of ways, including as an aid to Creative Machines, and using them to take sensor feedback from products in order to create better products, as well as using them as a primary way to develop safer autonomous vehicles and more dexterous robots, and run the first Quantum Artificial Intelligence simulations. In the future the primary use case of the technology will be to create highly engaging and interactive education and training programs, and act as a platform that allows researchers to speed up the training of AI models by factors of millions.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at a highly accelerated rate, primarily led by organisations in the Aerospace, Defence, Entertainment, Technology and Transport sectors. In time, as machines learn more about the dynamics and the physics of our world, they will take on more of the load and responsibility of designing and rendering simulated environments, similarly over time the technology will be enhanced by advances in Neural Interfaces which will allow humans and machines render and interact with simulations and immersive worlds in real time.

While Simulation Engines are in the Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Creative Machines, Neural Interfaces, and UHD Rendering Engines, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

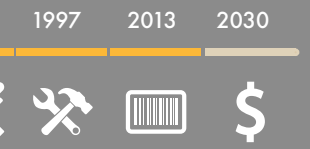
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23, '24

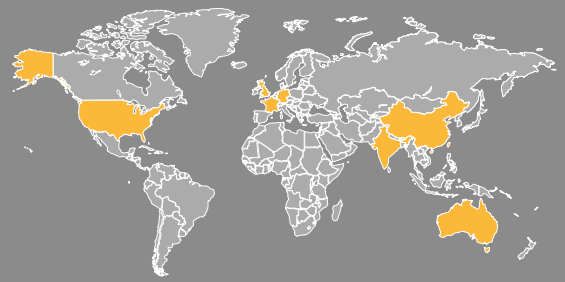
IMPACT

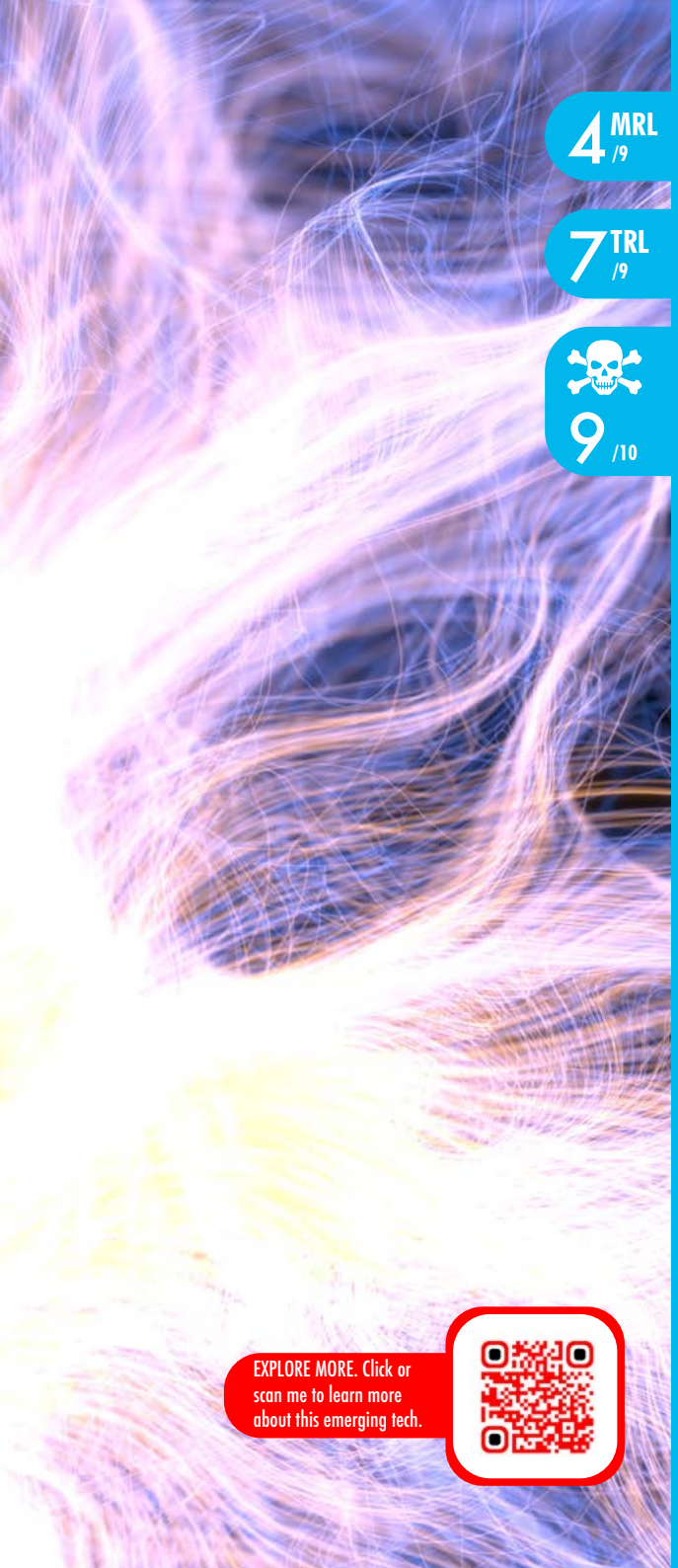
STATUS



Accessibility	8
Affordability	4
Competition	5
Demonstration	9
Desirability	9
Investment	6
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





4 MRL /9

7 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SWARM ARTIFICIAL INTELLIGENCE

SWARM ARTIFICIAL INTELLIGENCE, which is in the Prototype Stage, is the field of research concerned with developing new ways for different collections of entities, such as Nano-Machines and robots, to intelligently collaborate and work together to achieve specific tasks. Recently there have been a number of breakthroughs in the field, especially with regards to how robots are able to manage and organise themselves and combine their capabilities to accomplish set goals, as well as helping control the collective behaviours of different Artificial Intelligence programs, which reduces the risk of their going rogue.

DEFINITION

Swarm Intelligence is the influence of collective behavioural traits and ethics in a decentralised, self organising natural or artificial system to sway collective behaviours and outcomes.

EXAMPLE USE CASES

Today we are using Swarm Artificial Intelligence to create the first generations of robots that are capable of coming together and organising themselves to accomplish specific goals. in the future the primary use of this technology will be to create better cyber security solutions, coordinate Nano-Machines within the human body, and create robot swarms capable of accomplishing a myriad of tasks.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Technology sector, with support from government funding, and university grants. In time we will see the technology reach a point where machines are able to collaborate and coordinate with one another without the input of humans in order to achieve a myriad of goals.

While Swarm Artificial Intelligence is in the Prototype Stage, over the long term it will be enhanced by advances in Artificial Intelligence, Creative Machines, Nano-Machines, Neurobiotics, and Robotics, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

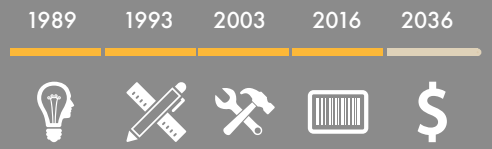
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

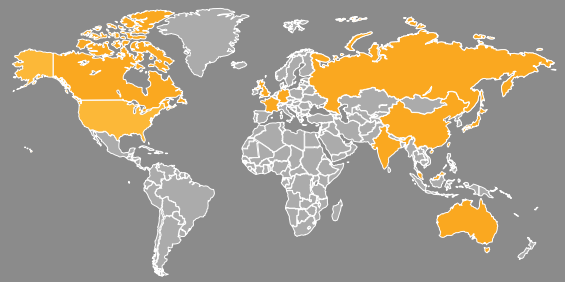
IMPACT

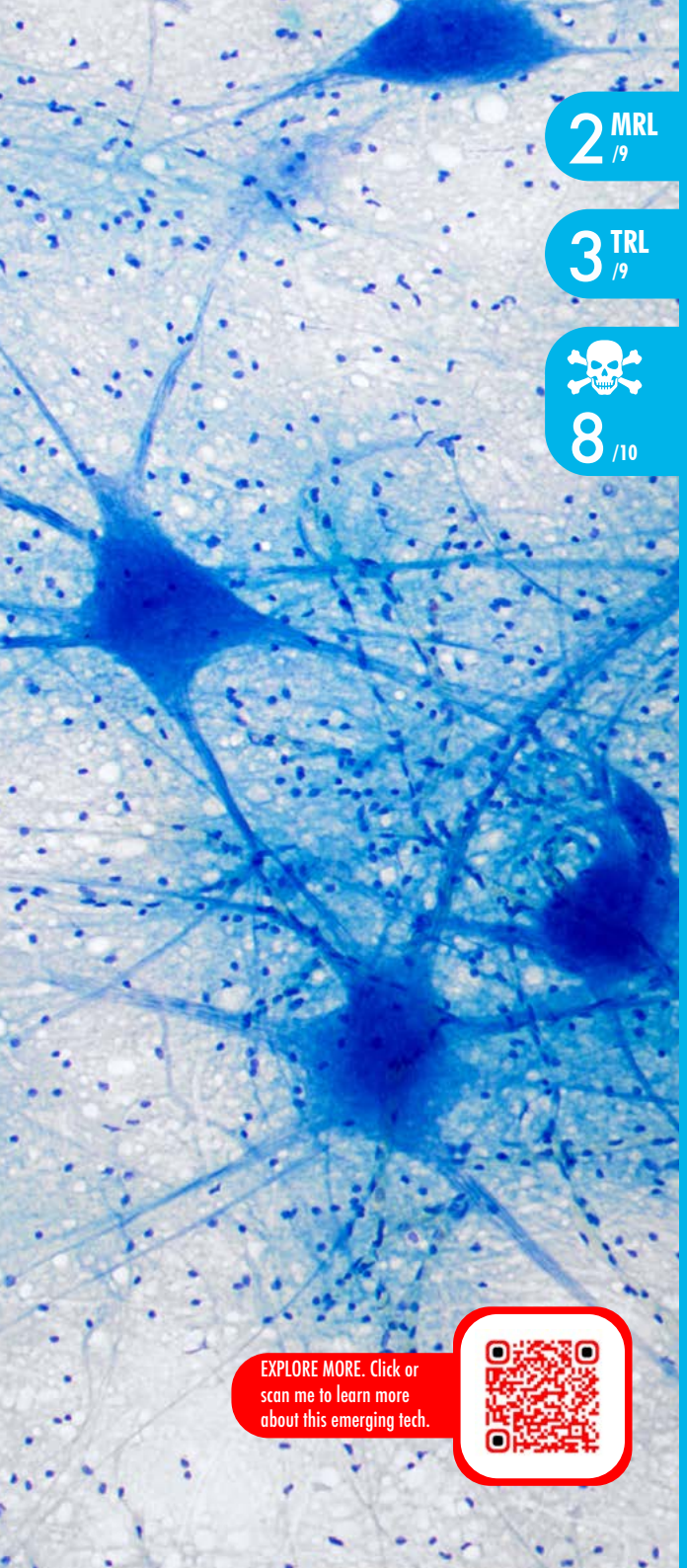
STATUS



Accessibility	5
Affordability	4
Competition	4
Demonstration	7
Desirability	8
Investment	5
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





2 MRL /9

3 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SYNTHETIC BIOLOGICAL INTELLIGENCE

SYNTHETIC BIOLOGICAL INTELLIGENCE, a General Purpose Technology, which is in the early Prototype Stage, is the field of research concerned with developing new forms and systems of intelligence that are purely biological in nature. Today humans are considered the pinnacle of biological intelligence and Artificial Intelligence (AI) is considered to be the "pinnacle" of machine intelligence. Synthetic Biological Intelligence therefore is the development of new organic and biological forms of intelligence that are non-human and exist in different distinct formats and systems. Recent breakthroughs include researchers growing Brain Organoids - in dishes and jars - whose synapses and biological structures self-organised and "acquired" intelligence, such as the ability to play and win different games including Pong. Furthermore, in many cases, these new classes of biological intelligence have outperformed equivalent machine AI's which is mind boggling in itself.

DEFINITION

Synthetic Biological Intelligence is the development of biological entities and systems capable of demonstrating intelligence, by whatever means, in their own right.

EXAMPLE USE CASES

While Biological Artificial Intelligence is still a nascent field it could one day be an incredibly powerful new form of so called "Wet Intelligence," and given its properties therte's no reason to believe that like traditional AI it couldn't could be used almost anywhere and in any use case.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate, predominantly led by government grants. The thought of being able to develop biological intelligences that have capabilities superior to our own which can be transplanted at will into any system anywhere is incredibly attractive to some. But the technology still has a long way to go so it will be decades before it commercialises, then there will be the fractious ethical and regulatory hurdles it will have to overcome ...

While Synthetic Biological Intelligence is in the early Prototype Stage over the longer term it could be enhanced by advances in 3D and 4D Bio-Printing, AI, Artificial Body Parts, Biological Computing and Electronics, DNA Neural Networks, Organic Computing, Organoids, Quantum Computing, Synthetic DNA, and other technologies, however over the long term it's unclear what it could be superceeded by.

MATTHEW'S RECOMMENDATION

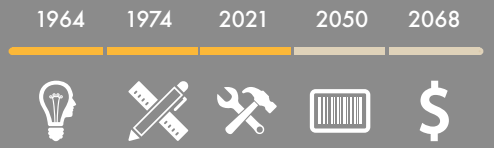
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23, '24

IMPACT

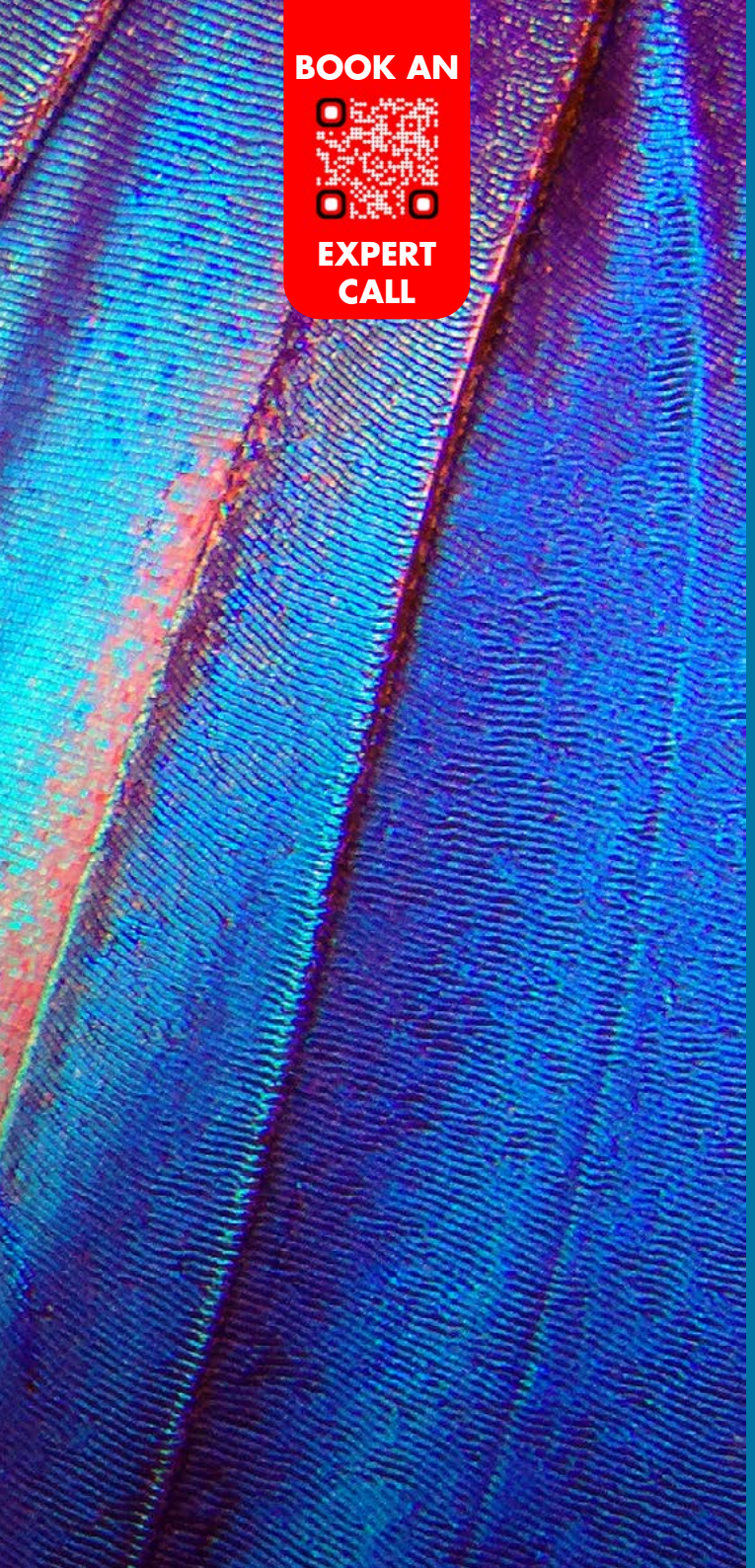
STATUS



Accessibility	3
Affordability	3
Competition	8
Demonstration	6
Desirability	9
Investment	3
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

MATERIALS



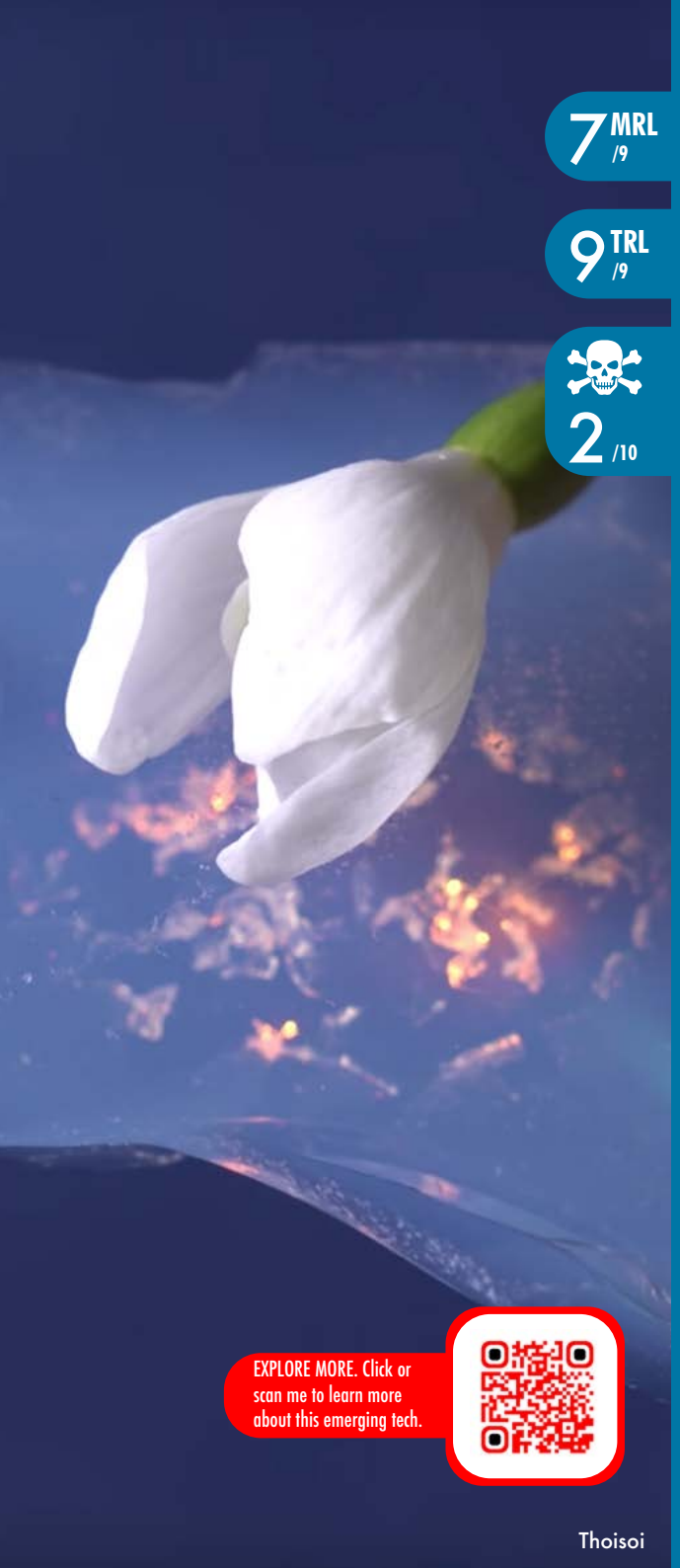
EVERYTHING IN the universe is made from something, whether it's Dark Matter and vacuums, or the smartphones and devices in our hands, but as we continue to develop new materials that have increasingly intelligent and sophisticated characteristics we radically change the type of products we can design and create. The result of which means that we are increasingly able to create everything from invisibility cloaks to polymorphic robots, and let our trains of thought run free - thoughts that the first telepathic materials can amplify and merge with others. And we're only just getting started with the material weirdness ...

In this section you will find details of the emerging technologies that made it into this years Griffin Emerging Technology Starburst along with details of other impactful emerging technologies:

1. Aerogels
2. Atomic Knots
3. Auto-Cannabalistic Materials
4. Bio-Active Materials
5. Bio-Genic Materials
6. Bio-Materials
7. Bio-Mineralisation
8. Carbon Nanotubes
9. Chromogenic Materials
10. Digital Metamaterials
11. Electrocaloric Materials
12. Flexible Ceramics
13. Graphene
14. Infinitely Recyclable Plastics
15. Kinetic Materials
16. Living Materials
17. Magneto Restrictive Materials
18. Matter Creation
19. Mega Magnets
20. Meta-Optics
21. Metal Organic Frameworks
22. Metamaterials
23. Nano-Materials
24. Plasmonic Paints
25. Polymers
26. Polymorphic Liquid Metals
27. Programmable Matter
28. Quantum Materials
29. Re-Programmable Inks
30. Reactive Materials
31. Room Temperature Superconductors
32. Self-Healing Materials
33. Smart Materials
34. Sono-Inks
35. Spray On Materials
36. Super Alloys
37. Synthetic Diamonds
38. Telekinetic Metamaterials
39. Telepathic Metamaterials
40. Time Crystals
41. Vascularised Nanocomposites

In addition to these emerging technologies there are many others that have yet to get an entry in this codex. These include, but are not limited to:

42. 2D Materials
43. 3D Printed Materials
44. Architectural Materials
45. Artificial Atoms
46. Bio-Ceramics
47. Bio-Compatible Materials
48. Bio-Glass
49. Bio-Inks
50. Bio-Plastics
51. Biodegradable Polymers
52. Carbon Fixing Materials
53. Designer Nanocrystals
54. Digital Materials
55. Electrochromic Materials
56. Embedded Logic Materials
57. Hybrid Particles
58. Hydrogels
59. Lavacrete
60. Liquid Armour
61. Liquid Light
62. Liquid Magnets
63. Liquid Metals
64. Living Metals
65. Magnetostrictive Materials
66. Metal Foam
67. Metallic Hydrogen
68. Nano-Ceramics
69. Nano-Photonic Materials
70. Optomechanics
71. Phase Change Materials
72. Polymetallic Complexes
73. Quantum Dots
74. Reprogrammable Materials
75. Semi-Conductors
76. Shape Changing Materials
77. Shape Memory Alloys
78. Sound Membranes
79. Stone Paper
80. Superfluids
81. Synthetic Materials
82. Thermo Bimetals
83. Thermoelectric Materials
84. Thermoplastic Polyurethane



7 MRL /9

9 TRL /9

2 /10

AEROGELS

AEROGELS, which are in the Prototype Stage and Productisation Stage, is the field of research concerned with developing lighter than air materials that have a range of interesting, and sometimes exceptional, characteristics. Recently there have been several breakthroughs in the field including the use of 3D Printing and Graphene to create new Aerogel materials that are 99 percent lighter than steel, but at the same time 10 times stronger, as well the development of new Aerogels with amazing thermal characteristics that can insulate people from extremely cold temperatures down to -60 Celsius.

DEFINITION

Aerogels are synthetic, porous, ultralight gel like materials with extremely low density and an exceptional range of customisable properties.

EXAMPLE USE CASES

Today we are using Aerogels to create clothing that keeps people warm in temperatures of -50 Celsius, and Aerogels that protect assets from temperatures in excess of 2000 Celsius. In the future the primary use cases for Aerogels will be to create products that have incredibly high strength to weight ratios, with the added bonus of exceptional thermal performance, whether or not it is needed.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace and Manufacturing sector, with support from government funding, and university grants. In time we will see advanced manufacturing technologies, such as 3D Printing, let researchers combine different materials together in new and unique ways, and in new structural formations that make Aerogels even more performant than they are today.

While Aerogels are in the Prototype Stage and Productisation stage, over the long term it will be enhanced by advances in Artificial Intelligence, 3D Printing, Carbon Nanotubes, Creative Machines, and Graphene, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

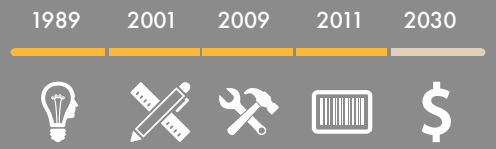
Thoisoi

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '19, '20, '21, '22, '23, '24

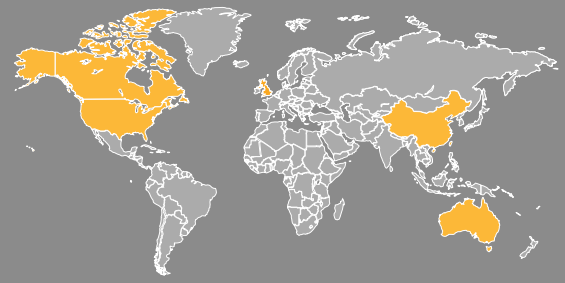
IMPACT

STATUS



Accessibility	8
Affordability	8
Competition	2
Demonstration	9
Desirability	8
Investment	6
Regulation	2
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



7 MRL /9

8 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ATOMIC KNOTS

ATOMIC KNOTS, which are in the Productisation Stage, is the field of research concerned with trying to create super dense materials that exhibit a wide range of exceptional characteristics, such as elasticity, shock absorbency, and strength, by finding new ways to create incredibly compact and knotted molecular structures that, according to scientists, are the equivalent to molecular chain mail. Recently there have been a number of breakthroughs in the field, especially in the field of chemical engineering, that have allowed researchers to create ultra thin and lightweight spray on materials that are bomb proof and shock proof.

DEFINITION

Atomic Knots are tight, complex molecular structures manufactured using chemical synthesis that can be used to create incredibly dense materials with a range of special properties.

EXAMPLE USE CASES

Today we are using Atomic Knots to create new types of body armour, spray on materials that protect buildings and other structures from bombs, and protect cars from being damaged even if they're hit with sledge hammers. In the future the primary use cases of this technology will be to protect assets from extreme impacts.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace and Manufacturing sectors, with support from government funding, and university grants. In time we will see the technology continue to accelerate as researchers find new ways to create even more super dense knot structures which will only serve to increase the usability and attractiveness of these materials to consumers.

While Atomic Knots are in the Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence, 3D Printing, Creative Machines, Molecular Assemblers, Nano-Manufacturing, and Polymers, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

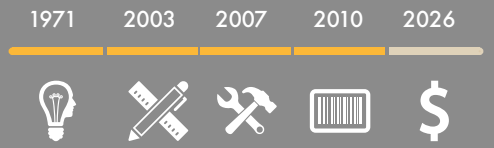
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '19, '20, '21, '22, '23

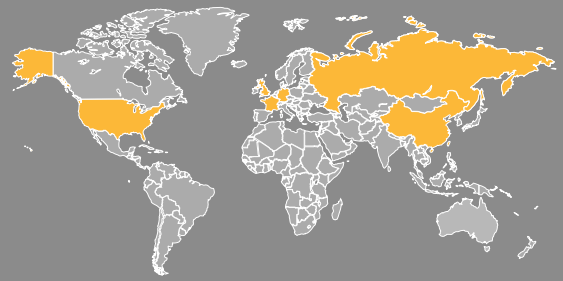
IMPACT

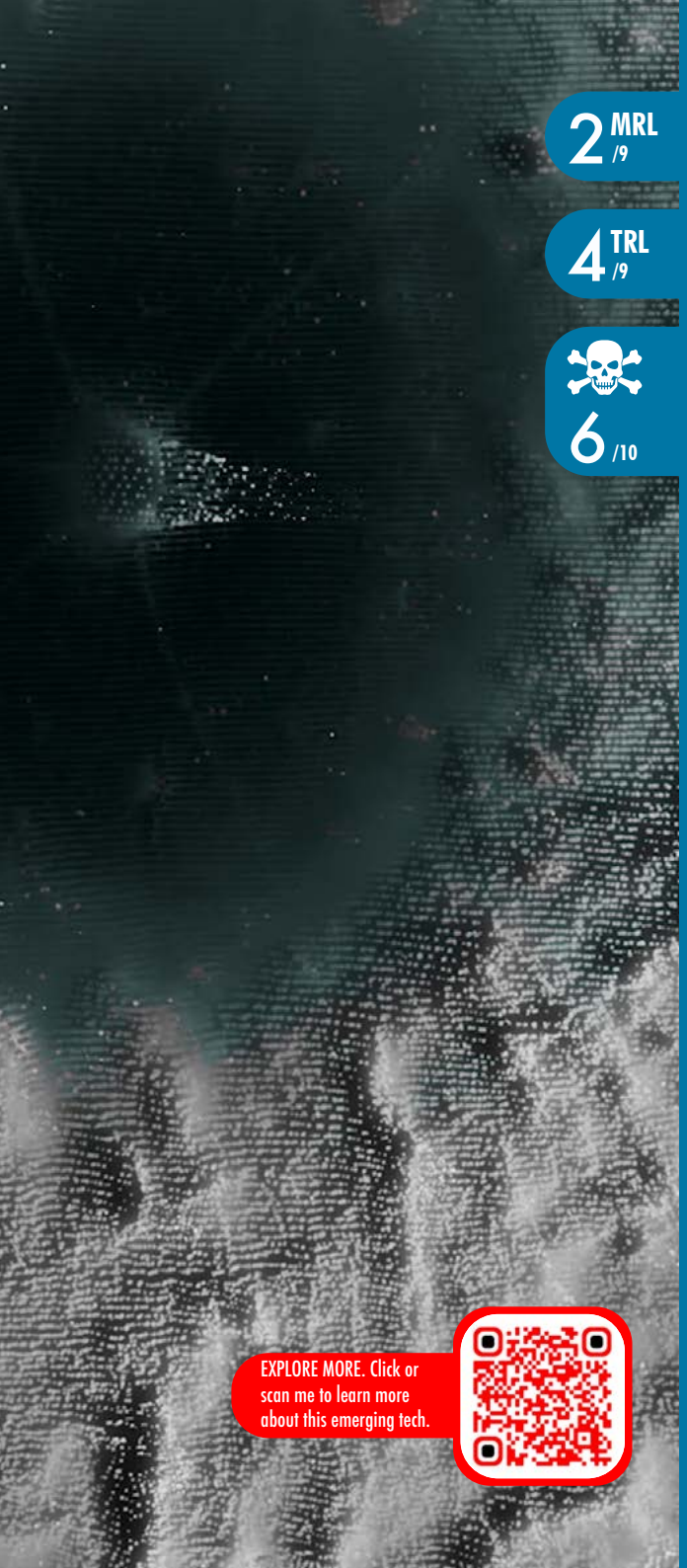
STATUS



Accessibility	7
Affordability	5
Competition	2
Demonstration	8
Desirability	8
Investment	3
Regulation	2
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





2 MRL /9

4 TRL /9

6 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

AUTO-CANNABALISTIC MATERIALS

AUTO-CANNIBALISTIC Materials, which are in the Prototype Stage, is the field of research concerned with developing new ways to create materials that can change shape and re-configure themselves on demand in response to specific events or stimulii. Recently there have been several breakthroughs in the field with the development of some of the first materials that are capable of automatically re-configuring their matrices and structures in order to form new matrices and structures.

DEFINITION

Auto-Cannabalistic Materials are materials that cannibalise themselves in order to create new shapes and structures.

EXAMPLE USE CASES

Today we are using small scale prototypes to prove the theory behind the technology and refine it. In the future the primary use case of this technology will be almost unlimited as organisations use it as a pathway to create fully self-configurable and re-configurable constructs and products.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by univesity grants. In time we will see the technology mature to the point where it becomes commercialised and viable to use in a wide variety of applications, and given the nature of the technology I would expect the regulatory oversight to be minimal which would accelerate its time to market.

While Auto-Cannabalistic Materials are in the Prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence, DNA Robots, Molecular Robots, Nanobots, Nano-Machines, and Quantum Computing, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

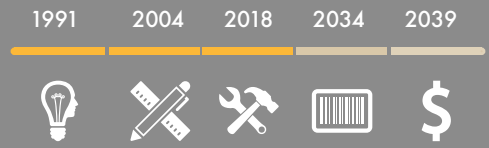
In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '22, '23, '24

IMPACT

STATUS



Accessibility	2
Affordability	4
Competition	3
Demonstration	3
Desirability	8
Investment	1
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

9 MRL /9

9 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

BIO-ACTIVE MATERIALS

BIO-ACTIVE MATERIALS, which are in the Mass Adoption Stage is the field of research concerned with developing materials that stimulate a biological response from the human body or more broadly from living organisms. Prepared using materials such as Ceramics, Hydrogels, metals, Nanoparticles, Polymers, and with many different forms including fibers, films, foams, and gels, Bio-Active Materials have a range of forms and functions. Even though this is a decades old field though as we continue to see developments across multiple technology areas it would be easy to say that the field's still just getting started with recent breakthroughs including the addition of stem cells into materials which, when implanted into the cavities in teeth grow the patients teeth back. There have also seen advances in the fields of bio-active cements, ceramics, composites, food stuffs, and many more.

DEFINITION

Bio-Active Materials are substances that have been engineered to interact with biological systems to produce a specific and predictable reaction.

EXAMPLE USE CASES

Today Bio-Active Materials are used in everything from bone repair, as is the case with Bio-Active Glass, all the way through to the use of anti-bacterial materials in the healthcare sector. The fastest growing segments though include the personal care sector and the animal and human food sectors where bio-active ingredients including amino acids, antioxidants, probiotics, and various minerals and vitamins are increasingly being used in a multitude of products.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in the field accelerate, predominantly led by the healthcare sector. As organisations increase their investment in the sector it's inevitable that the number of products in this category will grow and that they will become increasingly popular, however as the capabilities of the technologies that support this field improve there's no doubt that regulators will find it more challenging to quantify the risks around it.

While Bio-Active Materials are in the Mass Adoption Stage over the longer term they could be enhanced by advances in 3D and 4D Bio-Printing, AI, Bio-Manufacturing, and other technologies, however over the long term it's unclear what they could be superseded by.

MATTHEW'S RECOMMENDATION

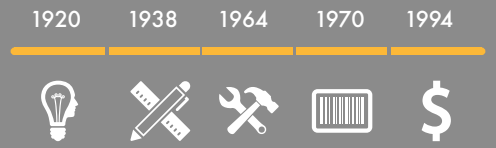
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

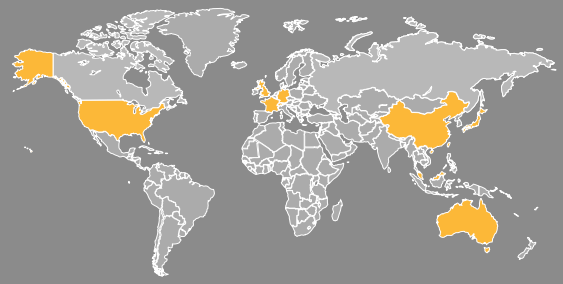
IMPACT

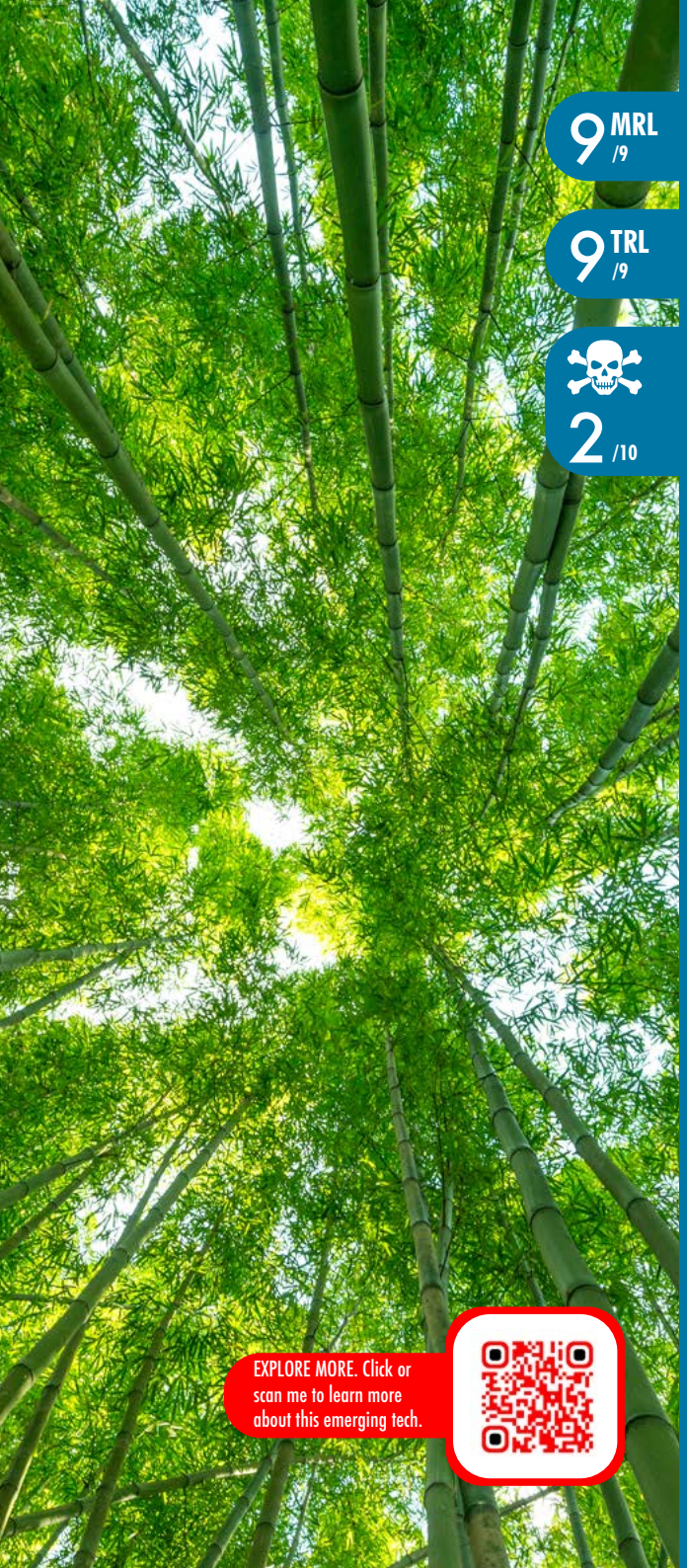
STATUS



Accessibility	7
Affordability	7
Competition	4
Demonstration	9
Desirability	8
Investment	6
Regulation	7
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS





BIO-GENIC MATERIALS

BIOGENIC MATERIALS, which are in the Commercialisation Stage, is the field of research concerned with developing new materials that originate from living organisms. Recently there have been a number of breakthroughs in this field, including the development of a variety of biogenic materials that are now starting to make their mark in the construction industry such as Bamboo, Bio-Resins, carbon negative concrete, cellulose glazing, Hempcrete, Kelp fibers, Mycelium finishes, transparent wood, and many others.

DEFINITION

Bio-Genic Materials are materials derived from living organisms that have numerous applications.

EXAMPLE USE CASES

As the number of biogenic materials that are commercially available continues to grow, as their costs drop, and as the Circular Economy gains prominence the majority of use cases for this technology at the moment are in the green construction industry. However, while that is the dominant market at the moment these materials are also finding their way into everything from clothing to packaging and as their availability and utility improves so too will their chances of making inroads into new use cases.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Biogenic Materials grow, predominantly driven by the Construction and Fashion sectors. The increasing use of these materials is testament to organisations growing need to be sustainable, and bearing in mind that many of these materials are biodegradable, carbon negative, as well as renewable it's no wonder that so many organisations are trying to incorporate them into their finished products, with the result being that this is a growing industry with a long life span.

While Biogenic Materials are still in the Commercialisation Stage it could be enhanced by advances in Bio-Manufacturing, Synthetic Biology, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

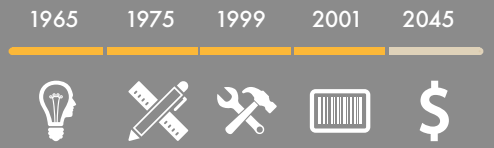
In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

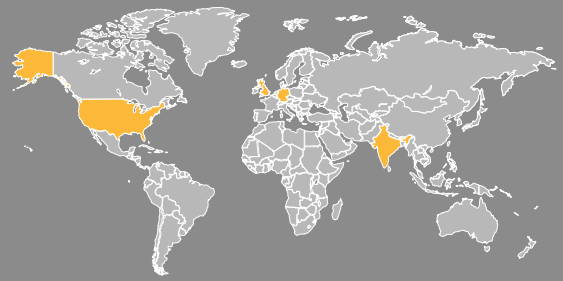
IMPACT

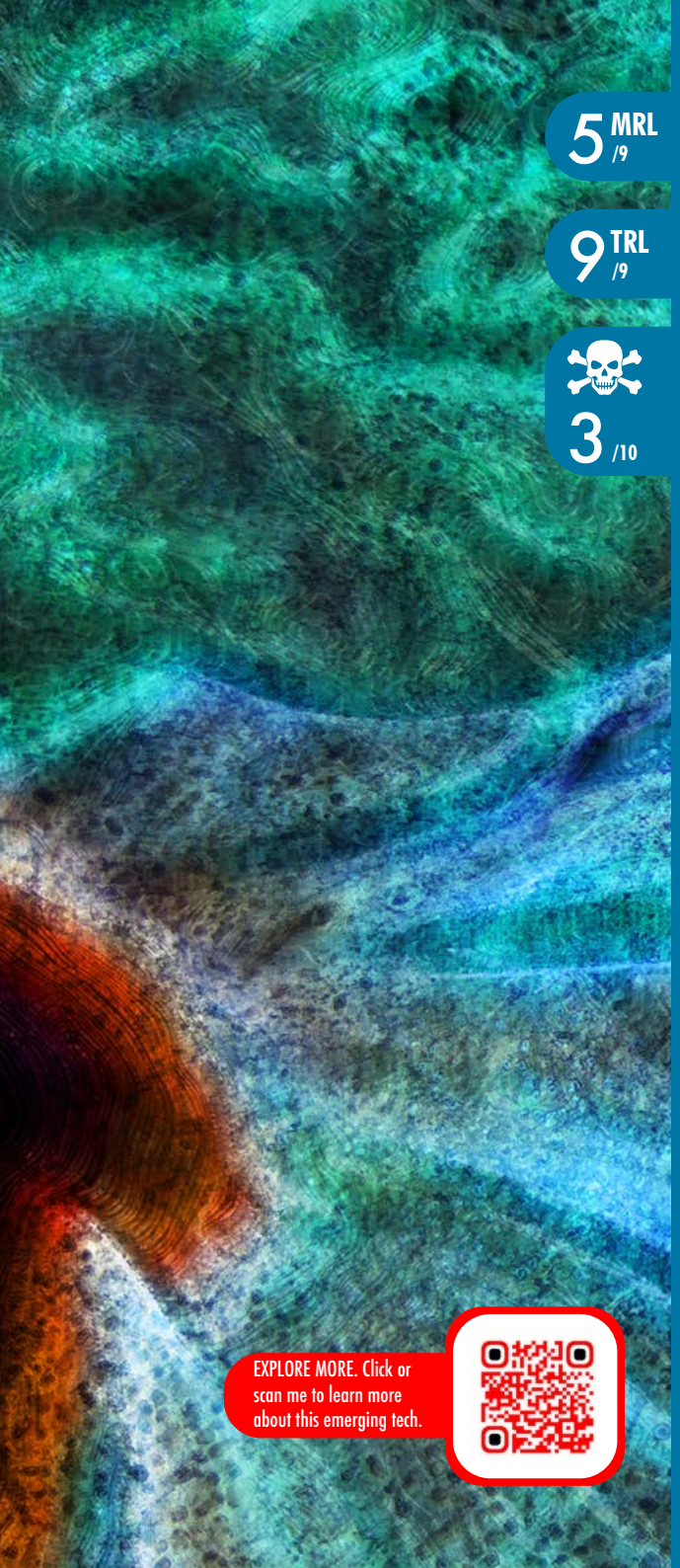
STATUS



Accessibility	5
Affordability	5
Competition	7
Demonstration	9
Desirability	7
Investment	4
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





5 MRL /9

9 TRL /9

3 /10

BIO-MATERIALS

BIO-MATERIALS, which are still in the Prototype Stage and Productisation Stage, is the field of research concerned with trying to create new classes of biologically inspired non-viable materials, using combinations of biological and synthetic manufacturing techniques, that can safely interact with other biological systems and exhibit a wide range of useful properties. Recently there have been a number of breakthroughs in creating Bio-Materials thanks to advances in biological and chemical engineering, imaging, and manufacturing, which now makes it possible to create non-valatile materials that can be used to regenerate and repair damaged or missing tissues within the human body, with the added benefit that many of these materials can be broken down by the body's natural metabolic processes once they've reached the end of their useful life. Additionally, the technology is now being used in the development of non-volatile 3D printed scaffolds that support and promote the growth of tissues outside of the human body before transplant.

DEFINITION

Bio-Materials are materials that have been engineered to interact with biological systems for a medical purpose.

EXAMPLE USE CASES

Today we are using Bio-Materials to promote new bone formation and soft-tissue healing within patients, and using them to create 3D printed scaffolds that help promote the growth of new tissues including human brain and heart tissue. In the future the primary use of this technology will be to help researchers grow replacement organs and tissues outside of the human body on demand before final transplatation.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Healthcare sector, with support from university grants. In time we will see Bio-Materials that leverage advances in Bio-Electronic and Regenerative Medicine that help dramatically accelerate the tissue growth and healing processes.

While Bio-Materials are in the Prototype Stage and Productisation Stage, over the long term they will be enhanced by advances in 3D Printing, Bio-Electronic Medicine, Regenerative Medicine, Stem Cell Technology, and Tissue Engineering, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

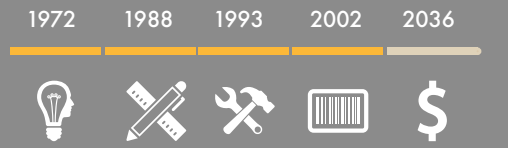
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

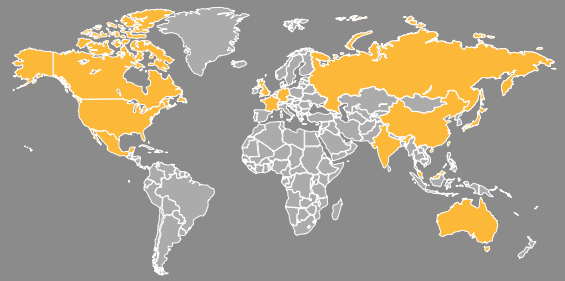
IMPACT

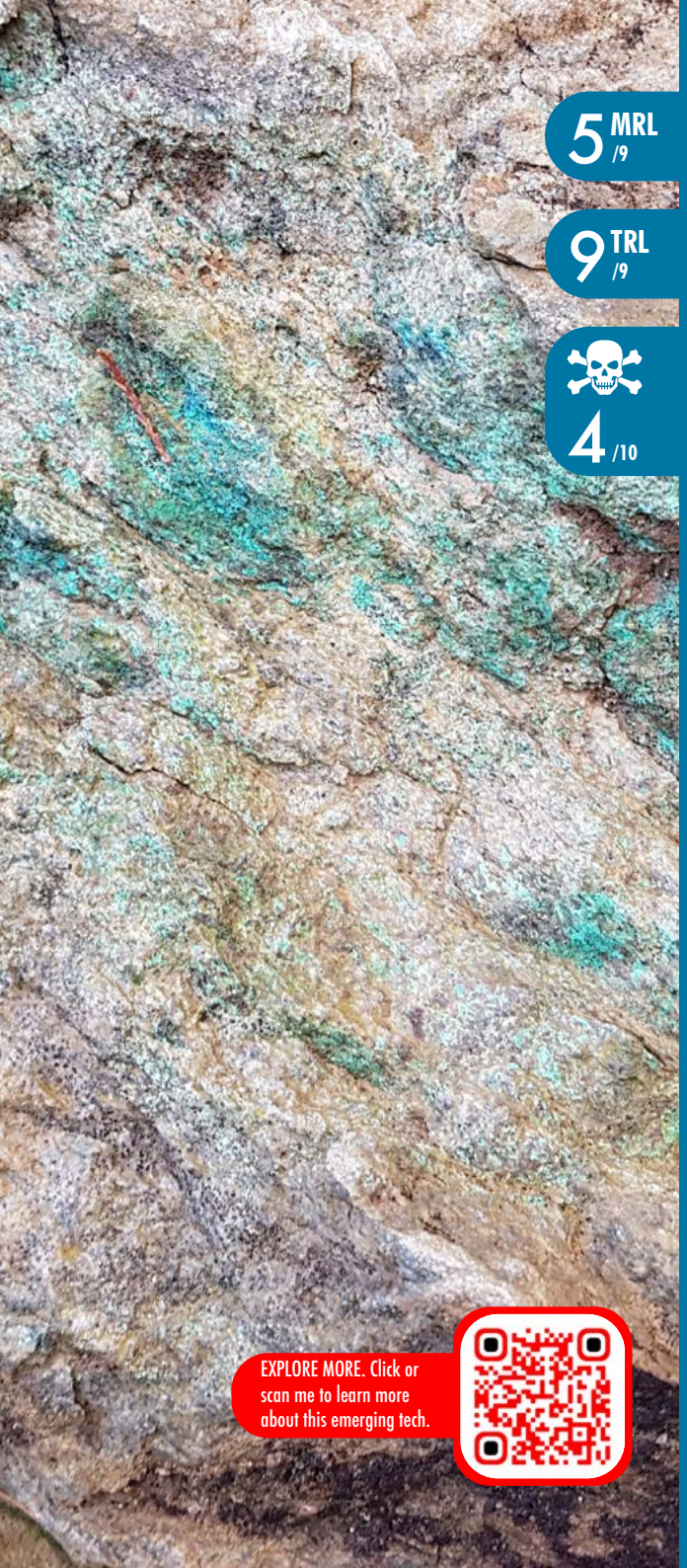
STATUS



Accessibility	6
Affordability	6
Competition	3
Demonstration	7
Desirability	8
Investment	6
Regulation	2
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





5 MRL /9

9 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

BIO-MINERALISATION

BIO-MINERALISATION, which is in the Prototype Stage, is the field of research concerned with developing new ways to combine specific bacteria, that have Bio-Mineralisation properties, with regular materials in order to change their characteristics and properties. Recent breakthroughs in the field include the development of Bio-Mineralisation bricks that combine bacteria with traditional building materials to create bricks that are not only stronger, but that are also capable of self-healing and self-replicating, with the added advantage being that the bacteria involved draw toxic greenhouse gases out of the air and lock them away in mineral form.

DEFINITION

Bio-Mineralisation is the process by which living organisms produce minerals that can be used to harden or stiffen materials.

EXAMPLE USE CASES

Today we are using small scale prototypes to prove the theory behind the technology and refine it. In the future the primary use case of this technology will be to create almost a new class of materials that are capable of using gases in their local environment in order to alter their properties, as well as self-heal and replicate themselves which could be used in construction, as well as a wide range of other use cases.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by organisations in the Construction and Manufacturing sector, with support from univesity grants. In time we will see the technology mature to the point where it is affordable and mature enough to be used as a viable alternative to many of today's most polluting materials, such as concrete, but depending on the use case the technology may well have to overcome stringent tests and regulatory oversight before it can see full commercial adoption.

While Bio-Mineralisation is in the Prototype Stage, over the long term it will be enhanced by advances in 3D Printing, CAST, CRISPR, Gene Editing, and Materials, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

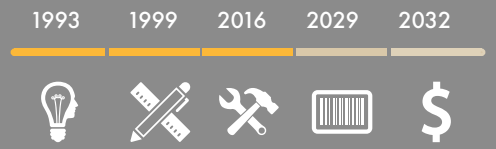
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21

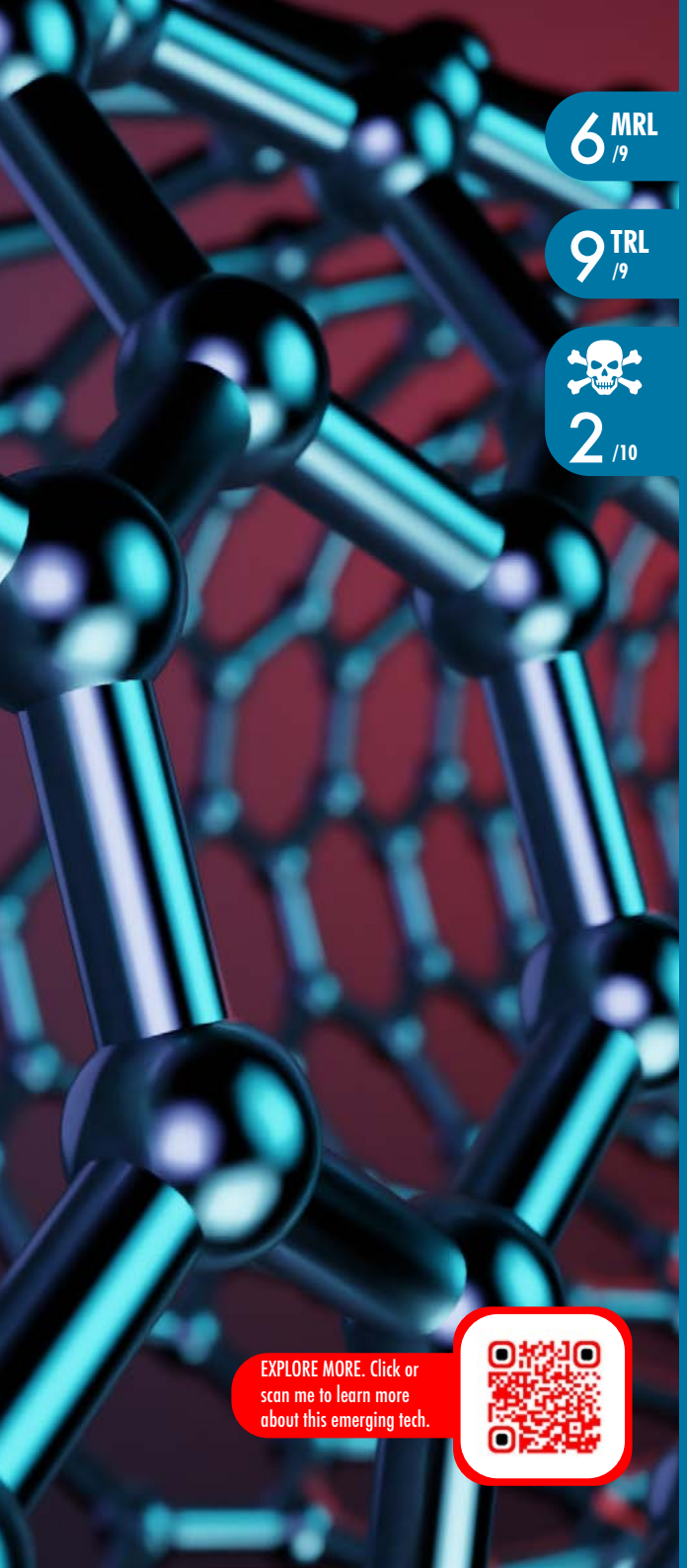
IMPACT

STATUS



Accessibility	6
Affordability	6
Competition	5
Demonstration	8
Desirability	7
Investment	2
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



6 MRL /9

9 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

CARBON NANOTUBES

CARBON NANOTUBES, which are in the Prototype Stage and early Productisation Stage, is the field of research concerned with developing the technology to the point where it can be mass produced. Recently there have been several breakthroughs in the field with the development of the world's first 70cm long Nano-cable, which, as development continues could one day be the foundational technology that helps us develop electric vehicles with a 16,000km range on a single charge, and even much hyped space elevators. Meanwhile, elsewhere the technology has been used to cure paralysis in humans, as the foundation for the next generation of electronics, and 0.5nm transistors. As a result, even with this small snapshot it is possible to see just how powerful and versatile the technology is.

DEFINITION

Carbon Nanotubes are cylindrical nanostructures with a exceptional range of properties that include conductivity and strength.

EXAMPLE USE CASES

Today we are using Carbon Nanotubes to cure human paralysis, by using it to bridge severed nerves, develop the world's blackest materials, which have space based applications, and manufacture 0.5nm transistors and energy dense, flexible battery systems. In the future the primary use cases of the technology could be almost limitless, ranging from helping create ultra strong nano-cables that can be used in Mechanical Batteries to revolutionise the electric vehicle industry, through to creating ultra strong ballistic armour and nano-cables strong enough to build the world's first space elevators.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Defence, Healthcare, Manufacturing and Technology sectors, with support from government funding, and university grants. In time we will see the technology become increasingly commercialised, and cable lengths increase as new manufacturing techniques are perfected.

While Carbon Nanotubes are in the Prototype Stage and early Productisation Stage, over the long term they will be enhanced by advances in Nanomanufacturing, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

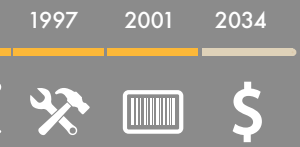
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

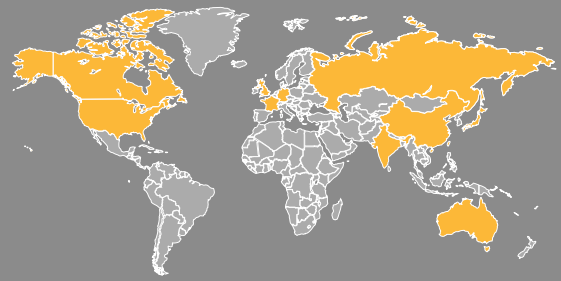
IMPACT

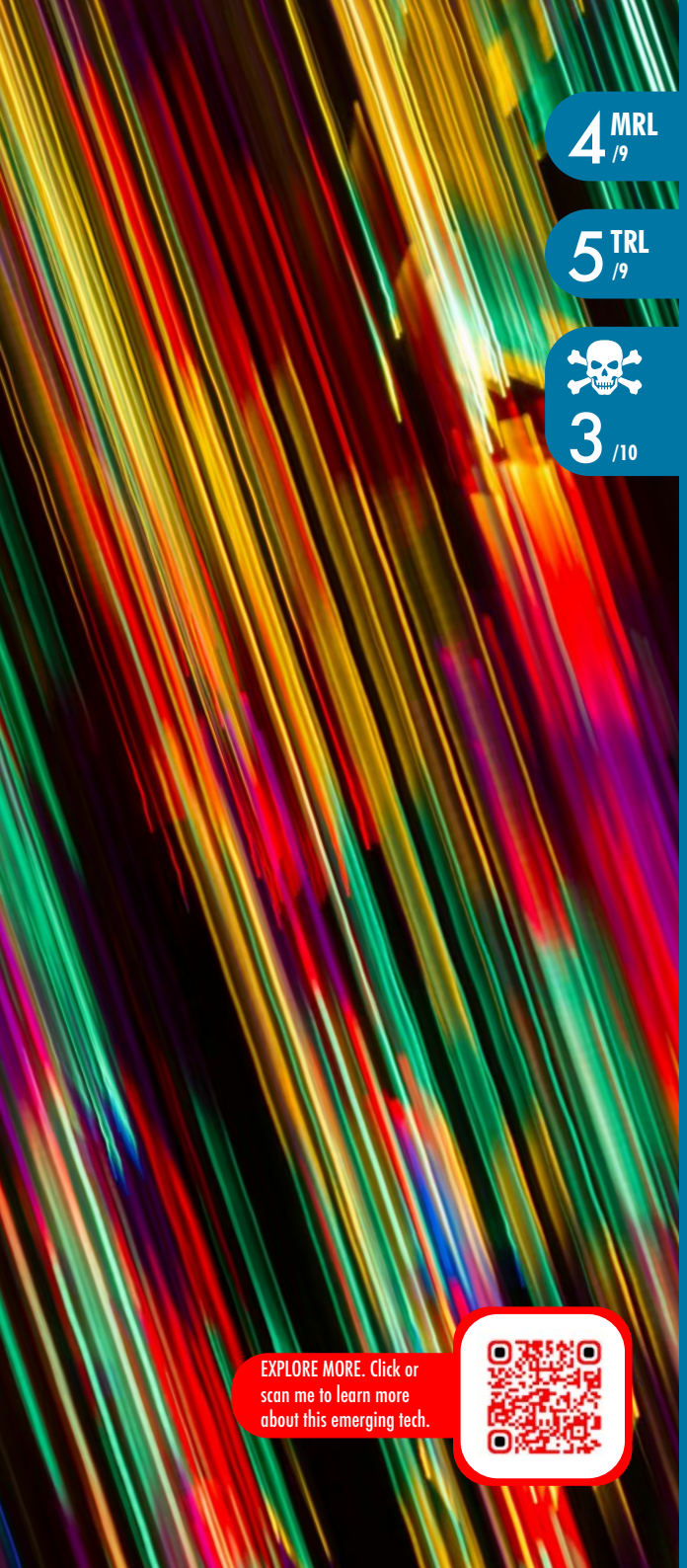
STATUS



Accessibility	6
Affordability	5
Competition	2
Demonstration	6
Desirability	9
Investment	8
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





4 MRL /9

5 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

CHROMOGENIC MATERIALS

CHROMOGENIC MATERIALS, which are in the Productised Stage, is the field of research concerned with trying to find new ways to create active camouflage-like systems and materials that can dynamically change colour on demand in response to electrochromic, photochromic, and thermochromic stimulii. Recently there have been a number of developments in the space which include the development of Digital Metamaterials

DEFINITION

Chromogenic Materials are materials that can change colour on demand in reaction to different stimulii.

EXAMPLE USE CASES

Today we are using Chromogenic Materials in everything from children's toys to coffee mugs that change colour in response to specific temperature changes. In the future though researchers hope these materials will unlock the door to a new class of Electro-active camouflage, and as it matures there are also obvious applications for the fashion industry and beyond.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Defence, Consumer Electronics, and Retail sector. In time we will see the technology move from being a passive technology to an active one that can respond dynamically to almost any type of stimulii, at which point it will open the door to a variety of new and interestingly unique use cases.

While Chromogenic Materials are in the Productised Stage, over the long term they will be enhanced by advances in Digital Metamaterials, and Metamaterials, as well as Advanced Manufacturing and Sensor technology, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

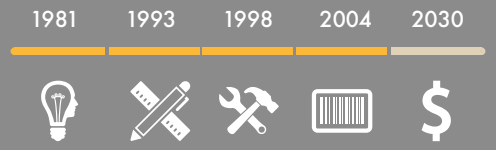
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

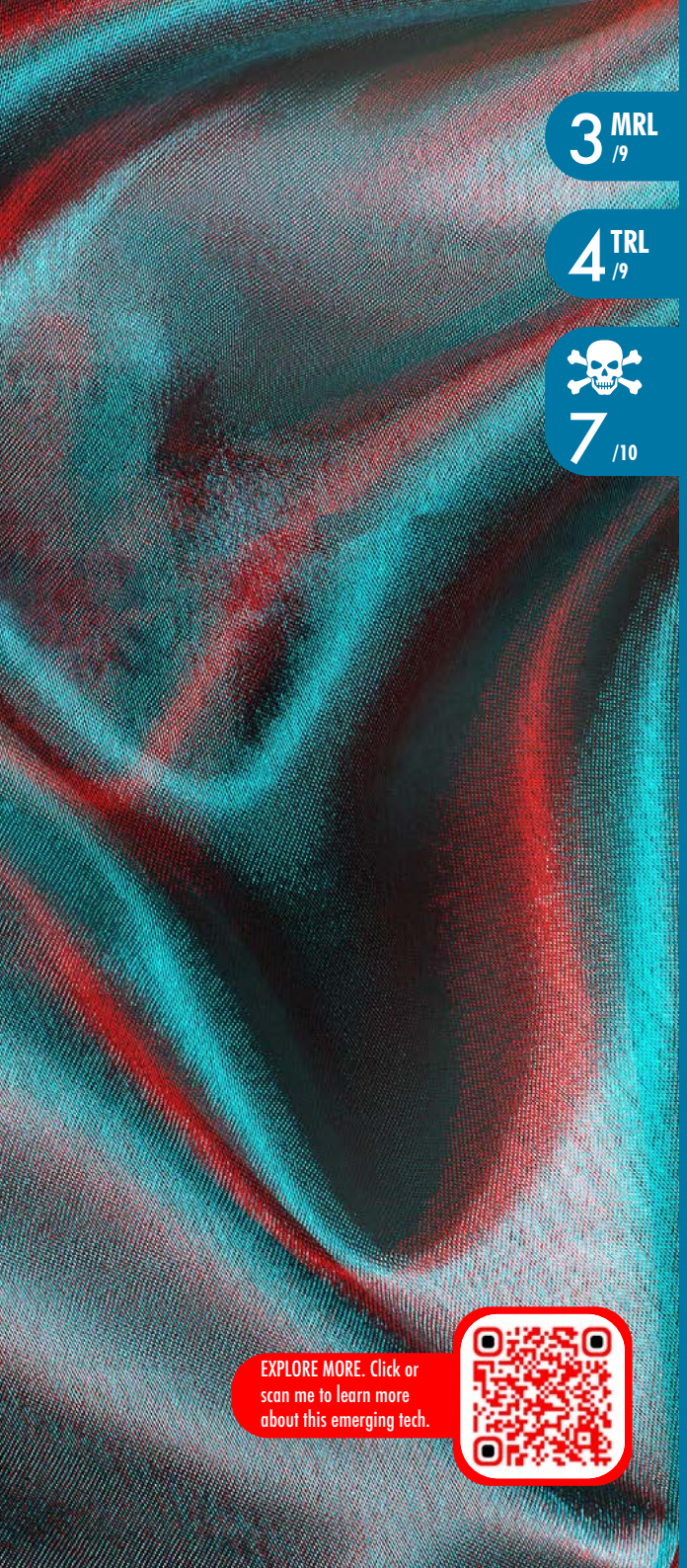
IMPACT

STATUS



Accessibility	4
Affordability	2
Competition	5
Demonstration	5
Desirability	7
Investment	4
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

4 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

DIGITAL METAMATERIALS

DIGITAL METAMATERIALS, which are in the Prototype Stage, is the field of research concerned with developing an entirely new class of digitised materials whose properties can be altered and tuned on demand. Recent breakthroughs in the space include the development of the first viable blueprint architecture that could be used to create Digital Metamaterials with extraordinary properties that include but are not limited to changing the acoustic, electromagnetic, strength, and tensile properties of materials, with some of the most interesting examples being the ability to tune and turn on and off properties such as invisibility cloaking and the ability to turn soft materials rock hard at will.

DEFINITION

Digital Metamaterials are Metamaterials that can be digitally controlled and tuned in order to produce a range of different unatural properties and functionalities.

EXAMPLE USE CASES

Today we are using Metamaterials to create invisibility cloaks, new forms of acoustic cloaking systems, and communications antennae. In the future the primary use case of this technology will be to create fully digitised materials and metamaterials that can assume almost any property or combination of properties imaginable, including but not limited to changing the acoustic, electromagnetic, strength, and tensile properties of materials, and as a result they will have a wide variety of applications.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Consumer Electronics sector, with support from univesity grants. In time we will see the technology mature to the point where researchers are able to beam high quality content directly into users eyes, but there will likely be significant cultural and regulatory hurdles to be overcome before the technology can be adopted.

While Digital Metamaterials are in the Prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Computing, Electronics, Graphene, Metamaterials, and Nano-Antennae, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

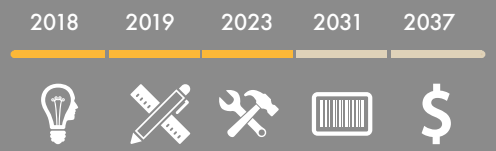
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '24

IMPACT

STATUS



Accessibility	2
Affordability	3
Competition	2
Demonstration	2
Desirability	9
Investment	1
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

5 TRL /9

2 /10

ELECTROCALORIC MATERIALS

ELECTROCALORIC MATERIALS, which are in the Prototype Stage, is the field of research concerned with developing materials that are able to change temperature in response to nothing more than an electrical stimulus. Recently researchers have made great strides in reducing the cost of the technology and have proved its viability in helping organisations create green zero emission heating and cooling systems which today account for over 15% of all Greenhouse Gas emissions.

DEFINITION

Electrocaloric Materials are materials that show a reversible temperature change under an applied electric field.

EXAMPLE USE CASES

Today researchers are using these materials to heat and cool environments, and have integrated the technology into domestic freezers and fridges. In the future this technology could be used to create Solid State Coolants which would have a huge number of use cases in everything from helping to cool computing devices and smart devices, through to heating and cooling vehicles.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Consumer Electronics, and Energy sector, with support from university grants. In time we will see the cost of the technology decrease to a point where it is competitive with more traditional polluting materials which, once it becomes capable of being manufactured and integrated at scale, could then put it on a collision course to replace them in all manner of products.

While Electrocaloric Materials are in the Prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence, as well as Advanced Manufacturing and Energy, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

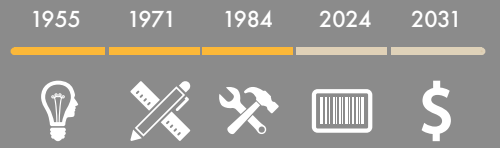
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: '21

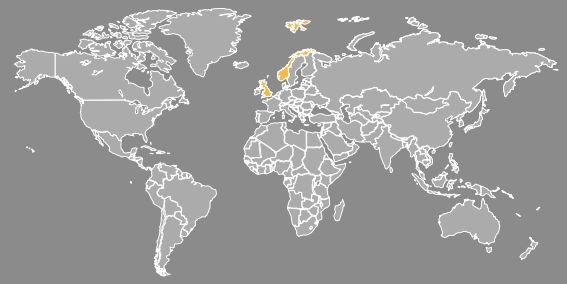
IMPACT

STATUS



Accessibility	5
Affordability	6
Competition	4
Demonstration	7
Desirability	7
Investment	5
Regulation	4
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



2 MRL /9

4 TRL /9

2 /10

FLEXIBLE CERAMICS

FLEXIBLE CERAMICS, which are in the Prototype Stage, is the field of research concerned with developing ceramics that are flexible rather than brittle like traditional ceramics. Recently there have been a number of breakthroughs in the field with researchers developing ceramics that are fully flexible and even foldable under stress but that still possess the durability, lightness, and thermal properties of traditional ceramics which makes them the ideal candidates for all manner of use cases that traditional ceramics haven't been ble to fulfil.

DEFINITION

Flexible Ceramics are ceramic-like materials capable of bending and flexing when under stress.

EXAMPLE USE CASES

Ceramics have all manner of use cases today but their brittle nature has limited their broader use. Now however Flexible Ceramics have the potential to be used in everything from gas and jet turbines, as well as in Fusion torexes, where the stresses and heat are extreme, and also in light weight body armour, prosthetics, exosuits, robotics, weapons, and even in traditional consumer electronics such as ovens and smartphones.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate, predominantly led by the aerospace and manufacturing sectors, with government grants. Ceramics are amazingly light and durable materials but their brittleness has so far severely limited their broader use, especially in defence. Now though the latest developments mean that we could finally see them break out of their niche and into the mainstream especially in use cases where so far aluminium, steel, and titanium alloys, as well as other super alloys, have traditionally dominated.

While Flexible Ceramics are in the Prototype Stage over the longer term they could be enhanced by advances in 3D and 4D Printing, AI, Nanomanufacturing, Polymers, Quantum Computing, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

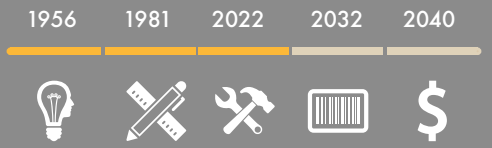
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23, '24

IMPACT

STATUS



Accessibility	4
Affordability	4
Competition	4
Demonstration	7
Desirability	9
Investment	4
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

8 MRL /9

9 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

GRAPHENE

GRAPHENE, which is in the Prototype Stage and early Productisation Stage, is the field of research concerned with the development of new Graphene manufacturing processes and products. Recently breakthroughs have included discovering new ways to cost efficiently manufacture Graphene at moderate, but not mass, scale, as well as developing new Graphene configurations that dramatically extend the materials usefulness, which includes using it to create the first generation of single step water purification systems, and Terahertz computer chips, among many more applications. Graphene's status as a wonder material is much hyped, and with good cause, consequently it will have far and wide ranging impacts on everything from the development of next generation electronics and energy systems to the development of new biomedical and robotics products, and almost everything in between.

DEFINITION

Graphene is a one atom thick sheet of pure Carbon that has very high strength to weight ratios and exceptional conductivity properties.

EXAMPLE USE CASES

Today we are using Graphene to create single step, passive water purification systems, edible electronics that can track the provenance of food stuffs, and synthetic cell sized robots, all the way through to new super energy dense LiOn batteries, and Aerogels that are 99 percent lighter than steel but 10 times stronger. In the future the primary use cases of the technology will be almost unlimited.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Defence, Manufacturing, and Technology sectors, with support from government funding, and university grants. In time we will see the technology become increasingly cheap and easy to manufacture, and as this happens researchers will similarly find it increasingly easy to develop new Graphene structures that have a variety of commercial applications.

While Graphene is in the Prototype Stage and early Productisation Stage, over the long term it will be enhanced by advances in Artificial Intelligence Creative Machines, and Nano-Manufacturing, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

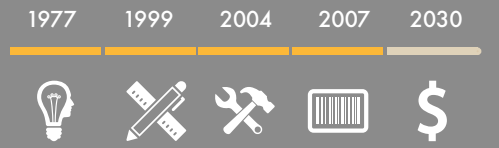
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

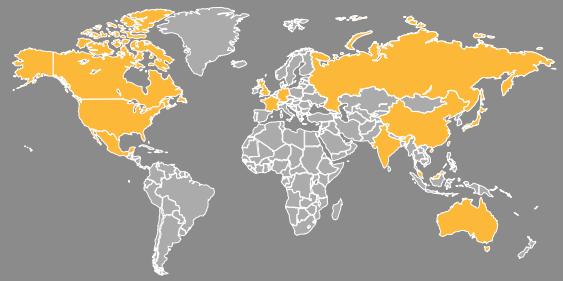
IMPACT

STATUS



Accessibility	6
Affordability	6
Competition	3
Demonstration	6
Desirability	9
Investment	8
Regulation	2
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

6 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

INFINITELY RECYCLABLE PLASTICS

INFINITELY RECYCLABLE PLASTICS, which are in the Prototype Stage, is the field of research concerned with developing new ways to recycle plastics whose properties don't degrade every time they are recycled as is the issue with current plastics and current recycling technology. Recent breakthroughs in the space include the development of a new process that breaks plastics back down to their individual chemical components, without any loss of quality, so they can be recombined again to form plastic that is as good as new.

DEFINITION

Infinitely Recyclable Plastics are plastics that can be infinitely recycled without any degredation or loss in quality.

EXAMPLE USE CASES

Today we are using small scale prototypes to prove the theory behind the technology and refine it. In the future the primary use of this technology will be to reduce the amount of plastic sent to landfill and give the circular economy a much needed boost.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by organisations in the Manufacturing sector, with support from univesity grants. In time we will see the technology mature to a point where it is capable of being integrated into recycling processing workflows, but in order to be adopted the technology and the processing equipment it will relies on will need to be affordable, easy to implement, and have a clear return on investment, and at the moment given the current state of investment in the sectors this technology targets that is open to question.

While Infinitely Recyclable Plastics are in the Prototype Stage, over the long term they will be enhanced by advances in Polymers, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22, '23

IMPACT

STATUS

Accessibility	4
Affordability	5
Competition	4
Demonstration	4
Desirability	8
Investment	2
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

5 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

KINETIC FABRICS

KINETIC FABRICS, which is in the Prototype Stage, is the fiel of research concerned with creating a new class of fabrics that are both able to harness and use motion for a variety of purposes. Recently there have been a number of breakthroughs in the space including the development of kinetic fabrics that can both listen to sounds and vibrations and play sounds and vibrations, the implications of which mean that fabrics can replay the breathing patterns and heart rhythms of individuals who may be many thousands of miles away,or even simulated, which can then be used for both educational purposes as well as to help improve sports performance and empathy.

DEFINITION

Kinetic Fabrics are fabrics that emulate, harness, and synthesis kinetic energy and reactions.

EXAMPLE USE CASES

Kinetic Fabrics have a variety of interesting use cases including the ability to act as a microphone and listen to all of the currently non-observable sounds of a persons body, the outputs of which can then be used to develop better Predictive Health and Quantified Self models which can be used to help organisations and individuals diagnose disease and the state of people's health faster so they can make interventions faster. Meanwhile other applications include the ability to play sound, which while useful from an entertainment perspective could also be used to disrupt eavesdropping, synchronise a persons breathing with other people remotely via taptic feedback to improve sports training and performance, and all manner of other examples.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, albeit from a low base, primarily led by organisations in the healthcare sector. In time we will see Kinetic Fabrics play a more significant role especially in the Smart Clothing and Wearable Technology spaces, but it's also highly likely that their use will spread to other sectors as the technology evolves.

While Kinetic Fabrics are in the Prototype Stage, over the long term they will be enhanced by advances in Computing, Electronics, Materials, and other fields but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

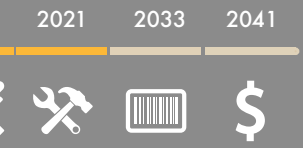
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

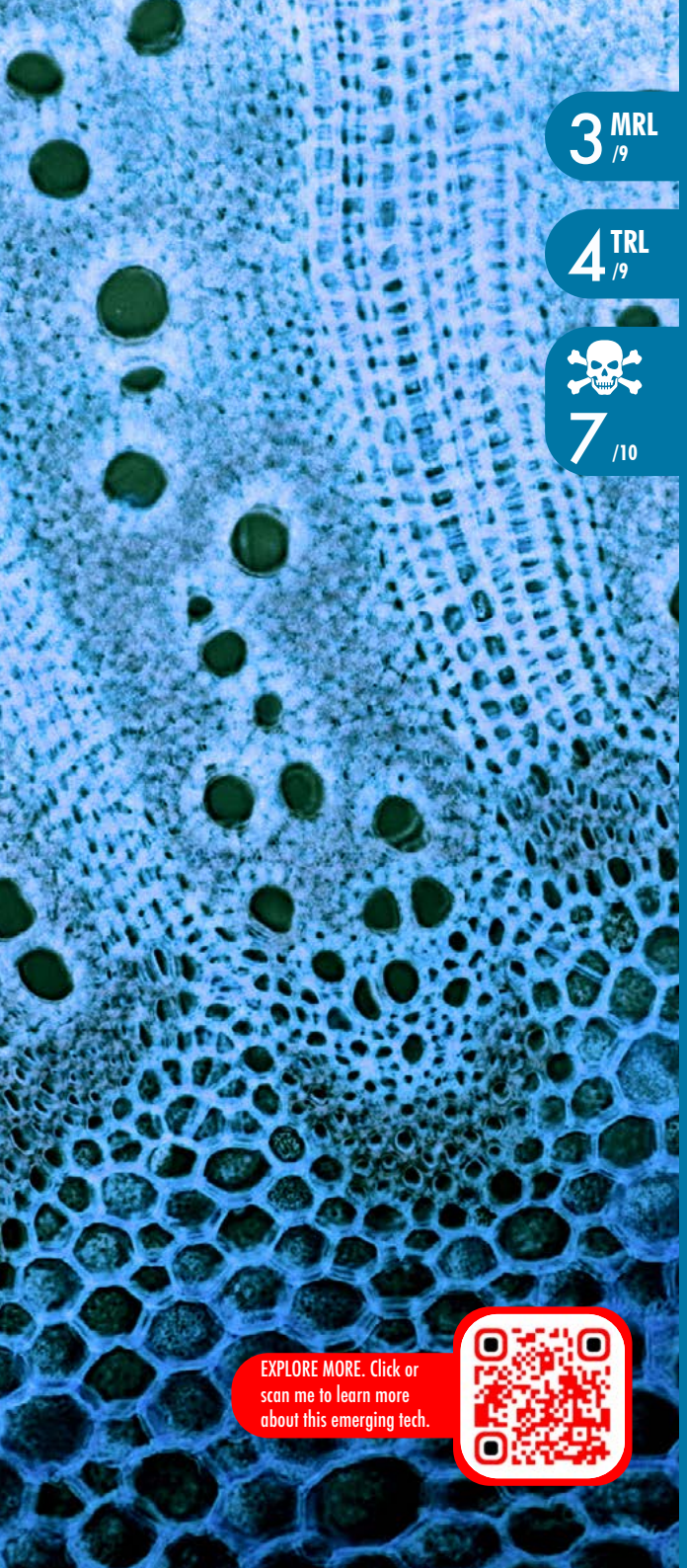
IMPACT

STATUS



Accessibility	6
Affordability	7
Competition	4
Demonstration	7
Desirability	7
Investment	3
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

4 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

LIVING MATERIALS

LIVING MATERIALS, which are in the Prototype Stage, is the field of research concerned with developing new ways to develop materials that are alive, but not sentient, that exhibit all the properties of living organisms, such as the ability to grow in a controllable manner, and self-heal, and self-replicate. Recently there has been a breakthrough in the field that saw the development of the first living material that exhibited all the traditional signs of life including the ability to metabolise, and while it wasn't used to develop a product just the concept of such a material is interesting enough for now.

DEFINITION

Living Materials are materials that exhibit all the signs of life but that stop short of being living organisms in the traditional sense of the term.

EXAMPLE USE CASES

Today we are using prototypes to prove the theory behind the technology and refine it. In the future the primary use case of this technology will be almost unlimited, especially when combined with other material types, to the point where when it's combined with the principles of Synthetic Biology not only could we see it being used to help create a new class of robots but also be used as the foundation to grow entire buildings or even cities.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by univesity grants. In time we will see the technology mature to the point where it will leave the labs and be commercialised, however the strangeness of the technology means that use cases will no doubt start off very narrow, such as being used as a coating for other materials, before its use cases are expanded into other areas such as the healthcare sector.

While living Materials are in the Prototype Stage, over the long term they will be enhanced by advances in CAST, CRISPR, Gene Editing, Semi-Synthetic Cells, Synthetic Cells, synthetic DNA, and Synthetic Biology, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

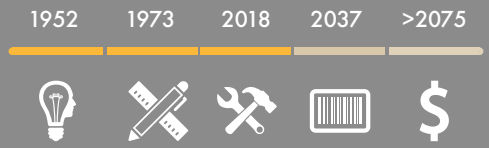
In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	3
Affordability	5
Competition	4
Demonstration	6
Desirability	8
Investment	1
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

4 MRL /9

7 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

MAGNETO RESTRICTIVE MATERIALS

MAGNETO RESTRICTIVE MATERIALS, which are in the Prototype Stage, is the field of research concerned with developing new kinds of materials whose properties and shape can be dynamically affected and altered by magnetism. While this is a comparatively old technology it was put on the shelf for decades by the Americans until the Chinese started experimenting with it for military applications. Recent breakthroughs in this field include the development of new magneto restrictive materials for stealth submarines which, when exposed to a mild magnetic field, makes those submarines invisible to sonar by making them appear, on the scopes, just like water.

DEFINITION

Magneto Restrictive Materials are substances that change their shape and or dimensions in response to applied magnetic fields.

EXAMPLE USE CASES

Today the primary use cases for this technology is in stealth military applications, certainly for sea, but also likely for air and land systems. However, other emergent use cases also include the ability to use this technology to create new acoustic and sonar systems, non-destructive testing systems, vibration and noise dampening, as well as magneto restrictive energy harvesting systems and sensing systems, all of which would have their own use cases.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in this technology increase, primarily led by organisations in the Defense sector and university grants. Magneto restrictive materials, which can dynamically change their dimensions and shape by nanometers or more under certain conditions, opens the door to create a whole new species of materials that have unique utility, and while it is likely that this technology will remain niche it could end up playing an important role in key sectors which means that, as we've seen before, it will likely remain a subtle but important technology for decades to come.

While Magneto Restrictive Materials are still in the Prototype Stage they could be enhanced by advances in Advanced Manufacturing, Artificial Intelligence, Materials, Nano-Manufacturing, Sensors, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

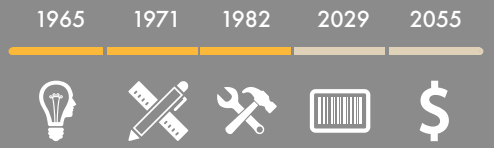
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	3
Demonstration	7
Desirability	8
Investment	4
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

1 MRL /9

4 TRL /9

10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

MATTER CREATION

MATTER CREATION, which is in the Concept Stage, is the field of research concerned with trying to reproduce one of the universes most fundamental capabilities that has so far eluded humanity - to create matter. Recently we saw the first ever breakthrough in this field, and while in ancient times philosophers talked about being able to create matter from nothing the actual reality isn't too far removed from that after scientists clashed individual gold atoms moving at near light speed in a particle collider with light, the result of which was the collision of photons to create electrons and positrons - Matter. Needless to say if this technology was ever able to be harnessed and matured then you could argue it would usher in yet another new age of humanity full of sci-fi-like potential.

DEFINITION

Matter Creation is the creation of electron and positron based matter from the collision of photons.

EXAMPLE USE CASES

Put mildly the future use cases of this technology would be infinite so this is likely one of the few paragraphs in this entire codex where I could write "anything is possible" as a future use case and I'd be right. So I'll just leave that one there.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in this field increase, primarily led by university grants. While this technology is incredibly exciting and full of potential being honest it's likely that it's more than a century before we could see working prototypes that have actual utility. In the meantime therefore I suggest you put this on your grand kids radars and get them to check on it every decade or so.

While Matter Creation is still in the Concept Stage it could be enhanced by advances in Artificial Intelligence, Quantum Computing, Materials, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

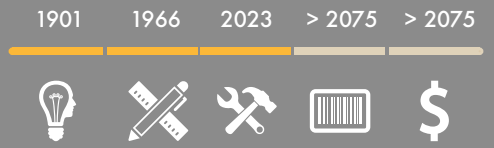
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few decades until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

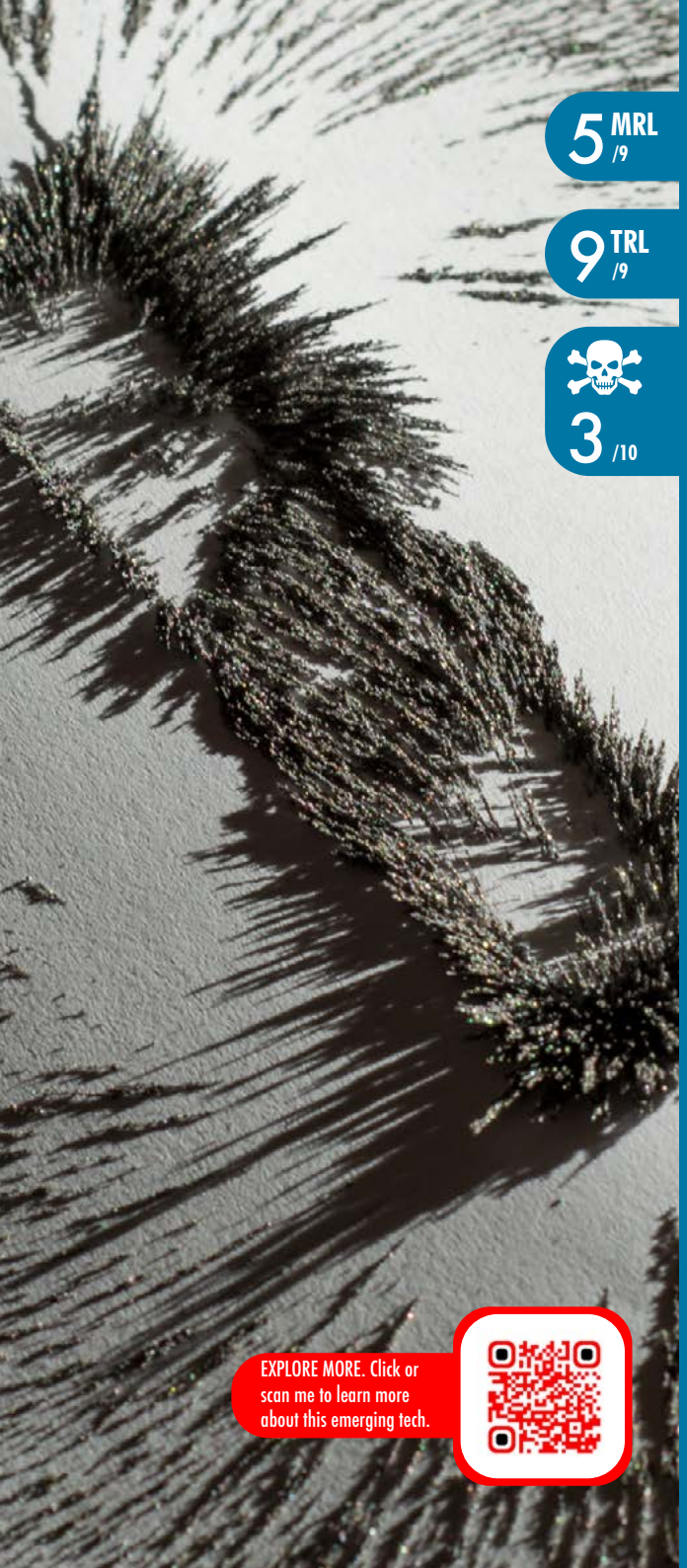
IMPACT

STATUS



Accessibility	1
Affordability	1
Competition	1
Demonstration	1
Desirability	9
Investment	1
Regulation	1
Viability	4

PRIMARY GLOBAL DEVELOPMENT AREAS



5 MRL /9

9 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

MEGA MAGNETS

MEGA MAGNETS, which are in the Prototype Stage, is the field of research concerned with developing incredibly powerful magnets. Recently researchers in the field have broken several long standing world records, including the record for the most powerful magnet which now clocks in at 32 Tesla units, which is at least 500,000 times more powerful than the Earth's magnetic field, and has revolutionary implications for Neutron and X-Ray scientific measurement products, as well as on the development of Fusion Reactors, MRI scanners, and new mass transit transportation systems, such as the Mach capable Hyperloops which rely on magnetic levitation to boost their speeds, long range wireless charging solutions, and much more.

DEFINITION

Mega Magnets are based on rare Earth elements whose properties can be harnessed to create exceptionally strong magnets.

EXAMPLE USE CASES

Today we are using Mega Magnets at a very large scale in platforms such as the Large Hadron Collider (LHC) to smash matter together, and in the world's most advanced Neutrino detectors. In the future the primary use cases of the technology will be to develop new ultra-sensitive healthcare and scientific measurement tools, which will lead to the development of new materials and Superconductors, among other things, and the pursuit to create the first commercially viable Fusion Reactors.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Energy, and Manufacturing sectors, with support from government funding, and university grants. In time we will see the technology increase in power, with new records being set more frequently, but as the technology gets more powerful its development will be hampered by our inability to contain or control the huge magnetic forces which today are increasingly causing explosions in labs.

While Mega Magnets are in the Prototype Stage at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

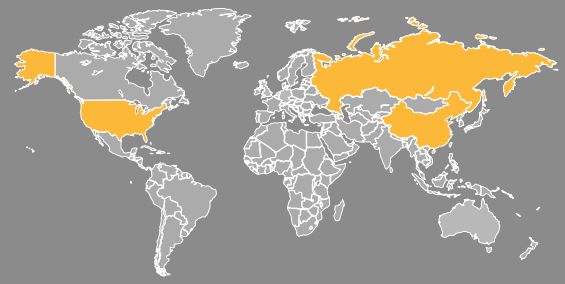
STARBURST APPEARANCES: '17, '18, '19

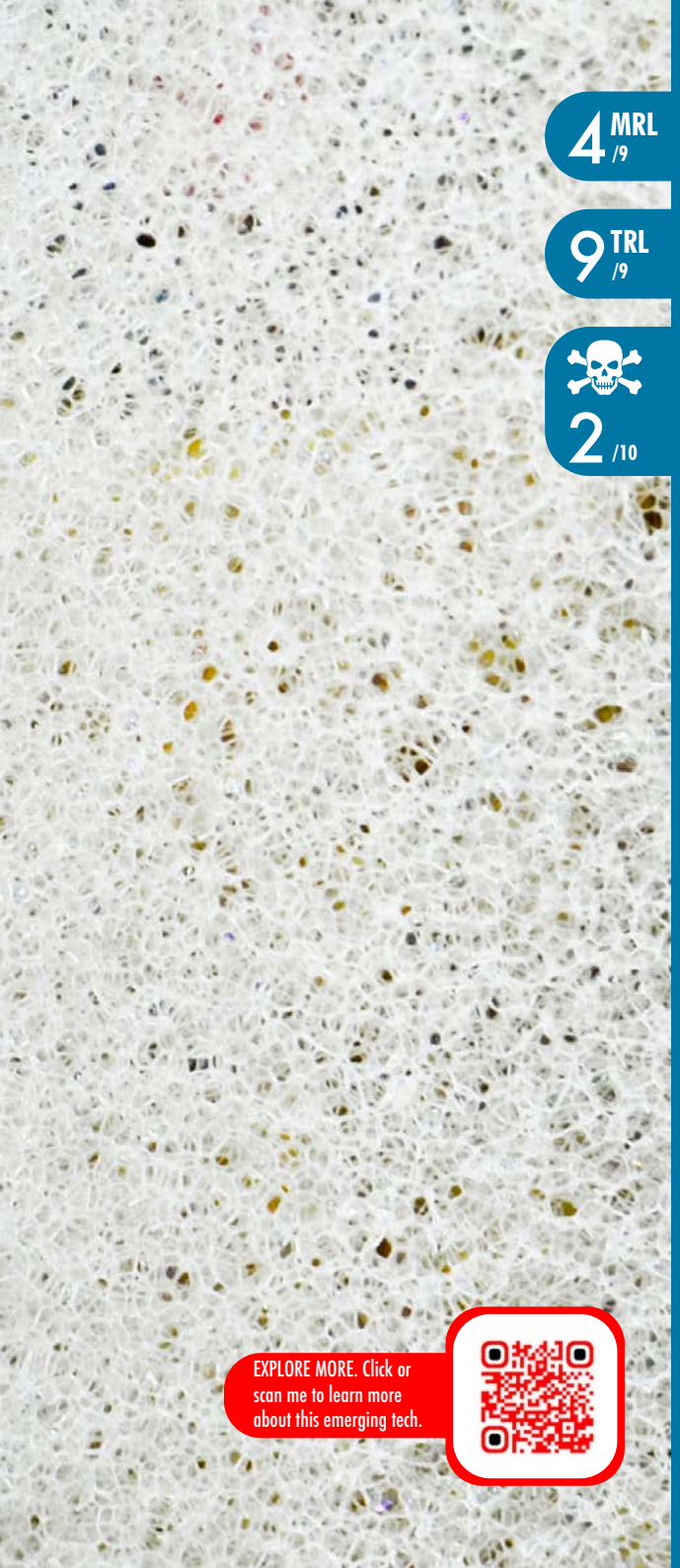
IMPACT

STATUS

Accessibility	7
Affordability	5
Competition	3
Demonstration	7
Desirability	7
Investment	6
Regulation	4
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





4 MRL /9

9 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

METAL ORGANIC FRAMEWORKS

METAL ORGANIC FRAMEWORKS, which are in the Prototype Stage, is the field of research concerned with developing a new range of highly porous materials that have huge surface areas and a wide variety of applications, that range from helping us dramatically reduce Carbon Dioxide emissions, to targeted drug delivery. Recently scientists found a new way to manufacture MOF's in low gravity environments which allowed them to create 1 gram of material that had an internal surface area larger than an entire football pitch, a breakthrough that opens the door to a variety of new applications. And elsewhere, researchers used the output of failed past experiments and Artificial Intelligence to discover new MOF intuitions that could lead to the creation of materials with even larger surface area to weight ratios.

DEFINITION

Metal Organic Frameworks are highly porous, crystalline substances made from compounds consisting of metal ions or clusters that are capable of forming 1D, 2D or 3D structures.

EXAMPLE USE CASES

Today we are using Metal Organic Framework materials to help us create new carbon free Supercapacitors, which could revolutionise the global energy industry, and to create highly porous materials that can soak up enormous quantities of pollutants from the atmosphere and water. In the future the primary use case of the technology will likely continue to be to absorb, capture, and where appropriate, release, large volumes of chemicals, compounds and gases, such as capturing and releasing Oxygen within spaceship cabins.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by organisations in the Aerospace sector, and university grants. In time we will see the development of MOF's with even larger surface area to weight ratios, which will open up a variety of new applications.

While Metal Organic Frameworks are in the Prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Creative Machines, and Nano-Manufacturing, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

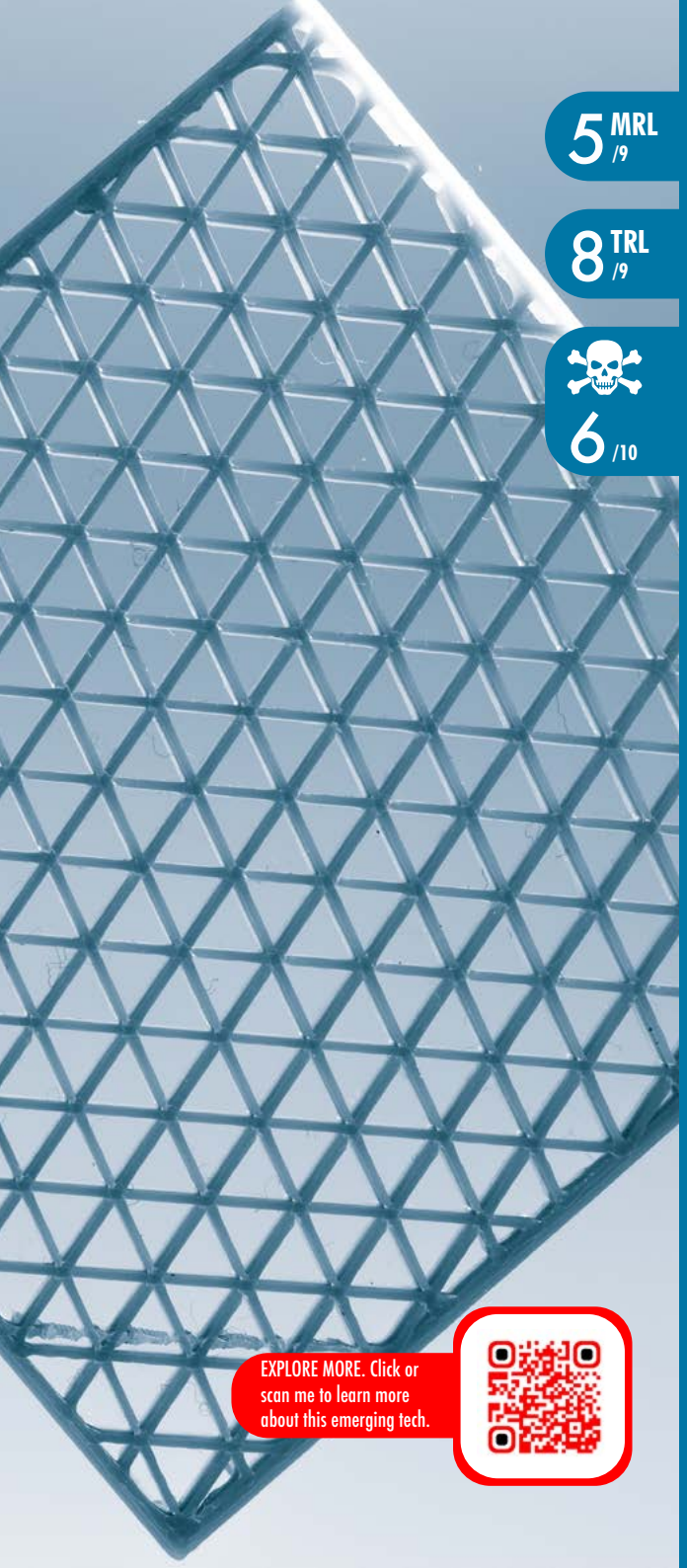
STARBURST APPEARANCES: '19, '20, '21, '22, '23

IMPACT

STATUS

Accessibility	5
Affordability	5
Competition	2
Demonstration	7
Desirability	8
Investment	5
Regulation	4
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



5 MRL /9

8 TRL /9

6 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

METAMATERIALS

METAMATERIALS, which are in the Prototype Stage and early Productisation Stage, is the field of research concerned with finding new ways to create materials that have properties that aren't found in nature, and as you'd expect some of the resulting materials are fabulously weird. Recently breakthroughs in the development of nanoscale structures have helped researchers create an array of new and interesting metamaterials including the first prototype invisibility cloaks, and materials that are as soft and elastic as rubber, until they're exposed to a current, after which they're as hard and as inflexible as steel. As researchers ability to manufacture new materials with a range of internal structures and symmetries improves, which will let them create metamaterials with different properties, it is inevitable we will see more metamaterials making it into our everyday world.

DEFINITION

Meta Materials are synthetic composites with structures and properties not found in natural materials

EXAMPLE USE CASES

Today we are using Metamaterials to create the first generation of invisibility cloaks, and turn ordinary surfaces into speakers and energy charging platforms, to create new classes of ultra-sensitive communications antennae for cars and smartphones, and materials that automatically transform from hard to soft on impact - something that could be especially useful in future cars. In the future the primary use cases for the technology will include using it to develop new smart clothing, soft robots, and many more applications.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Defence, and Manufacturing sector, with support from government funding, and university grants. In time we will see the complexity and cost of creating and manufacturing these materials fall dramatically, which will open the door to a host of new and sometimes weird applications.

While Metamaterials are in the Prototype Stage and early Productisation Stage, over the long term it will be enhanced by advances in 3D Printing, Artificial Intelligence, Creative Machines, Nano-Manufacturing, and Nanophotonic Materials, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

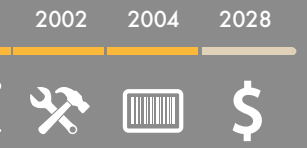
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19

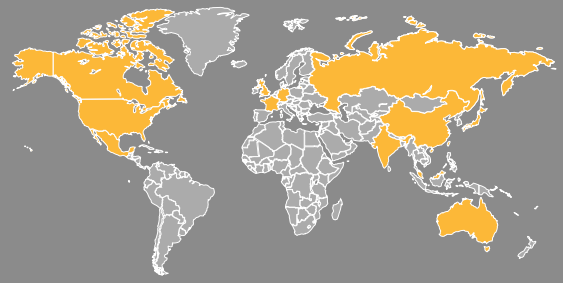
IMPACT

STATUS



Accessibility	7
Affordability	7
Competition	2
Demonstration	7
Desirability	8
Investment	7
Regulation	4
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



6 MRL /9

8 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

Harvard University

META-OPTICS

META-OPTICS, which are in the early Productisation Stage, is the field of research concerned with developing new Metamaterials that can be used in imaging, or "optical," applications. Recent breakthroughs include the development of revolutionary flat Metalenses that can capture and manipulate the entire visible electromagnetic spectrum at the nanoscale, including "white light," to capture and create images, as well as breakthroughs in using the principles underlying the technology to create revolutionary invisibility cloaking systems.

DEFINITION

Meta-Optics are materials that can capture and harness the weird properties of Metamaterials to bend and manipulate light for different purposes.

EXAMPLE USE CASES

Today we are using the first Metalense prototypes to create nanoscale camera systems that could one day be used in smartphones, and create materials capable of bending and manipulating light in ways never seen before. In the future the primary applications of the technology will include creating Virtual Reality headsets with atomic thin, tunable, display systems that can be perfectly focused, and creating the world's first true invisibility cloaks, and much more besides.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Defence, and Consumer Electronics sectors, with support from and university grants. In time we will see the cost of developing these systems fall substantially, and be refined to the point where they can be used in everyday commercial applications.

While Meta-Optics are in the Prototype Stage, over the long term they will be enhanced by advances in 3D Printing, Metamaterials, Nano-Manufacturing, and Nanophotonic Materials, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

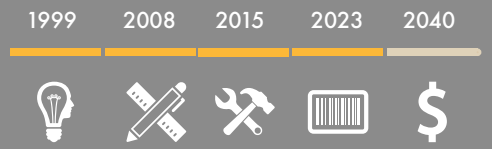
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21

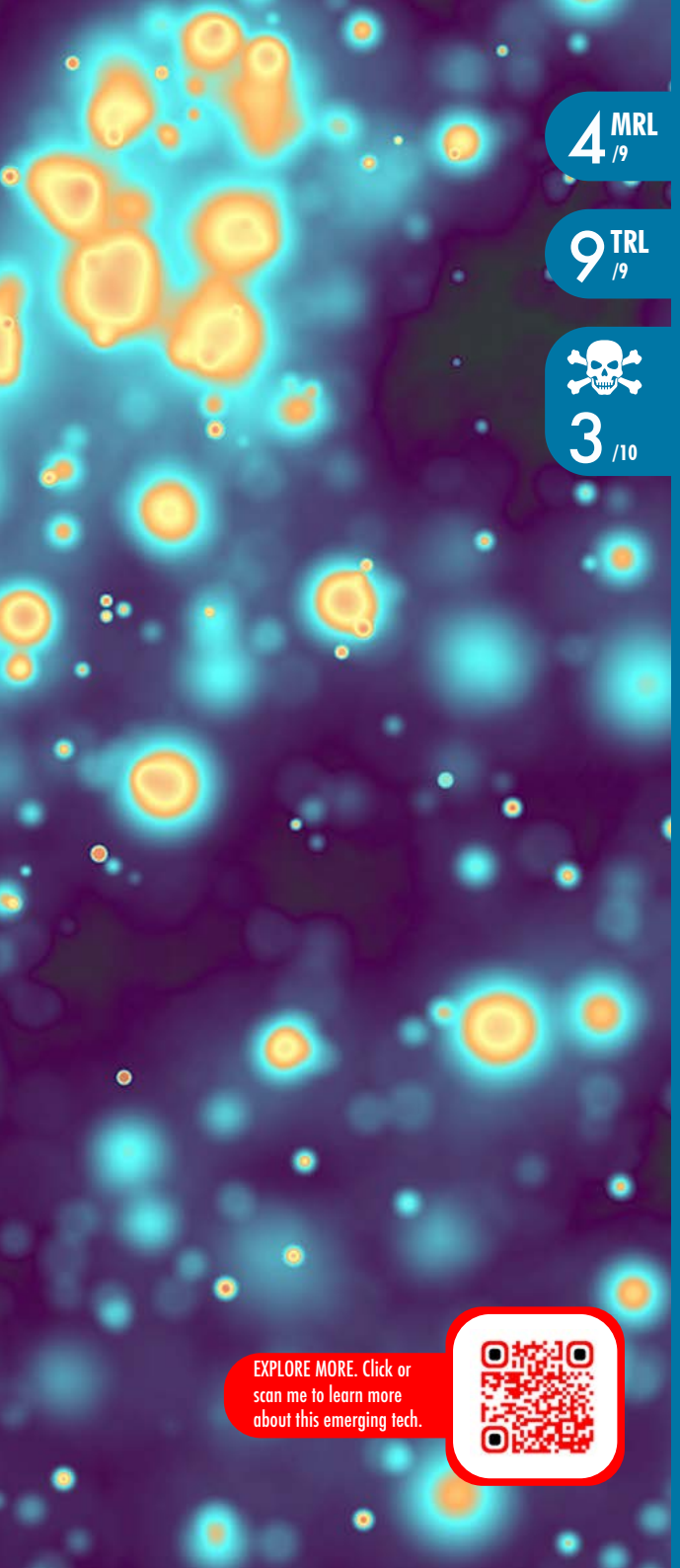
IMPACT

STATUS



Accessibility	1
Affordability	2
Competition	2
Demonstration	5
Desirability	7
Investment	2
Regulation	3
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



4 MRL /9

9 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

NANO-MATERIALS

NANO-MATERIALS, which are in the Productisation Stage, is the field of research concerned with developing nanoscale materials, and materials with nanoscale properties, that have a wide range of applications. Recently there has been an explosion in the number of Nano-Materials being used in products, but despite this rise in adoption significant questions about their impact on human health remain, and that, arguably, remains one of the largest hurdles the industry has to overcome before it really takes off.

DEFINITION

Nano-Materials are insoluble or Bio-Persistent manufactured materials that have one or more external dimensions at the nanoscale or an internal nanoscale structure

EXAMPLE USE CASES

Today we are using Nano-Materials to improve the catalytic efficiency of Fuel Cells in electric vehicles and reduce the amount of rare Earth elements they use by 90 percent, and create new nanoscale detectors that can sense minute concentrations of chemicals and gases on alien planets, as well as in more conventional products including flash drives, hair dryers, nail polish, sunscreens and toothpaste. In the future the primary use cases for the technology will be almost limitless.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Defence, Energy, and Manufacturing sector, with support from government funding, and university grants. In time we will see our ability to create nanoscale materials, and materials with nanoscale properties, improve to the point where they are cost effective to mass produce, but some of them will likely face regulatory hurdles before they can be sold or used, especially in the consumer and healthcare sectors.

While Nano-Materials are in the Productisation Stage, over the long term they will be enhanced by advances in 3D Printing, Artificial Intelligence, Creative Machines, Molecular Assemblers, Nanoceramics, Nanoparticles, Nanomanufacturing, and Nanophotonic Materials, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

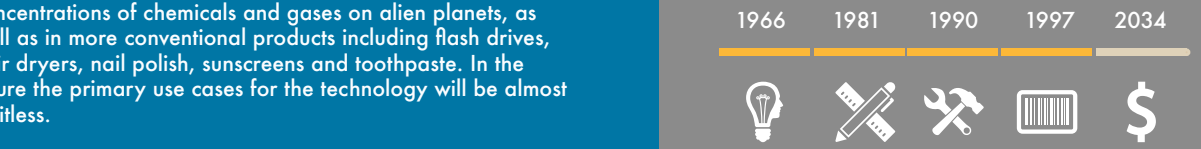
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19

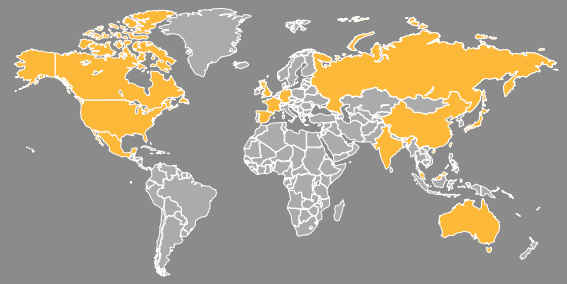
IMPACT

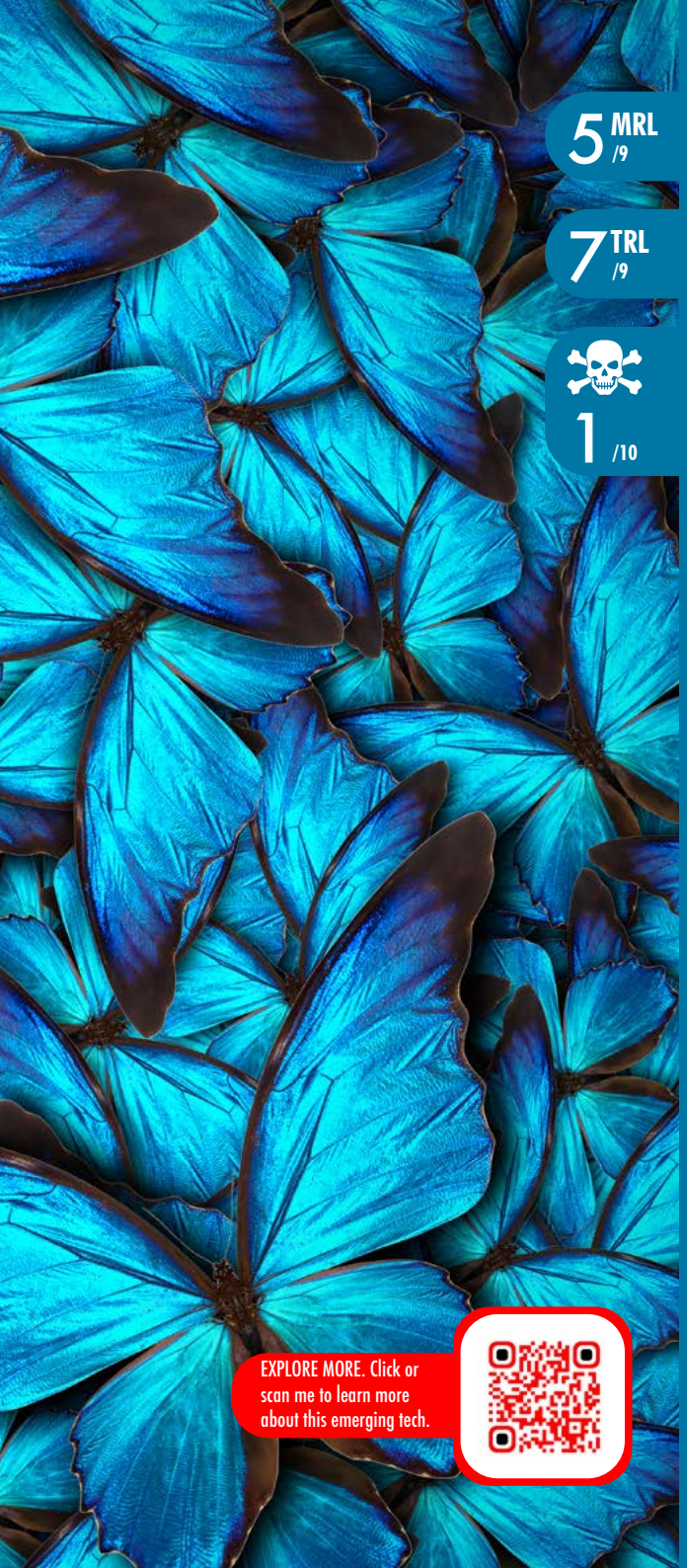
STATUS



Accessibility	8
Affordability	7
Competition	4
Demonstration	8
Desirability	8
Investment	8
Regulation	6
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





5 MRL /9

7 TRL /9

1 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

PLASMONIC PAINTS

PLASMONIC PAINTS, which is in the Prototype Stage, is the field of research concerned with trying to develop new nanostructured materials - and paints - that have unique and ever lasting optical properties, some of which draw their inspiration from nature. Recent breakthroughs in the space have been coming thick and fast, especially as it gets easier to fabricate nanostructured materials using technologies such as 3D Printing and other techniques, with some of the most notable breakthroughs including the development of new paints that mimic the nanostructures of butterfly wings and which never fade under any conditions, are the same colour from any angle, and which are super lightweight - all of which make this technology interesting and in some cases valuable in unexpected ways.

DEFINITION

Plasmonic Paints are coatings containing nanostructures that manipulate light at the plasmonic scale offering unique optical properties.

EXAMPLE USE CASES

The primary use case of this technology at the moment is in applications where colours need to be permanent and or light weight, with one example being in the aviation industry where aircraft manufacturers using this technology have been able to save hundreds of kilograms of weight - or the weight of a grand piano - which if spread across the global aviation fleet could help cut 2% or more of global emissions. Other use cases also include anti-counterfeiting, enhanced solar cells, as well as architecture and automotive applications, and even perhaps eventually fashion applications.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Plasmonic Paints increase, albeit from a very low base, primarily led by university grants. While this is arguably the first time in a long time that paint has been reinvented this is a technology that is coming of age because other complimentary technologies have finally caught up with the vision. However, while the results we're seeing to date are impressive over the long term there is little to suggest this will go mainstream and not remain a niche technology.

While Plasmonic Paints are still in the Prototype Stage they could be enhanced by advances in 3D Printing, Artificial Intelligence, Nano-Manufacturing and Nanotechnology, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

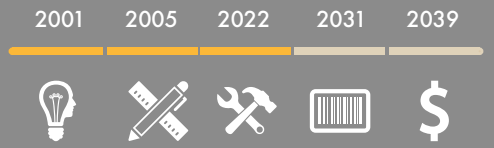
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

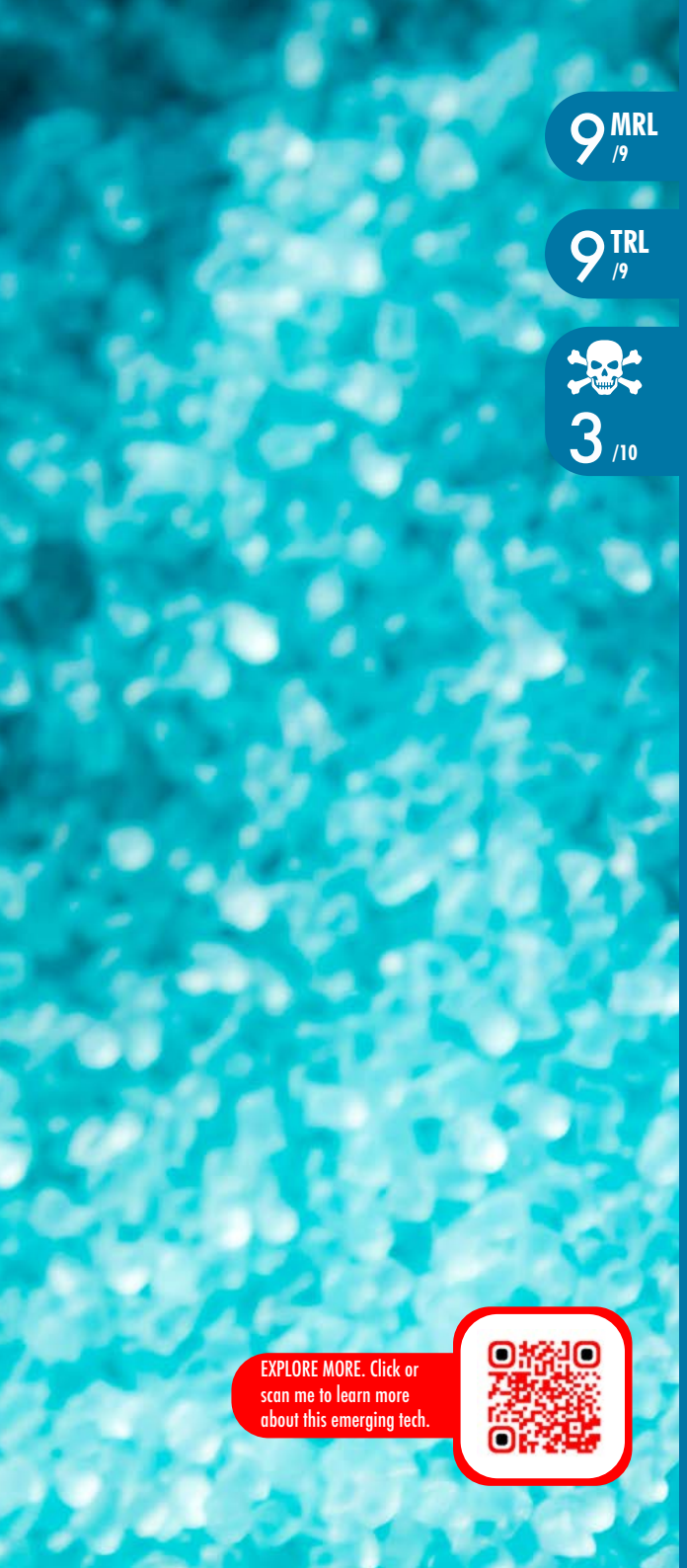
IMPACT

STATUS



Accessibility	4
Affordability	5
Competition	3
Demonstration	8
Desirability	8
Investment	3
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



9 MRL /9

9 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

POLYMERS

POLYMERS, which are in the Mass Adoption Stage, is the field of research concerned with developing new polymers that have a wide range of characteristics. Recently there have been a number of breakthroughs in creating more environmentally friendly polymers, as well as new energy orientated polymers and shape shifting polymers, the latter of which opens up a variety of new biomedical opportunities to create new biosensors, and shape shifting medical implants.

DEFINITION

Polymers are materials which have a molecular structure built up chiefly, or completely, from a large number of similar units bonded together.

EXAMPLE USE CASES

Today we use Polymers in almost every product you touch and use, from the plastic bottles in your hand, to the smartphones and gadgets in your pockets, and millions of other applications and products in between. In the future the primary use cases of polymers will remain, however, polymers will also form the foundation of a new type of molecular Exascale computing platform, help rip anti-biotic resistant bacteria apart like a chainsaw, and be used to help charge electric vehicles in just seconds.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Consumer Electronics, Defence, Manufacturing, and Retail sectors, with support from university grants. In time we will see the number of applications for the technology continue to increase almost exponentially as researchers create and discover new polymers with new capabilities.

While Polymers are the Mass Adoption Stage, over the long term it will be enhanced by advances in 3D Printing, Artificial Intelligence, and Creative Machines, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

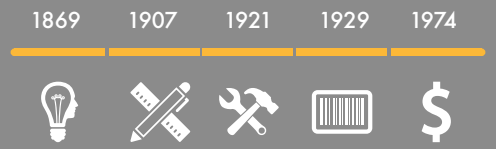
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '19

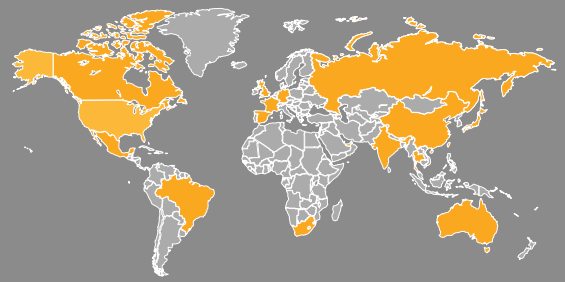
IMPACT

STATUS



Accessibility	9
Affordability	9
Competition	6
Demonstration	8
Desirability	9
Investment	9
Regulation	7
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



2 MRL /9

4 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

POLYMORPHIC LIQUID METALS

POLYMORPHIC LIQUID Metals, which are in the Prototype Stage, is the field of research concerned with developing new types of materials and metals that can change their shapes and properties on demand in response to specific stimulii. Recent breakthroughs in the field include the development of new Polymorphic Liquid Metals that are so responsive and can change their shapes so fast you could almost think of them as being alive.

DEFINITION

Polymorphic Liquid Metals are materials that can change their shape on demand in response to external stimulii.

EXAMPLE USE CASES

Today we are using small scale prototypes to prove the theory behind the technology and refine it. In the future the primary use case of this technology will be almost unlimited and could lead to the development of everything from shape shifting polymorphic robots all the way through to new classes of liquid based computing platforms.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Manufacturing and Technology sectors, with support from univesity grants. In time we will see the technology mature to the point where it can be used to create the first viable polymorphic products but at the moment there are a number of problems to overcome including the development of the control systems needed to control the technology's behaviours, as well as more practical problems such as how make it rigid, as and when needed. As a reasult it will be a long time until we see it being commercialised.

While Polymorphic Liquid Metals are in the Prototype Stage, over the long term they will be enhanced by advances in Chemical Computing, Digital Metamaterials, Liquid Computing, Metamaterials, Programmable Materials, Sensors, and Smart Dust, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

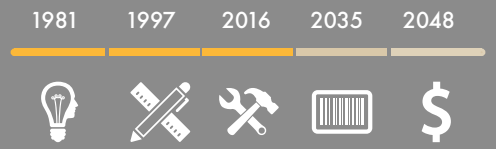
In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	3
Affordability	4
Competition	3
Demonstration	5
Desirability	9
Investment	2
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

2 MRL /9

3 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

PROGRAMMABLE MATTER

PROGRAMMABLE MATTER, which is in the Concept stage and early Prototype stage, is the field of research concerned with trying to develop materials capable of programmatically changing their shape and other properties, including conductivity, density, and optical characteristics, among others, in response to stimuli. While the rate of progress in the field is slow but steady it is clear that we are still a very long way away from being able to create matter that can spontaneously transform itself from one object, or form, into another on command. That said though recently there have been significant breakthroughs in a number of complimentary technology areas, including 4D Printing, Micromotes, that are dust sized computer platforms packed full of sensors, Swarm Artificial Intelligence and Swarm Robotics, and as all of these individual components mature one day they will let us create Programmable Materials, or "Grey Goo" as it's sometimes known, that's capable of on demand self-assembly and self-organisation.

DEFINITION

Programmable Matter can change its physical properties and characteristics based on user or autonomous stimuli.

EXAMPLE USE CASES

Today the early Programmable Matter prototypes, which are predominantly 4D printed, are simply experiments that researchers are toying with to test various approaches and theories. In the future the primary use case of this technology is limitless.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily funded by university grants. In time we will see researchers start zeroing in on specific approaches that work, and eventually through a process of elimination and experimentation we'll start seeing the first basic products emerge, and while most of today's research is focused on mechanical and synthetic systems, in time we will see the rise of biological inspired programmable matter.

While Programmable Matter is in the Concept stage and early Prototype stage, over the long term it will be enhanced by advances in 3D Printing, 4D Printing, Artificial Intelligence, Creative Machines, Micromotes, Nano-Manufacturing, Smart Dust, and Swarm Robotics, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

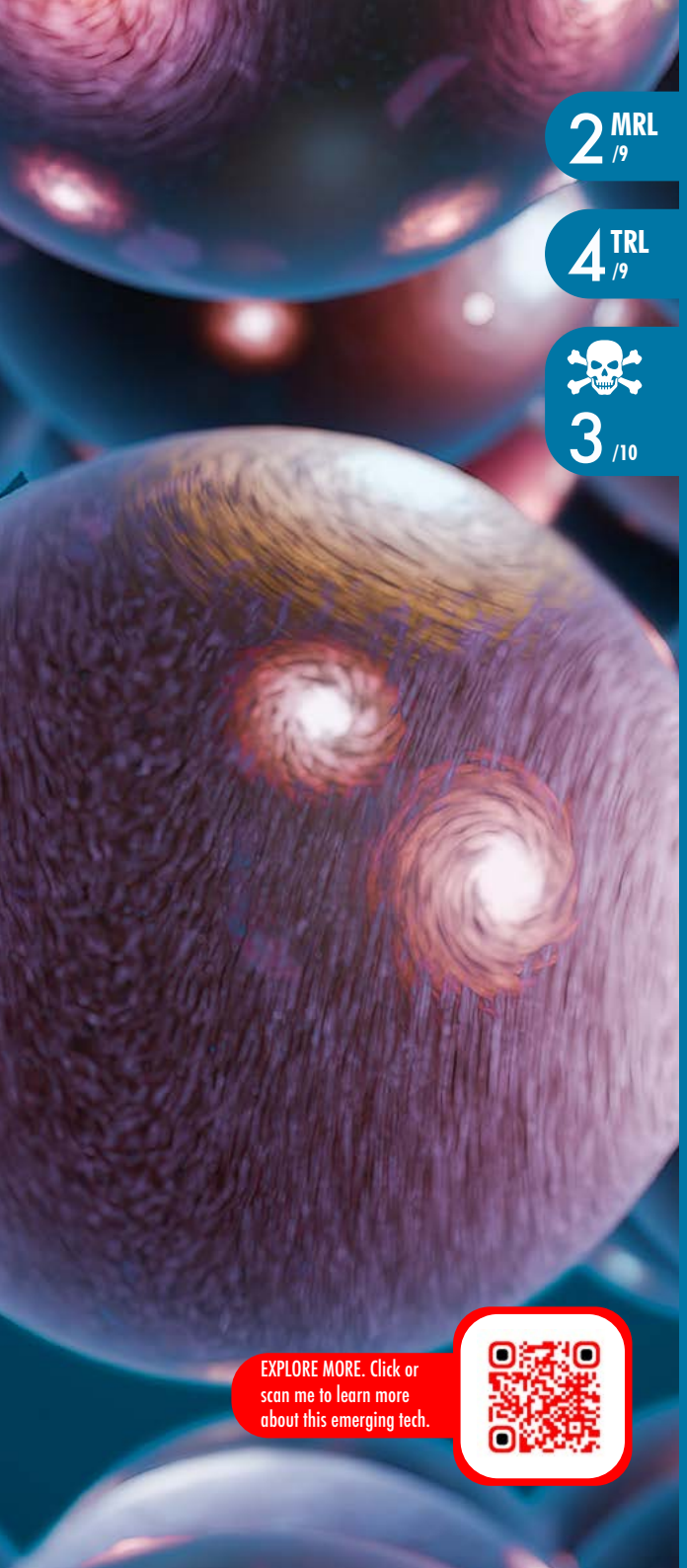
STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

IMPACT

STATUS

Accessibility	2
Affordability	2
Competition	1
Demonstration	2
Desirability	8
Investment	4
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



2 MRL /9

4 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

QUANTUM MATERIALS

QUANTUM MATERIALS, which are in the Prototype Stage, is the field of research concerned with trying to discover new quantum materials, where the spin and charge can be controlled, that could open the door to new commercial applications and products, including the development of completely new types of devices and materials, whether those be in the communications, computing, or energy sectors, or even in the consumer goods sector. Recently there have been a number of interesting developments in this field including the development of new alternative Rare Earth materials which can act as replacements to traditional Rare Earth materials, new Wave Computing devices, and others.

DEFINITION

Quantum Materials encompasses all materials whose essential properties cannot be described in terms of semi-classical particles and low level quantum mechanics.

EXAMPLE USE CASES

Today quantum materials are used in everything from computer hard drives and MRI's to superconductors, but future use cases could include the development of new catalysts and photovoltaic materials that don't degrade or loose performance over time, sensors that are immune to the noise of the environment around them, rare earth replacements, room temperature quantum electronics and superconductors, and many other examples.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, from a moderate base, primarily led by organisations in the defense, energy, and technology sectors, with support from government funding and university grants. In time we will see more Quantum Materials being commercialised but most people won't even know they exist.

While Quantum Materials are in the Prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Materials, Nano-Manufacturing, Quantum Computing, Quantum Electronics, and others, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '22, '23, '24

IMPACT

STATUS

Accessibility	2
Affordability	2
Competition	2
Demonstration	6
Desirability	8
Investment	2
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

REACTIVE MATERIALS

REACTIVE MATTER, which is in the early Prototype Stage, is the field of research concerned with developing new materials that vigorously condense, decompose, polymerise, or become self-reactive, when exposed to stimuli including pressure, shock, and temperature. While research in the field is slow being able to create multi-property materials that alter their characteristics, chemical composition, and state on demand could have a range of interesting applications, including the ability to create Transient Electronic systems, such as military drones, that complete their missions, and then vaporise leaving no trace of their existence.

DEFINITION

Reactive Materials can change their physical and, or chemical, properties when exposed to external environmental stimuli.

EXAMPLE USE CASES

Today there the Reactive Material prototypes are being used to test and refine the theory that we can create materials that are capable of changing their characteristics, chemical composition, and state, on demand. In the future the primary use of this technology could be to use it to create Transient Electronic systems, that can be used in the Defence and Healthcare sectors, as well as a wide variety of other products, but at the moment many of those use cases remain fuzzy.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Defence and Healthcare sectors, with support from government funding, and university grants. In time we will see the technology develop and mature but it is likely to be a very slow and winding path before we realise their potential.

While Reactive Materials are in the Prototype Stage, over the long term it will be enhanced by advances in 3D Printing, Artificial Intelligence, Creative Machines, and Nano-Manufacturing, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

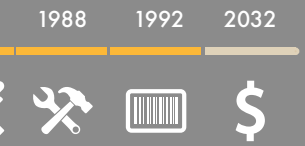
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19

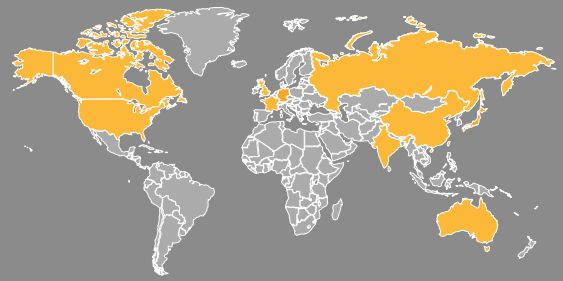
IMPACT

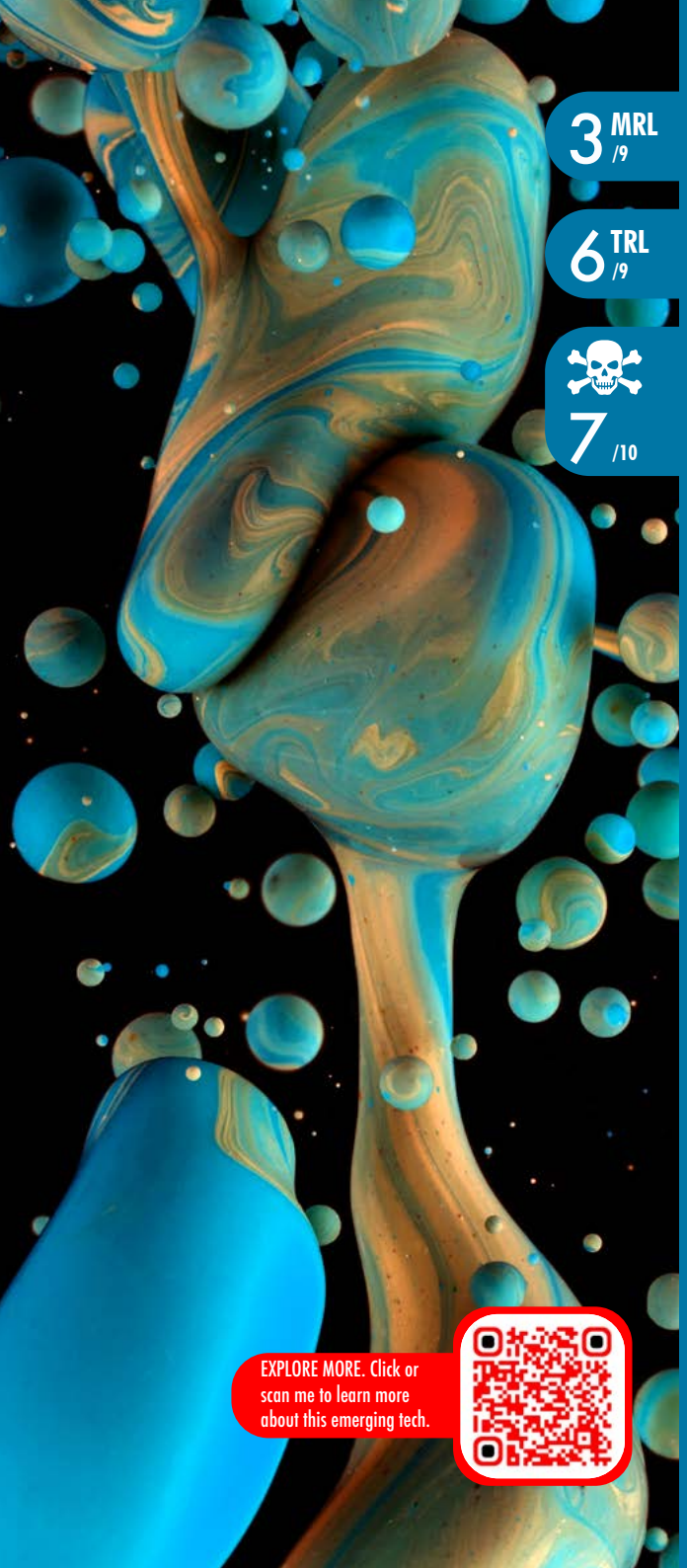
STATUS



Accessibility	8
Affordability	7
Competition	4
Demonstration	6
Desirability	8
Investment	4
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





3 MRL /9

6 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

RE-PROGRAMMABLE INKS

RE-PROGRAMMABLE INKS, which are in the Productisation Stage, is the field of research concerned with developing new types of printable ink that, once printed can be re-programmed using external stimulii to change their properties, such as colour and texture. Recent breakthroughs in the field include the development of re-programmable inks that, when exposed to specific wavelengths of light, can change their colour time and time again.

DEFINITION

Reprogrammable Inks are inks that can be re-programmed on demand using external sources that allow them to assume different attributes and properties.

EXAMPLE USE CASES

Today we are using Re-Programmable Inks to create clothes and shoes that can change colour on demand. In the future the primary use case of this technology will be almost limitless as the number of new properties that can be programmed into the materials at the macro scale and nano scale increases.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Manufacturing sector, with support from univesity grants. In time we will see the technology mature at an increasingly fast pace, and given the fact that it is highly unlikely to be subjected to any regulatory scrutiny I anticipate it will be adopted quickly especially as more organisation leverage the benefits of 3D Printing and 4D Printing technologies which over time will allow for increasingly fine grained control of the technology.

While Re-Programmable Inks are in the Productisation Stage, over the long term they will be enhanced by advances in 3D Printing, 4D Printing, Bio-Inks, and Programmable Materials, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

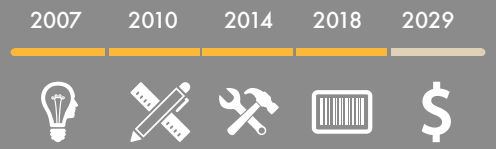
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22, '23

IMPACT

STATUS



Accessibility	6
Affordability	6
Competition	5
Demonstration	6
Desirability	9
Investment	3
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

4 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ROOM TEMP SUPERCONDUCTORS

ROOM TEMPERATURE SUPERCONDUCTORS, which are in the early Prototype Stage, is the field of research concerned with creating superconductors that work at, or very close to, room temperature. Recently there have been a number of breakthroughs in the field with the development of a Lanthanum Hydride superconductor that worked at -23 Celsius, which smashed the previous record of -230 Celsius, and elsewhere researchers recently managed to create the first ever sample of Metallic Hydrogen, another room temperature superconductor. As research in the field continues if, or when, researchers manage to create the first viable commercial product it will revolutionise several industries including communications and technology.

DEFINITION

Room Temperature Superconductors are materials that exhibit superconductive properties at, or near, room temperature.

EXAMPLE USE CASES

Today we are using the first Room Temperature Superconductors to test several approaches and theories, and refine the technology. In the future the primary applications of the technology will include using it to make the generation, transmission and use of electricity vastly more efficient.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Energy sector, with support from government funding, and university grants. In time we will see researchers continue to break records and get closer to creating room temperature superconductors that operate at, or above, 0 Celsius, but the biggest hurdle they have to overcome is creating a product that is stable at normal atmospheric pressure, and being able to commercialise it.

While Room Temperature Superconductors is in the early Prototype Stage, over the long term it will be enhanced by advances in Advanced Manufacturing, and Artificial Intelligence, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

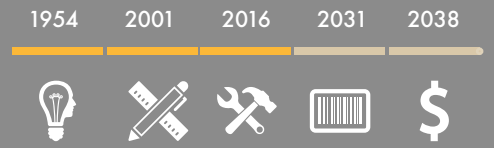
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19

IMPACT

STATUS



Accessibility	1
Affordability	1
Competition	1
Demonstration	2
Desirability	9
Investment	4
Regulation	3
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

5 MRL /9

9 TRL /9

5 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SELF-HEALING MATERIALS

SELF-HEALING MATERIALS, which are in the Prototype Stage and early Productisation Stage, is the field of research concerned with creating materials that are capable of self-healing in the event of minor, or in some cases catastrophic, damage. Recently there have been a number of breakthroughs in the field including both biological solutions such as using bacteria to secrete Calcite to repair concrete, as well as more traditional solutions that include using soft polymers to create self-healing Soft Robots, and Liquid Metals to repair catastrophic damage in electronic products.

DEFINITION

Self-Healing materials have structurally incorporated components or compounds that allow them to self repair themselves.

EXAMPLE USE CASES

Today we are using Self-Healing Materials to create self-healing windscreens for commercial aircraft, and screens for smartphones, as well as self-healing concrete. In the future the primary use cases of this technology will be almost limitless, including using it to create self-healing computer chips and vehicles, and everything in between.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Defence, Consumer Electronics, Healthcare, and Manufacturing sectors, with support from university grants. In time we will see the technology mature and become commercially viable for use across multiple sectors.

While Self-Healing Materials are in the Prototype Stage and early Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Creative Machines, Bio-Manufacturing, Liquid Metals, Nano-Manufacturing, Polymers, and Vascularised Nanocomposites, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

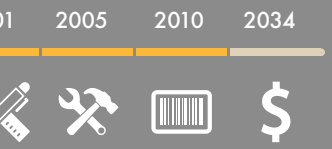
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

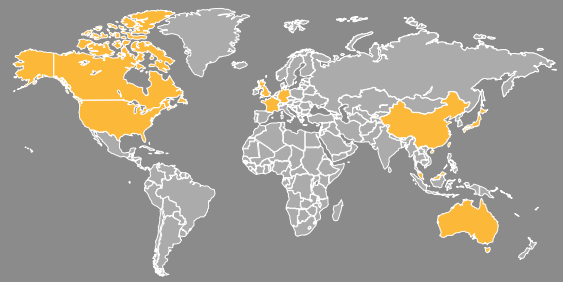
IMPACT

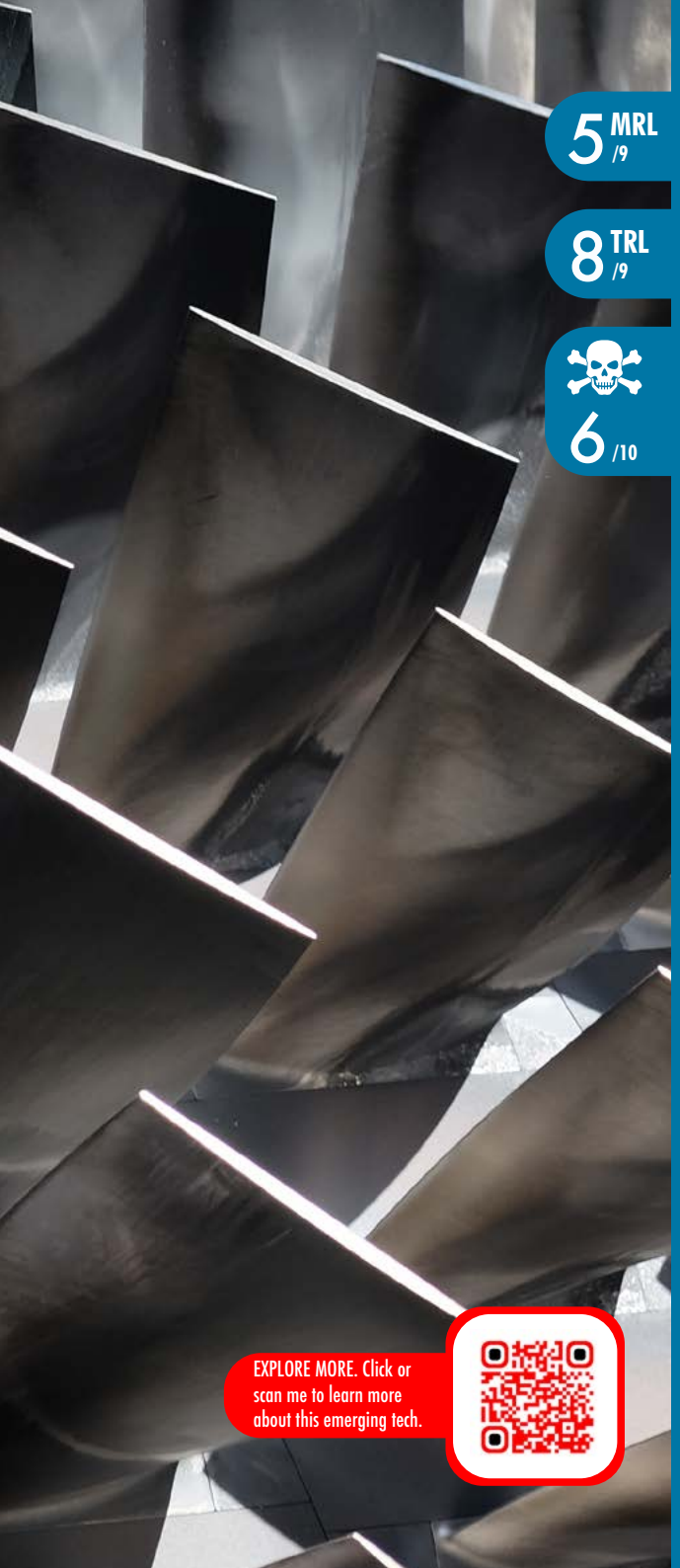
STATUS



Accessibility	5
Affordability	6
Competition	5
Demonstration	7
Desirability	9
Investment	7
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





5 MRL /9

8 TRL /9

6 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SMART MATERIALS

SMART MATERIALS, which are in the Productisation Stage, is the field of research concerned with developing materials embedded with intelligence, in the form of compute and sensors, that allow them to monitor and react to stimuli. Recently there have been a significant number of breakthroughs in a variety of complimentary fields, including in the development of 2D Graphene Antennae, Micromotes, Piezoelectric fabrics, Sensors, and Smart Nanobot sprays, which when combined means we increasingly have the capability to turn existing dumb materials smart, as well as create a wide range of new, advanced smart materials that can be used to manufacture everything from Smart Clothes and Wearables, through to Smart Buildings, and robots that have "intelligence" distributed throughout their entire bodies, rather than having to rely on a single, central "brain."

DEFINITION

Smart Materials are materials that can sense, monitor, and react to external stimuli.

EXAMPLE USE CASES

Today we are using Smart Materials in a wide range of applications, including liquid shock absorbers in cars that stiffen when magnetic fields are applied, and Photochromic pigments used in sunglasses, through to Hydrogels used to create artificial cartilage and robotic muscles, and robotic skins. In the future the primary use cases for the technology will be almost limitless.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Consumer Electronics, Defence, Manufacturing, Retail, and Technology sector, with support from government funding, and university grants. In time we will see the type and variety of commercially available smart materials accelerate exponentially to the point where they will become ubiquitous.

While Smart Materials are in the Productisation Stage, over the long term they will be enhanced by advances in 3D Bio-Printing, 3D Printing, 4D Printing, Bio-Manufacturing, Micromotes, Nano-Manufacturing, Piezoelectric Energy Systems, and Sensor Technology, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

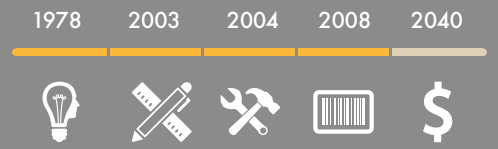
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19

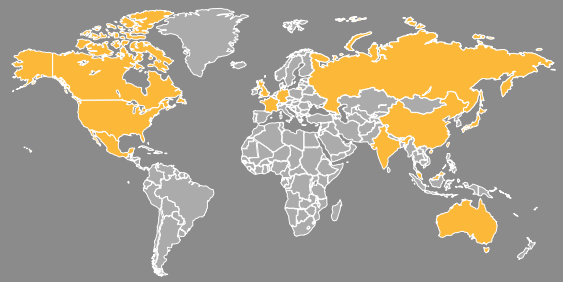
IMPACT

STATUS



Accessibility	6
Affordability	6
Competition	5
Demonstration	7
Desirability	8
Investment	8
Regulation	4
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

6 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SONO-INKS

SONO-INKS, which are in the Prototype Stage, is the field of research concerned with developing new kinds of inks that can be altered, assembled, and modified in situ using ultrasound or other external mechanical stimuli. Recent breakthroughs in this field include the development of Sono-Inks that can be moved into specific places within the human body and then shaped and hardened in vivo to create bio-compatible 3D shapes, and in time it's believed that this same technology might one day open the door to letting us acoustically 3D print human organs and other tissues within the human body - as well as other sci-fi-like applications.

DEFINITION

Sono-Inks are inks that contain nanoparticles that respond to ultrasound waves which allows them to be precisely controlled and manipulated.

EXAMPLE USE CASES

While a nascent field this technology's primary use case at the moment is being able to print bio-compatible structures deep within the human body which has applications for purposes ranging from bone healing through to heart valve repair. As the technology matures though other applications will emerge and increasingly we'll be able to use it to acoustically 3D print all manner of objects within objects, such as within micro-electronics, enclosed spaces, and so forth all using minimally invasive techniques.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Sono-Inks increase, albeit from a low base, primarily led by the Healthcare sector and university grants. The ability to control and manipulate inks, in this case, within the confines of different environments and objects opens the door to a whole new world of minimally invasive printing solutions, and while the development of Artificial Intelligence systems for control, and the development of new material types are important in the expansion of this technology, its unique characteristics mean that it has longevity, even if it is likely that it will remain niche for some time.

While Sono-Inks are still in the Prototype Stage they could be enhanced by advances in 3D Ultrasonic Printing, Artificial Intelligence, Materials, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

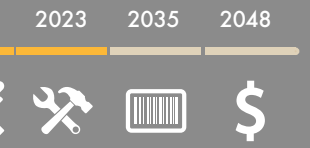
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

IMPACT

STATUS



Accessibility	3
Affordability	3
Competition	3
Demonstration	7
Desirability	7
Investment	2
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

7 MRL /9

8 TRL /9

5 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SPRAY ON MATERIALS

SPRAY ON MATERIALS, which are still in the Prototype Stage and early Productisation Stage, is the field of research concerned with creating a range of materials, including Smart Materials, that can be applied using just a simple spray. Recently there have been a number of breakthroughs in creating a range of new Spray On Materials, including spray on 2D Antenna made from Graphene, that can connect dumb objects to the internet of Things, through to creating spray on Nanobot materials that are not only embedded with connectivity capabilities and sensors, but also intelligence, and these have been thanks primarily to breakthroughs in a wide range of complimentary material science fields.

DEFINITION

Spray On Materials can be sprayed onto any surface to either protect them or enhance their functional properties or performance.

EXAMPLE USE CASES

Today we are using Spray On Materials to create spray on clothes, and omni-phobic coatings that protect products from everything from corrosion to water, and spray on materials that are capable of helping buildings withstand terrorist explosions. In the future the primary applications of the technology will be almost limitless.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Defence, Manufacturing, and Retail sectors, with support from university grants. In time we will researchers continue to experiment with different cocktails of both biological and chemical compounds, and begin seeing this field converge with other emerging technology fields including those listed below, which will make these materials even more varied and valuable.

While Spray On Materials are in the Prototype Stage and early Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Atomic Knots, Bio-Manufacturing, Graphene, Micromotes, Nano-Manufacturing, Polymers, Sensor Technology, and Smart Materials, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

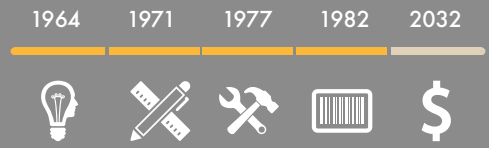
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21

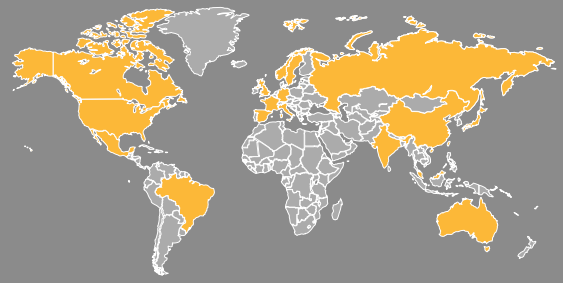
IMPACT

STATUS



Accessibility	8
Affordability	7
Competition	5
Demonstration	7
Desirability	7
Investment	6
Regulation	4
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

8 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SUPER ALLOYS

SUPER ALLOYS, which are in the Productisation Stage, is the field of research concerned with trying to develop new non-ferrous high performance alloys that exhibit outstanding durability, strength, and surface stability at high temperatures. Recently there has been an increasing flurry of activity in the field because of the need for new high performance alloys in the aerospace and defense sectors, but we have also seen Artificial Intelligence's manage to create surprisingly high performing Nickle alloys at speeds that would have been unimaginable just a few years ago which now have many of the people in the space, including the likes of NASA, very excited.

DEFINITION

Super Alloys are heat resistant alloys of Cobalt, Iron-Nickel, and Nickel which can be used at high temperatures, often in excess of 0.7 of absolute melting.

EXAMPLE USE CASES

While there are many use case examples some of the most interesting include the development of new super alloys that will enable the development of ultra fast ultra light new aircraft, for example hypersonic aircraft. However, other use cases include high speed energy turbines, as well as airfoils, nozzles, turbochargers, and vanes - anything where high temperatures and high performance are needed.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, from a moderate base, primarily led by organisations in the aerospace, aviation, defense, and energy sectors, with support from government funding and university grants. In time we will see more super alloys come to the market especially in the aerospace and energy sectors, and as Artificial Intelligence gets better at designing them we will see their rate of development accelerate exponentially.

While Super Alloys are in the Productisation Stage, over the long term they will be enhanced by advances in 3D Printing, Artificial Intelligence, Materials, Nano-Manufacturing, and others, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

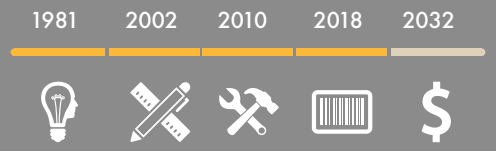
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '22, '23, '24

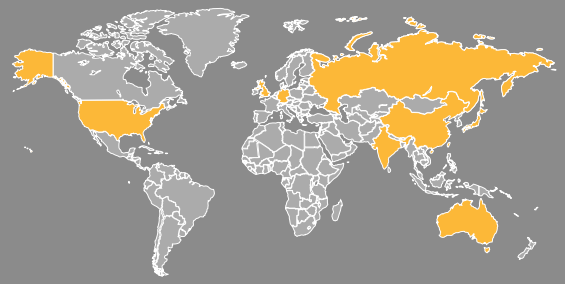
IMPACT

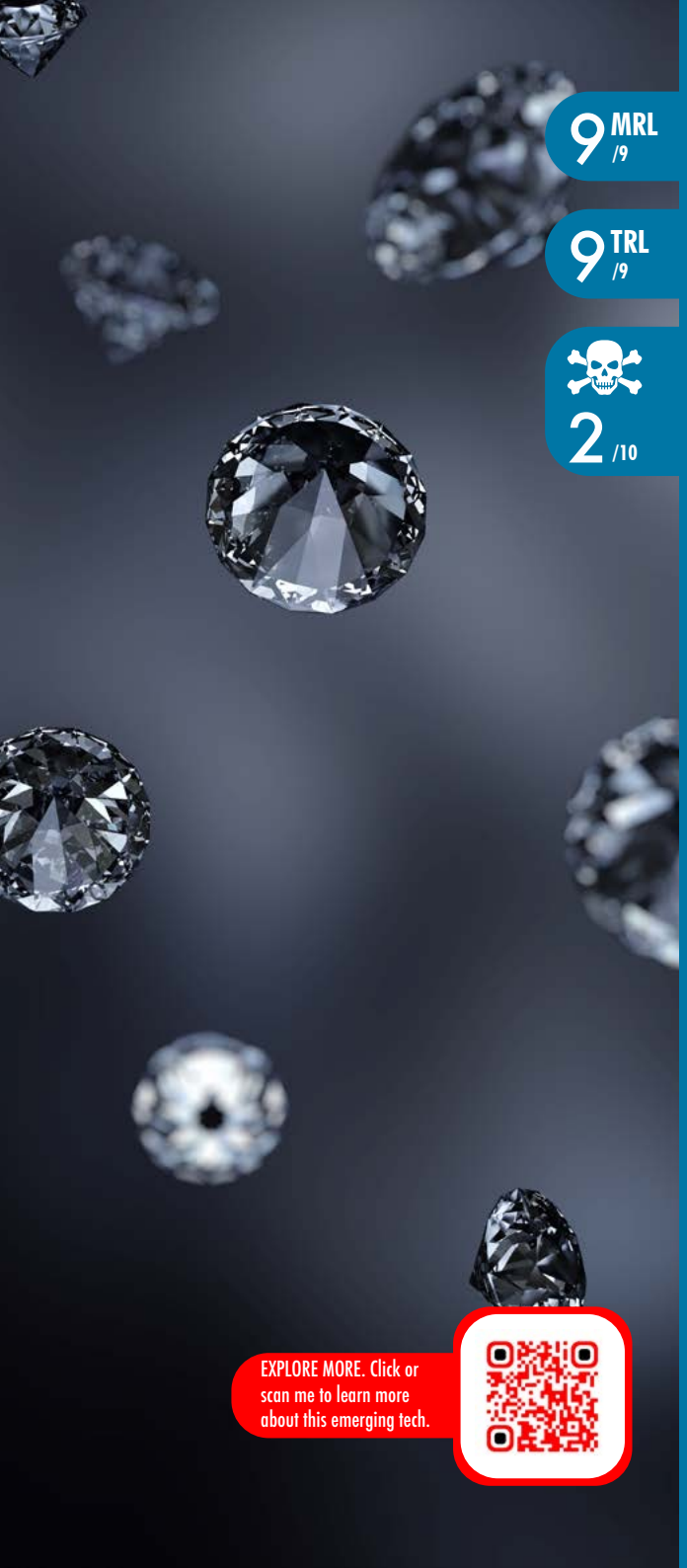
STATUS



Accessibility	5
Affordability	6
Competition	5
Demonstration	8
Desirability	9
Investment	6
Regulation	4
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





9 MRL /9

9 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SYNTHETIC DIAMONDS

SYNTHETIC DIAMONDS, which are in the Mass Adoption Stage, is the field of research concerned with developing new synthetic diamond manufacturing processes and synthetic diamond formats. While this field is arguably mature recent advances in manufacturing mean that there is still a lot of potential for this field to grow and expand into novel new markets - something that's neatly demonstrated by recent breakthroughs that have seen synthetic diamond materials being turned into high performance semiconductors and transistors, as well as viable memory components for the next generation of ultra-powerful quantum computers.

DEFINITION

Synthetic Diamonds are lab grown diamonds that have the same physical and optical properties as natural diamonds.

EXAMPLE USE CASES

While many people are familiar with the concept of using synthetic diamonds in everything from coatings, dies, drill bits, jewellery, nuclear batteries, quarrying tools, and toughened glass, increasingly as the cost of manufacturing diamond wafers falls future use cases will more commonly include everything from laser optics and quantum computer memory systems, all the way through to high performance semiconductors and transistors.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate, albeit from a low base, predominantly led by the manufacturing and technology sector. Today the cost of creating diamond wafers is still approximately 10,000 times greater than that of creating silicon wafers but as the costs continue to fall exponentially it won't be long before synthetic diamonds become an intriguing alternative, and given diamonds unique electrical and thermal properties it's therefore likely we will see it being used in more tech-centric use cases.

While Synthetic Diamonds are in Mass Adoption Stage over the longer term they could be enhanced by advances in AI, 3D Printing, Nanomanufacturing, and other technologies, however over the long term it's likely that they will be superseded by another novel material, possibly a hybrid Graphene construct, but that's unclear.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

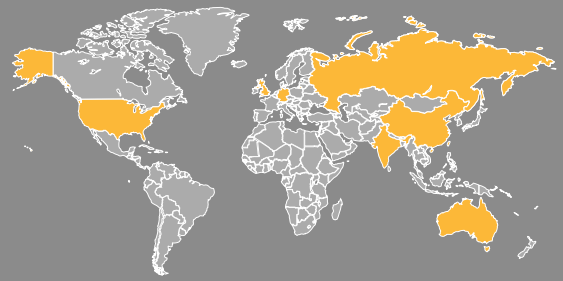
IMPACT

STATUS

1962	1974	1950	1962	1994

Accessibility	8
Affordability	5
Competition	4
Demonstration	9
Desirability	9
Investment	6
Regulation	4
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

4 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

TELEKINETIC METAMATERIALS

TELEKINETIC METAMATERIALS, which are in the early Prototype Stage, is the field of research concerned with developing new Metamaterials, with unnatural properties, whose form, function, and properties can be controlled using nothing more than people's thoughts. Recent breakthroughs in this field include the development of the first ever materials that are able to adapt their form, function, and properties, such as acoustic and optical properties, in response to people's thoughts, and while this is a brand new field these prototypes open the door to some interesting and sci-fi-like use cases - especially when we consider the amazing developments that we've already seen in the development of new Digital Metamaterials and conventional Metamaterials.

DEFINITION

Telekinetic Metamaterials are materials with properties not found in nature whose shape and properties can be manipulated using human thought.

EXAMPLE USE CASES

The first uses cases for Telekinetic Metamaterials will likely be in defence where in combination with Brain Machine Interfaces (BMI) they could conceivably be used to adapt Sixth Generation aircraft avionics and skins in real time according to the pilots thoughts and observations. However, they could also have applications in the future development of thought controlled Programmable Materials, Shape Shifting Robots, and Smart Dust, among other use cases.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in Telekinetic Materials accelerate, albeit from a very low base, predominantly led by the defence sector and government and military grants. The development of materials that can change their forms, functions, and properties in response to people's thoughts opens up a whole world of hitherto unimaginable sci-fi-like use cases, and as BMI's themselves miniaturise, this convergence of technologies could prove much more powerful than many people think.

While Telekinetic Metamaterials are in the early Prototype Stage over the longer term they could be enhanced by advances in 3D and 4D Printing, AI, Digital Metamaterials, Metamaterials, Nanomanufacturing, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

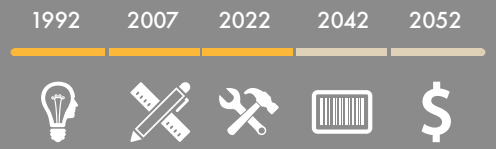
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23, '24

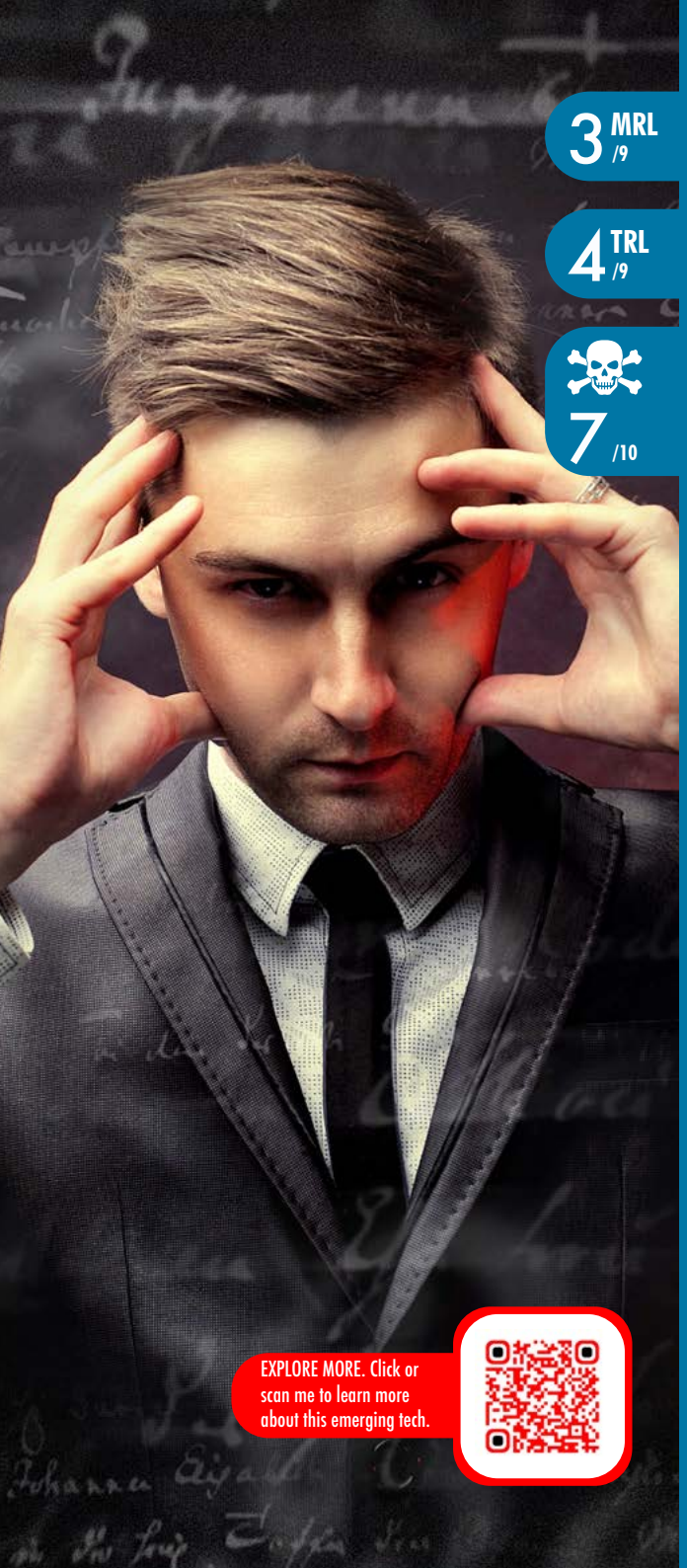
IMPACT

STATUS



Accessibility	3
Affordability	3
Competition	2
Demonstration	6
Desirability	8
Investment	2
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

4 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

TELEPATHIC METAMATERIALS

TELEPATHIC METAMATERIALS, which are in the early Prototype Stage, is the field of research concerned with developing a new class of Metamaterial, with unnatural properties, that acts as a conduit to augment, enable, and enhance human telepathic capabilities - whether it's between other people or machines. Recent breakthroughs in the field include the development of the first native Metamaterials, which in some ways resemble very advanced Brain Machine Interfaces (BMIs), that enabled researchers to communicate their thoughts directly to different devices using thought alone.

DEFINITION

Telepathic Metamaterials are materials with properties not found in nature that enable and enhance telepathic communication.

EXAMPLE USE CASES

While the existing use case for Telepathic Metamaterials is to enable basic human telepathic communication, whether it's Mind to Mind or Mind to Device, such as converting thoughts into imagery, text, video, and so forth, and communicating them onwards in the future it's conceivable that they could also be used to amplify, augment, and enhance human telepathic abilities. Think of the Cerebro in X-Men and you might start getting the idea. Sticking with this trend they could also be used to enable people to use their thoughts to control large scale distributed drone and robot swarms, something that could be especially pertinent in the defence sector.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate, albeit from a very low base, predominantly led by the defence and healthcare sectors. Over time it's likely that Telepathic Metamaterials and the field of BMI will converge, and the unison between the two could prove more interesting and more powerful than people might think. As a result I expect interest and investment in this field to increase, albeit constrained to niche research groups and geographies.

While Telepathic Metamaterials are in the early Prototype Stage over the longer term they could be enhanced by advances in 3D and 4D Printing, AI, BMIs, Computing, Digital Metamaterials, Hive Minds, Nanomanufacturing, Quantum Materials, Telepathy, and other technologies, however over the long term it's unclear what they will be superseded by.

MATTHEW'S RECOMMENDATION

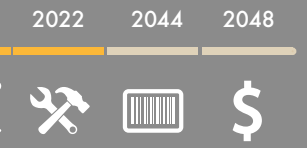
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23, '24

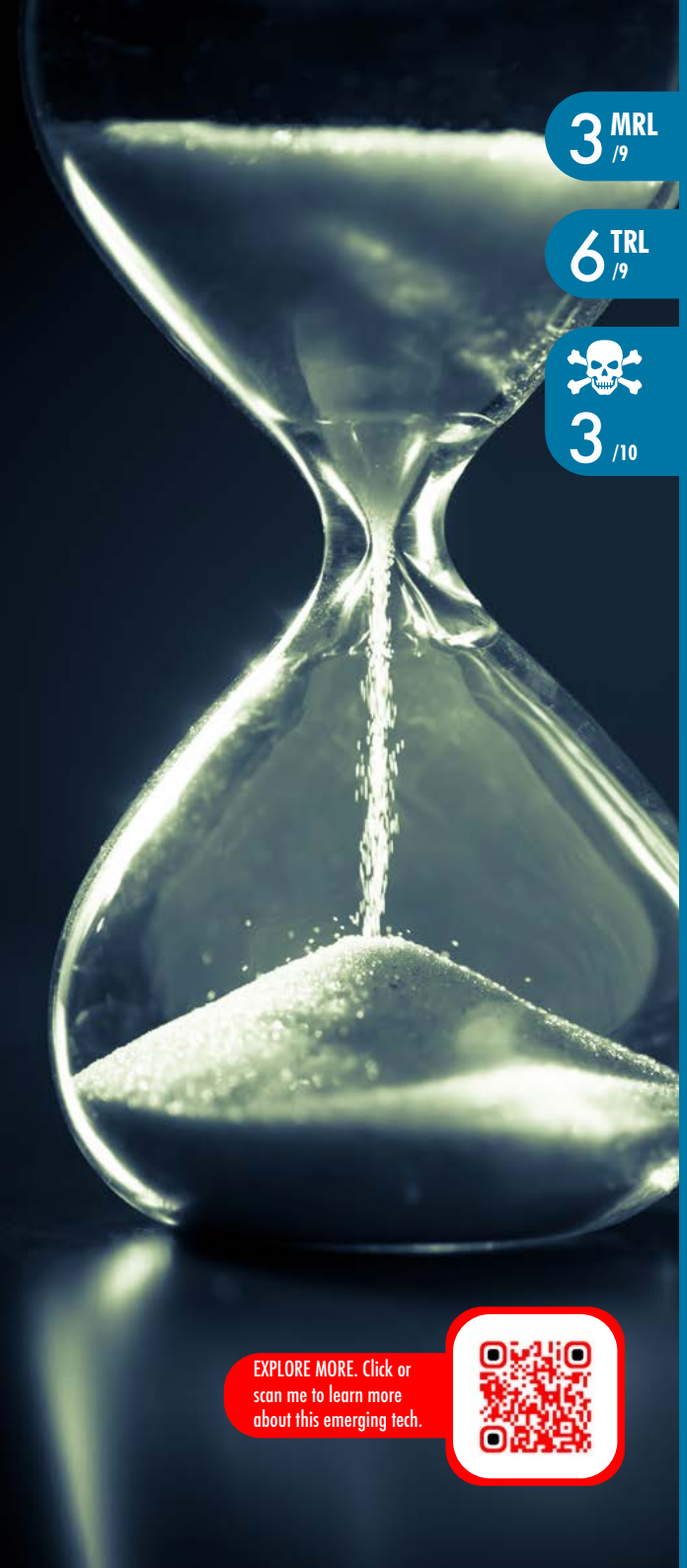
IMPACT

STATUS



Accessibility	3
Affordability	3
Competition	2
Demonstration	6
Desirability	8
Investment	2
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

6 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

TIME CRYSTALS

TIME CRYSTALS, which are in the early Prototype Stage, is the field of research concerned with developing spontaneously symmetrical materials that occupy the lowest energy ground states possible. Recently there have been several breakthroughs in the field including the direct observation of Time Crystals as well as the creation of the first stable Time Crystal whose properties and stability made it ideal for use in Qubit RAM for the next generation of Quantum Computers. As researchers discover more about these odd materials it's likely that in time they'll become more impactful and open the door to all manner of new novel use cases.

DEFINITION

Time Crystals are repeating structures of atoms that move in repetitive motions which cannot loose energy to their environment because they are already in their quantum ground state.

EXAMPLE USE CASES

As Time Crystals are a relatively new known concept the use cases for them are generally unclear. That said though one of their primary use cases could be as quantum computer memory, and this use case alone makes them a very interesting technology especially as that field expands. Meanwhile, other use cases include using them to maintain highly stable particle beams that are potentially orders of magnitude better than today's particle beams, which has implications not only for Fusion Energy but also for the healthcare sector, and beyond.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in the field accelerate, primarily led by government grants. While Time Crystals have long been theorised their recent observation and manufacture means that we are now starting to reach a point in time where they could be turned into viable components in all manner of exotic products, from Fusion reactors and particle beams, to Quantum Computers. As a result it's highly likely that research in the field will increase albeit led by specific niche research groups.

While Time Crystals are in the early Prototype Stage over the longer term they could be enhanced by advances in AI, Atomic Manufacturing, Quantum Materials, Quantum Sensors, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

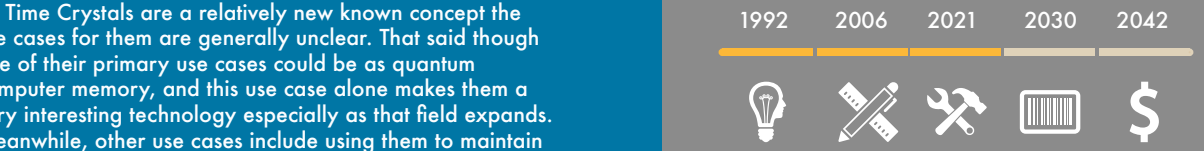
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

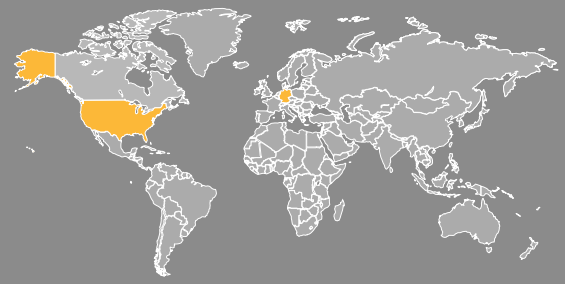
IMPACT

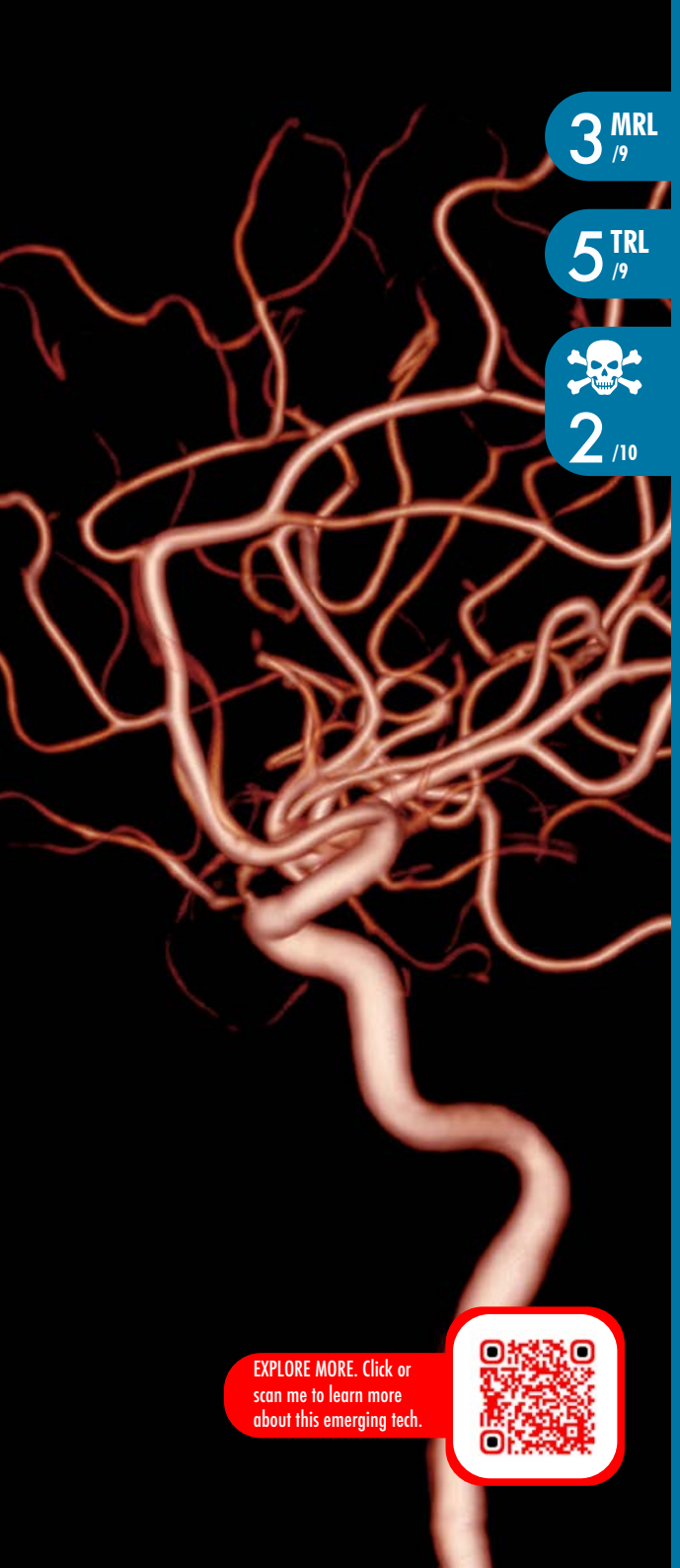
STATUS



Accessibility	3
Affordability	3
Competition	2
Demonstration	5
Desirability	6
Investment	2
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS





3 MRL /9

5 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

VASCULARISED NANOCOMPOSITES

VASCULARISED NANOCOMPOSITES, which are still in the Prototype Stage, is the field of research concerned with trying to create materials that can self-heal under a wide variety of extreme conditions, including within the torus of Fusion Reactors where the Plasma temperatures are so high, often in the hundreds of millions of degrees Celsius, they quickly degrade the materials of the chamber to the point where Fusion quickly collapses. Vascular Nanocomposites are so called because their internal structures resemble those of the human vascular system, containing billions of nanoscale capillaries that are capable of pumping healing liquids to where they're needed in order to fix breaks, and recently there have been several breakthroughs in the field.

DEFINITION

Vascularised Nanocomposites are materials that vascularise under specific conditions in a way that allows liquids to flow through them.

EXAMPLE USE CASES

Today we are using the first Vascularised Nanocomposite prototypes to create the first generation of self-healing Fusion reactors. In the future the primary use cases of the technology will include using it in any applications where self-healing materials have value.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Energy, and Manufacturing sectors, with support from government funding, and university grants. In time we will see the technology mature to the point where it becomes commercially viable and reliable enough to use in an increasingly wide variety of applications.

While Vascularised Nanocomposites are in the Prototype Stage, over the long term they will be enhanced by advances in 3D Printing, Artificial Intelligence, Creative Machines, Nanocomposites, Nano-Manufacturing, Self-Healing Materials, Simulation Engines, and Smart Materials, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '19

IMPACT

STATUS

Accessibility	3
Affordability	3
Competition	4
Demonstration	7
Desirability	6
Investment	4
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

ROBOTICS

MENTION THE word "robot" and everyone automatically thinks of mechanical automatons that are either confined to the factory floor or are trying to take over the world. And while the former are now at the point where they can learn new skills via Hive Minds and Human-Robot telepathic connections, the latter, among other things, is being used to help test and flex 3D printed human skin before it's transplanted onto patients - in short, "Human skin over a metal endoskeleton." Does that ring any bells?

As we continue to push the boundaries of what's possible many of the exotic robots we're developing are helping us build everything from the first Molecular Assemblers to the first Nanobot killing cancer machines, and while we aren't quite living in the world of sci-fi robots we're getting very close, especially as they learn how to design, evolve, and manufacture themselves ...

In this section you will find details of the emerging technologies that made it into this years Griffin Emerging Technology Starburst along with details of other impactful emerging technologies:

1. Androids
2. Anthrobots
3. Bio-Hybrid Robots
4. Crystal Robots
5. Cyborgs
6. DNA Robots
7. Drones
8. Evolutionary Robotics
9. Exo-Suits
10. General Purpose Robots
11. Inflatable Robots
12. Living Robots
13. Molecular Robots
14. Nano-Machines
15. Neurobiotics
16. Robots
17. Shape Shifting Robots
18. Slime Robots
19. Soft Robots
20. Swarm Robotics
21. Syncell Robots

In addition to these emerging technologies there are many others that have yet to get an entry in this codex. These include, but are not limited to:

22. Artificial Nervous Systems
23. Artificial Neurons
24. Artificial Synapses
25. Co-Bots
26. Conscious Robots
27. Micro Robots
28. Nanobots
29. Polymorphic Robots
30. Robot Plants
31. Soft Exo-Suits
32. Utility Fog

ANDROIDS

ANDROIDS, which are in the Prototype Stage, is the field of research concerned with making human-like robots that will eventually be indistinguishable from real people. While researchers in the field are slowly edging closer to Uncanny Valley they still have a way to go, but in spite of this advances in several key technology areas, from the development of new actuation systems to new skin-like materials, as well as the use of 3D Printing, Artificial Intelligence, and Machine Vision, mean that now the end is possibly in sight. Recently there have been a number of developments, such as new human-like eye and vision systems, as well as the production of more life-like and fluid motion systems, as well as new data capture and response systems, that are making Androids increasingly life-like.

DEFINITION

Androids are a form of robots or other artificial being that is designed to resemble a human.

EXAMPLE USE CASES

Today Androids are used mostly for entertainment purposes. In the future though researchers believe they could be used to help people extend their physical presence to anywhere on Earth via Tele-Operations and Tele-Presence technologies which would allow those people to carry out physical work, for example, remotely.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Technology sector. In time we will see Androids mature to the point where they are, to all intents and purposes, indistinguishable from humans at which point regulators will need to discuss how they are governed and their rights, and society will have to adjust.

While Androids are in the Prototype Stage, over the long term they will be enhanced by advances in Advanced Manufacturing, Intelligence, Robotics, and Sensor technologies, but at this point in time it is not clear what they will be replaced by but there is no doubt that they will be complimented by Human 2.0 as well as other Robo forms and formats.

MATTHEW'S RECOMMENDATION

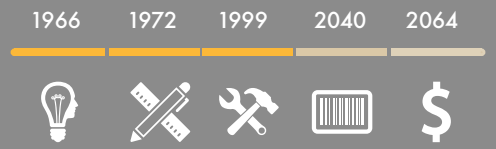
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '21, '22, '24

IMPACT

STATUS



Accessibility	4
Affordability	2
Competition	2
Demonstration	3
Desirability	7
Investment	5
Regulation	5
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

4 TRL /9

9 /10

ANTHROBOTS

ANTHROBOTS, which are in the early Prototype Stage, is the field of research concerned wit using human cells to create new forms of programmable living robots that are able to carry out specific functions and tasks. Recently there have been a small number of significant breakthroughs in this field as researchers managed to create not only living functional Anthrobots that could carry out basic tasks such as environmental monitoring, but that could also independently replicate. While this is an interesting technology to watch, with good potential, we must be cognisant of the ethical implications of using human cells to create what can quite literally be viewed as a new species of Artificial Lifeforms - whether they are programmable living robots or not.

DEFINITION

Anthrobots are programmable mobile living robots made from human cells that can carry out a multitude of different tasks.

EXAMPLE USE CASES

While the future use cases of this technology include tasks such as monitoring, in time we could also see Anthrobots take on more complex tasks such as building and developing micro or nanoscale materials and products, as well as being used in human in vivo medical applications and elsewhere. They could also one day be imbued with biologically inspired compute and intelligence which would then make them quite a formidable technology with sci-fi-like application albeit at the nano and micro scale.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Anthrobots increase, primarily led by university grants. While this technology is ethically questionable it does tie in with the larger trend of developing programmable living robots, the usefulness and utility of which will only increase over time. Therefore, while this is a niche technology with a long development and maturity cycle, with possible regulatory hurdles along the way, today we could nonetheless be seeing the development of a new form of Artificial Lifeform, imbued with compute and intelligence that could eventually take on sentience and a literal life of its own.

While Anthrobots are still in the early Prototype Stage they could be enhanced by advances in Artificial Intelligence, Biological Computing, Living Robots, Nano Computing, Nanotechnology, Synthetic Biology, and other technologies, however over the long term it could be replaced by a variety of alternative micro and nanoscale robots.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

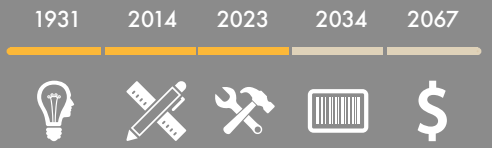
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

IMPACT

STATUS



Accessibility	2
Affordability	3
Competition	4
Demonstration	8
Desirability	6
Investment	2
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

4 MRL /9

5 TRL /9

7 /10

BIO-HYBRID ROBOTS

BIO-HYBRID ROBOTS, which are in the Prototype Stage, is the field of research concerned with developing robots, especially small format robots, that incorporate living materials into their designs. Recently there have been a number of breakthroughs in combining basic living tissues, as well as plant tissues, with robots to create a small array of Bio-Hybrid Robots that are capable of lifting objects, movement, and rudimentary sensing.

DEFINITION

Bio-Hybrid Robots combine different technological and biological components together in order to create new types of robots with new unique properties and capabilities.

EXAMPLE USE CASES

Today we are using the first Bio-Hybrid Robots to test the impact of new medical treatments on biological tissues. In the future the primary applications of the technology will include drug testing, and pharmaceutical studies, as well as environmental impact studies, and even search and rescue.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Healthcare and Technology sectors, with support from government funding, and university grants. In time we will see researchers ability to combine biological components with inorganic and synthetic components improve dramatically to the point where they are able to create increasingly complex systems, however, any applications involving healthcare will likely face heavy regulatory burdens which will slow their eventual adoption.

While Bio-Hybrid Robots are in the Prototype Stage, over the long term it will be enhanced by advances in 3D Bio-Printing, 3D Printing, Artificial Intelligence, Biological Computing, Bio-Manufacturing, CRISPR Gene Editing, DNA Computing, Micromotes, Nano-Manufacturing, Neurobiotics, Soft Robots, and Tissue Engineering, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

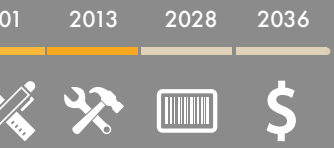
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '19, '20, '21, '22, '23

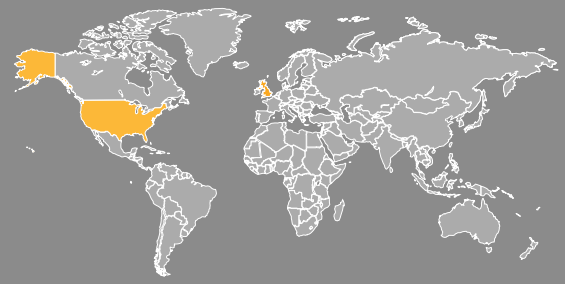
IMPACT

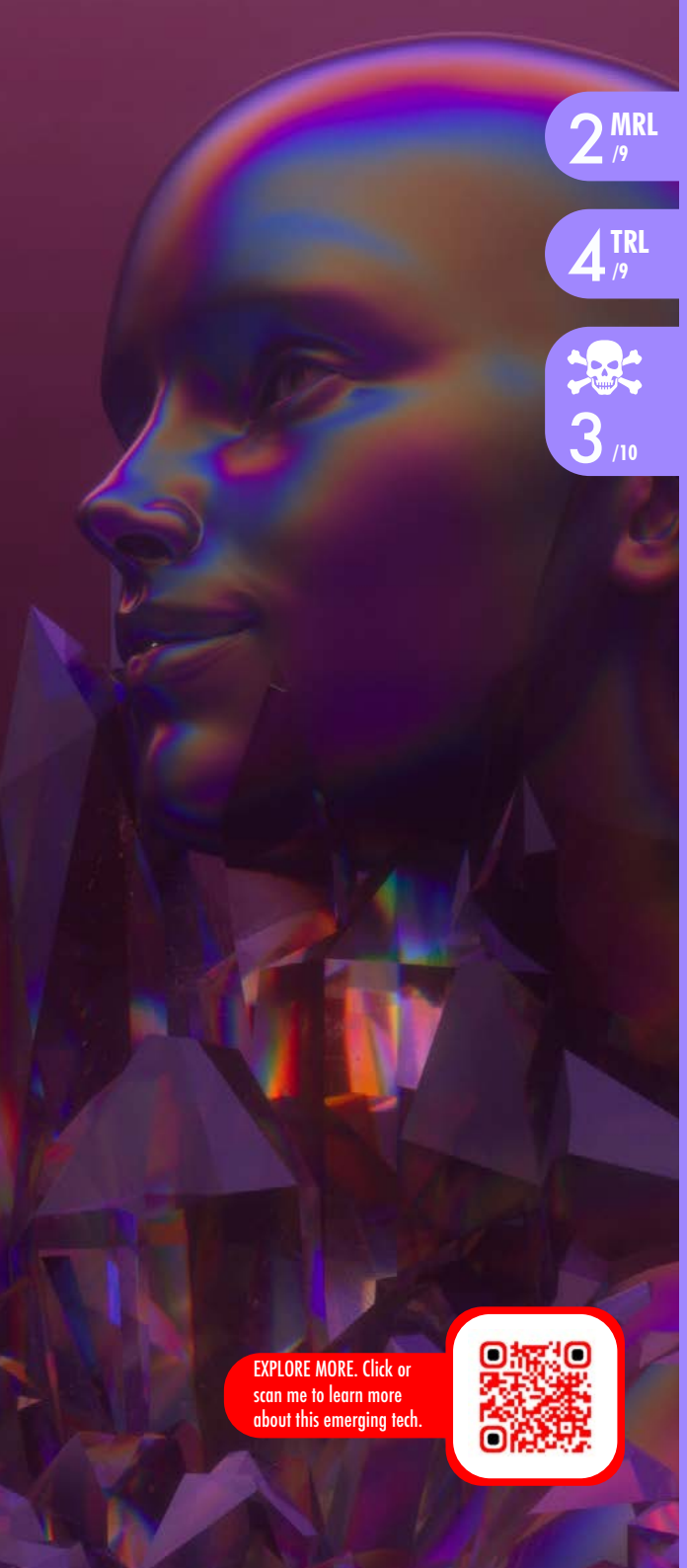
STATUS



Accessibility	4
Affordability	5
Competition	3
Demonstration	6
Desirability	7
Investment	4
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





2 MRL /9

4 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

CRYSTAL ROBOTS

CRYSTAL ROBOTS, which are in the Prototype Stage, is the field of research concerned with trying to find new ways to animate and use crystals for robotic applications. Recent breakthroughs in this field, which have unsurprisingly been sparse, include the use of AI to design new crystal robots and systems that are capable of self-reconfiguration, or in other words changing shape without any form of human intervention. By building modular crystalline robots, some of which are capable of moving and operating unthethered, researchers believe that this nacent field could have important applications in the development of soft robots and new kinds of sensor systems. However, other recent breakthroughs have included the development of ice robots which can repair themselves and shape shift so, as you can see, this is an interesting albeit wierd technology.

DEFINITION

Crystal Robots are 2D or 3D mechanical systems composed of crystalline atoms which are capable of performing basic motions.

EXAMPLE USE CASES

While today this field is nascent it's believed that some future use cases could include developing Crystal Robots that are capable of responding to particular stimulii, such as temperature, and that they could have applications as sensors, switches, and other areas. However, other more exotic use cases include the use of self-repairing shape shifting ice robots which can be used for interplanetary exploration.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate, albeit from a very low base, predominantly led by government grants. While Crystal Robots will undoubtedly find some niche applications, perhaps in the compute or electronics fields, as well as in the sensor field, it is understandably a very niche technology which means that it is at high risk of stagnating or vanishing altogether. That said though it could be buoyed by the rise in interest in Metamaterials and Nanomanufacturing.

While Crystal Robots are still in the Prototype Stage they could be enhanced by advances in AI, Materials, Nanomanufacturing, and other technologies, however over the long term it could be replaced by a variety of alternative robotic and sensor-like technologies.

MATTHEW'S RECOMMENDATION

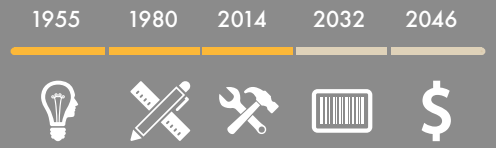
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

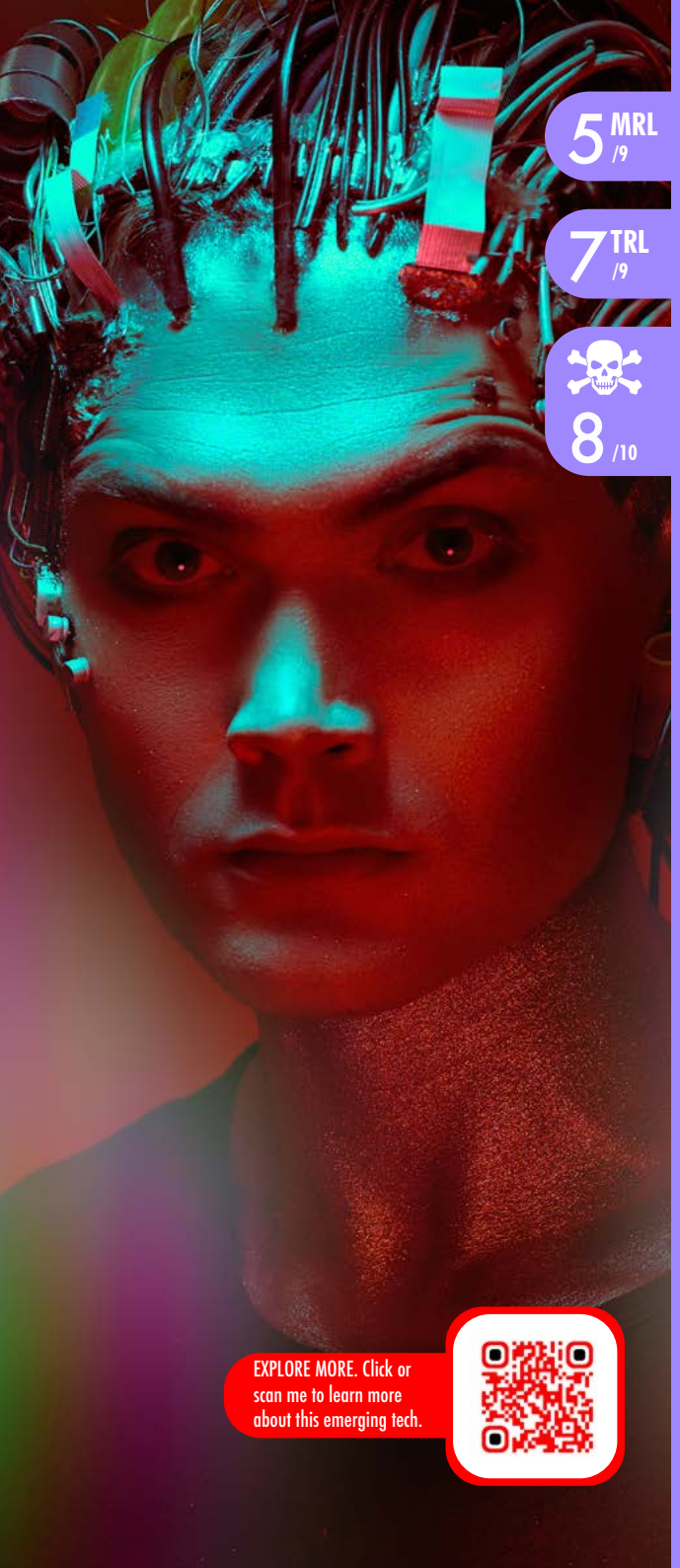
IMPACT

STATUS



Accessibility	4
Affordability	5
Competition	7
Demonstration	6
Desirability	5
Investment	1
Regulation	1
Viability	6

PRIMARY GLOBAL DEVELOPMENT AREAS



CYBORGS

CYBORGS, which are in the Productisation Stage, is the field of research concerned with trying to develop suites of integrated organic and bio-mechatronic components and systems that can be used either individually or collectively to create a cybernetic organism. While people have been body hacking themselves for decades, in various ways, recently there have been a number of developments that will accelerate the development of fully fledged cybernetic organisms. These include the development of the first Biological-Artificial neurons and synapses, an acceleration in the development of bionic components and organic compute and network constructs, bio-compatible electronics and materials, and a variety of other innovations.

DEFINITION

Cyborgs are people whose physical abilities have been extended beyond normal human limitations by mechanical elements built into the body.

EXAMPLE USE CASES

Today most people who call themselves Cyborgs have used technology to augment only a few of their human attributes, such as being able to hear colour. In the future though the technologies behind the Cyborg movement will fuel the trend of human augmentation, and what some people have called "The ultimate human accessories."

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Healthcare and Technology sectors, with support from government funding and university grants. In time we will see the technologies needed to create cybernetic organisms mature to the point where regulators and society at large will be faced with questions that range from the issues of Trans-Speciation through to how to regulate human augmentation, Human 2.0, and the Singularity.

While Cyborgs are in the Prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Bio-Compatible electronics and materials, Bio-Robotic Sensors, Brain Machine Interfaces, Machine Vision, as well as Advanced Manufacturing, Biotech, Communications, Compute, Energy, Materials, Robotics, and Sensor technologies, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

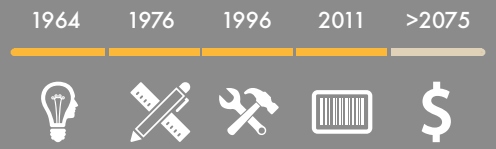
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '21, '22

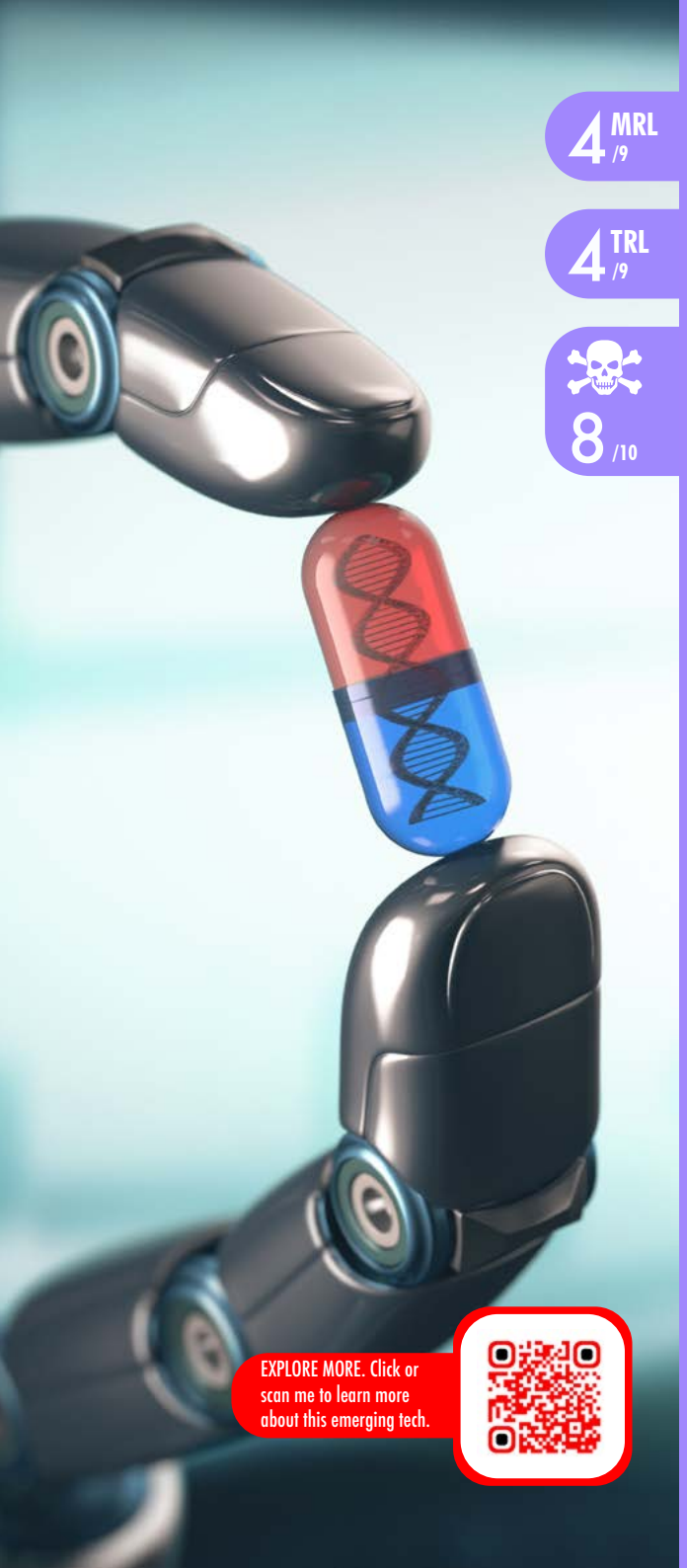
IMPACT

STATUS



Accessibility	3
Affordability	4
Competition	3
Demonstration	6
Desirability	5
Investment	4
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



4 MRL /9

4 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

DNA ROBOTS

DNA ROBOTS, which are in the Concept Stage and early Prototype Stage, is the field of research concerned with developing robots made exclusively from DNA that are capable of performing an increasingly wide array of actions. Recently there have been several breakthroughs in the technology, primarily in the areas of DNA Origami, and DNA Synthesis, that have allowed researchers to create programmable DNA robots capable of performing very specific actions, such as product assembly and sorting, which means that one day they could form the basis of the world's first viable Molecular Assemblers.

DEFINITION

DNA Robots are robots made from DNA that can be pre-programmed to interact in a predictable way to perform specific actions.

EXAMPLE USE CASES

Today we are using prototype DNA Robots to assemble and sort molecular sized products, and detect cancers. In the future the primary applications of the technology will include Healthcare applications, Molecular Assemblers, and many more.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Healthcare sector, with support from government funding, and university grants. In time we will see researchers become capable of increasingly complex machines that offer a more sophisticated range of abilities, and the technology could also be enhanced with the technologies named below to create DNA Robots with built in compute and intelligence.

While DNA Robots are in the Concept Stage and early Prototype Stage, over the long term they will be enhanced by advances in 3D Bio-Printing, Biological Computing, CRISPR Gene Editing, DNA Computing, DNA Neural Networks, Molecular Assemblers, Soft Robots, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

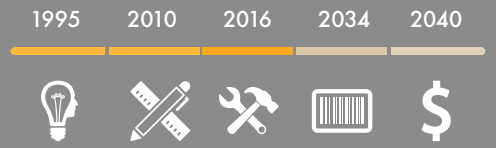
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23, '24

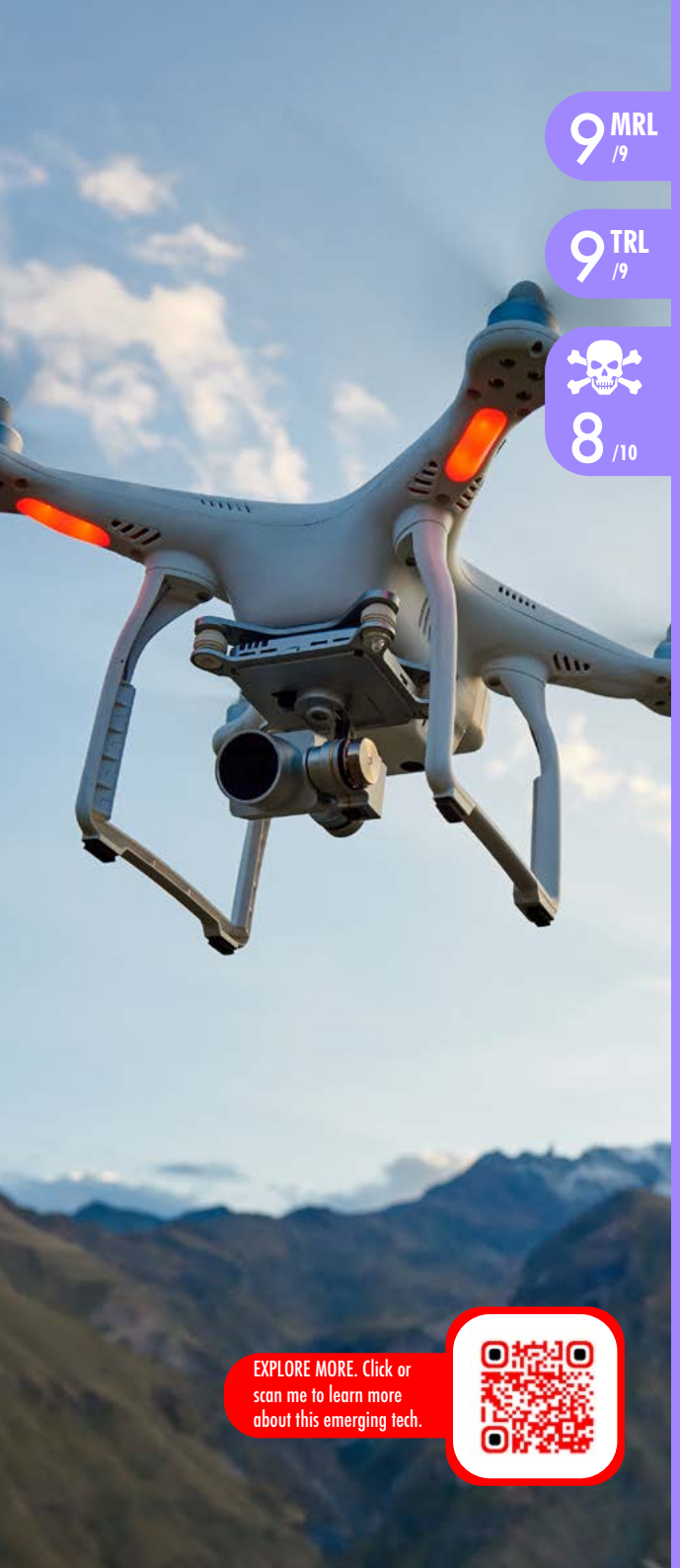
IMPACT

STATUS



Accessibility	2
Affordability	4
Competition	2
Demonstration	6
Desirability	8
Investment	3
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



9 MRL /9

9 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

DRONES

DRONES, which are in the Productisation Stage, is the field of research concerned with making a wide range of unmanned, semi-autonomous, or autonomous machines that come in a variety of sizes and formats that have applications in a multitude of different environments and situations. Drones are one of a number of fields that are now taking off and in the Productisation Stage, but despite that they, like many technologies, are still in their infancy and there's still a huge amount of potential to be embedded into, and extracted from them. Recently there have been significant advances in Drone control systems, energy, and materials.

DEFINITION

Drones are unmanned, semi autonomous or autonomous vehicles or machines.

EXAMPLE USE CASES

Today we are using Drones in a myriad of ways, including to survey buildings, energy grids, and pipelines, but we are also using them for content creation, defence, entertainment, and transportation, and much more. In the future the primary use case of the technology will include applications where semi-autonomous and autonomous drone operations add value.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Defence, Consumer Electronics, Energy, and Transportation sector, with support from government funding, and university grants. In time we will see the variety of drones available on the market, and their capabilities, both semi-autonmous and autonomous, increase, and it goes without saying that their futures are closely tied to developments in the Advanced Manufacturing, Compute and Systems, Communications, Energy, Intelligence, and Sensor categories.

While Drones are in the Productisation Stage, over the long term it will be enhanced by advances in 3D Printing, Artificial Intelligence, Creative Machines, Diffractive Neural Networks, Laser Energy Transmission, Machine Vision, Materials, Molecular Assemblers, Photovoltaics, Polymers, Printable Batteries, Self-Healing Materials, Sensor Technology, Simulation Engines, Solid State Batteries, Structural Batteries, Swarm Artificial Intelligence, Swarm Robotics, Transient Electronics, and Wireless Energy, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

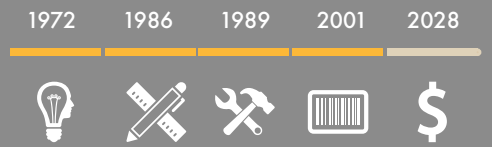
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19

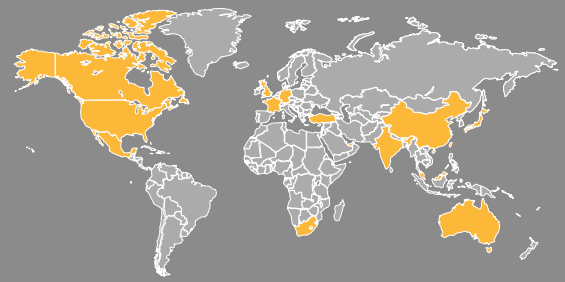
IMPACT

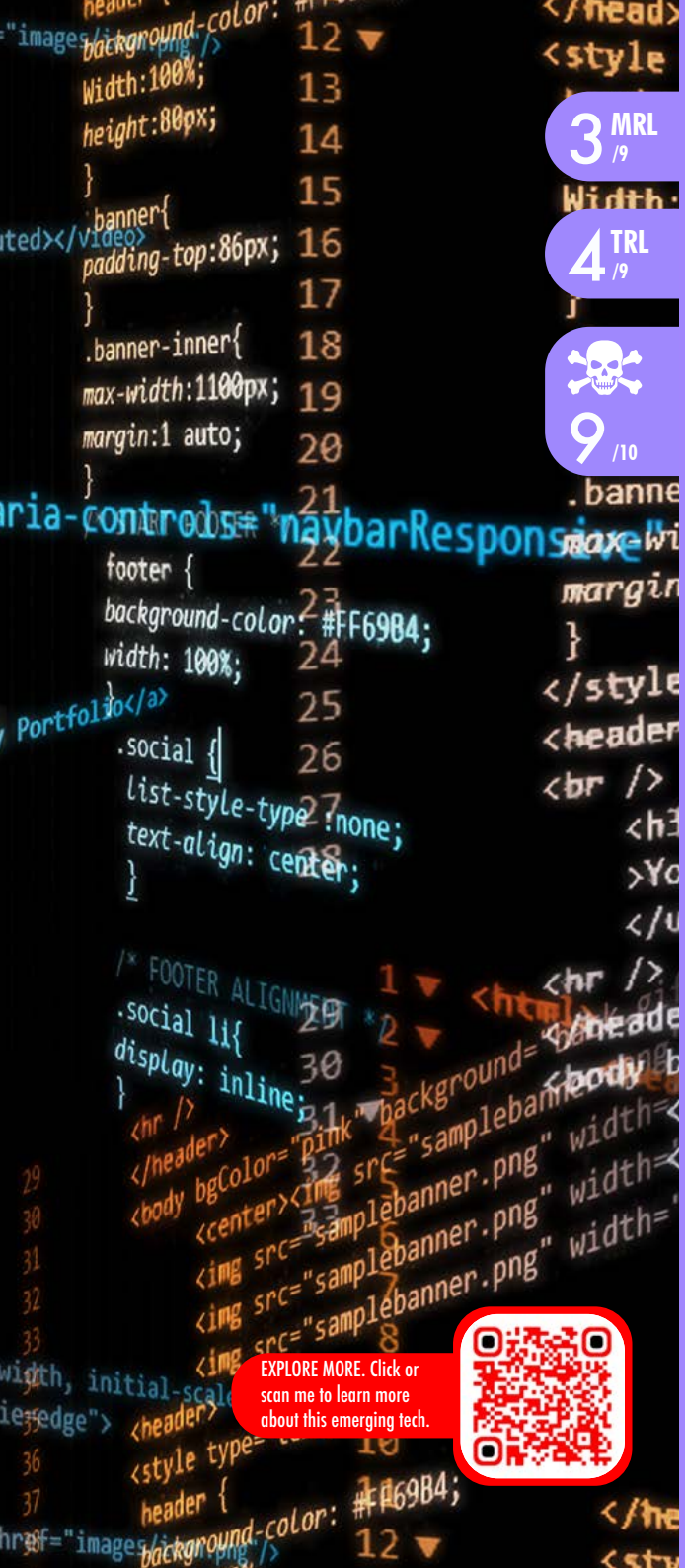
STATUS



Accessibility	9
Affordability	8
Competition	7
Demonstration	9
Desirability	9
Investment	8
Regulation	7
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





EVOLUTIONARY ROBOTICS

EVOLUTIONARY ROBOTICS, which are in the Prototype Stage, is the field of research concerned with developing new ways to emulate and replicate the evolutionary qualities of living organisams in robots. Recent breakthroughs in the space include the ability for robots to merge code bases, in the same way animals combine genetic material in order to evolve, and the development of new robotic systems that allow robots to sense their environments, and then use Creative Machines and simulated environments to help them discover new ways to adapt to it - whether those adaptations result in minor functional or shape changes, or result in the robots designing new parts for themselves and 3D printing them off, such as 3D printing a new type of leg that helps them cover a different tye of terrain.

DEFINITION

Evolutionary Robotics are a class of robots that can combine their code, evolve, and reproduce in the same way natural organisms do, but at an exponential rate.

EXAMPLE USE CASES

Today we are using prototypes to prove the theory behind the technology and refine it. In the future the primary use case of this technology will be almost limitless and ultimately lead to a point were we see robot evolution accelerated millions fold and where one robot really can "do it all."

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by organisations in the Technology sector. In time we will continue to see the rapid development of the technology and as it matures it is inevitable that organisations will see it as a must have technology that they can use and adapt for their own use, and as a result once the technology is established it is likely to become the defacto way robots in the future are architected and built.

While Evolutionary Robotics are in the Prototype Stage, over the long term they will be enhanced by advances in Advanced Manufacturing, Artificial Intelligence, Brain Machine Interfaces, Creative Machines, Hive Minds, Machine Vision, Materials, Molecular Assemblers, Neuromorphic Computing, Neuro-Prosthetics, Quantum Computing, Sensors, and Simulation Engines, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

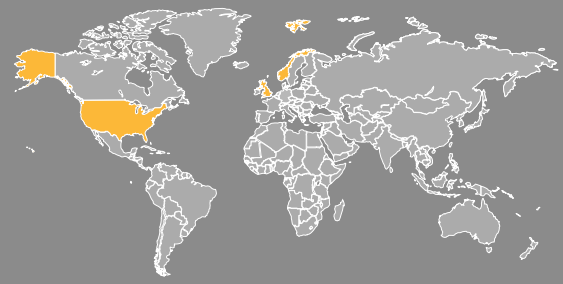
STARBURST APPEARANCES: '20, '21, '24

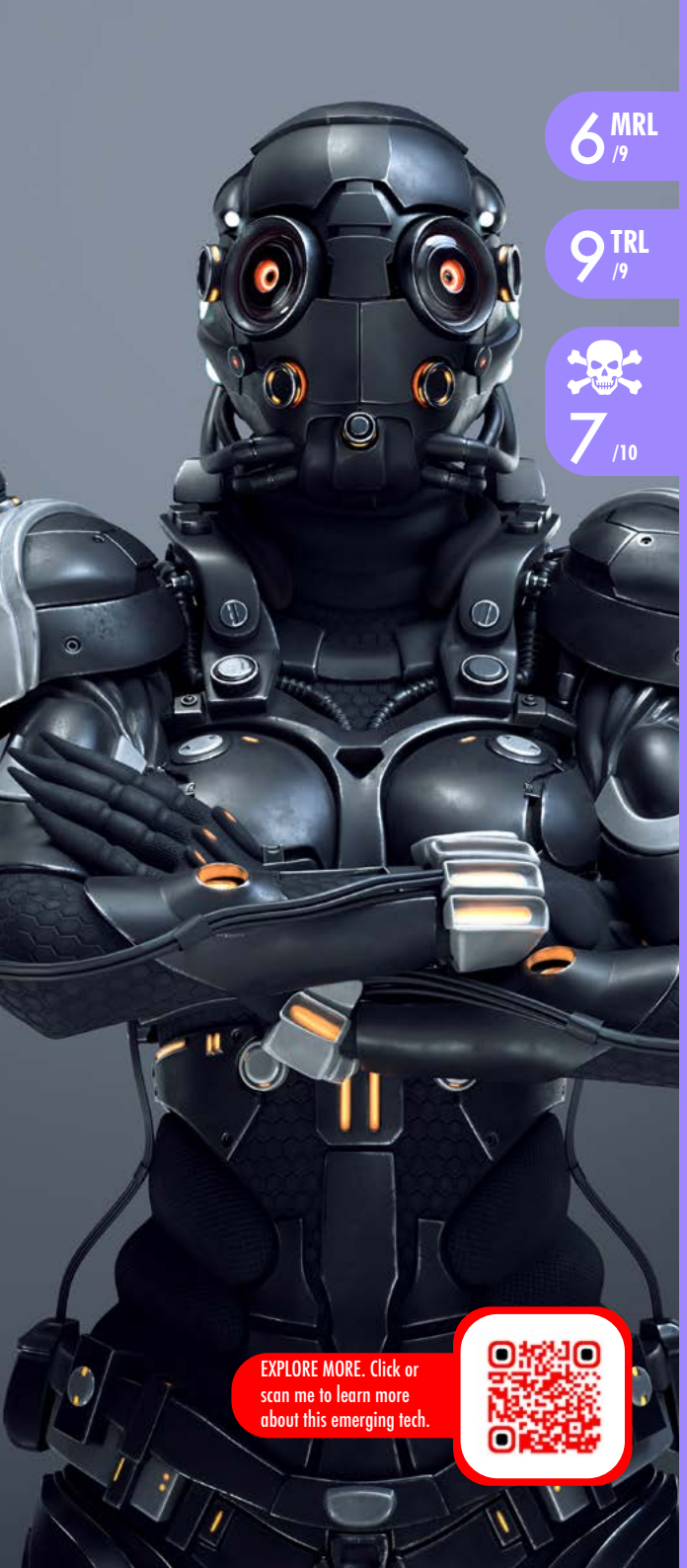
IMPACT

STATUS

Accessibility	3
Affordability	4
Competition	2
Demonstration	8
Desirability	9
Investment	4
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





6 MRL /9

9 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

EXO-SUITS

EXO-SUITS, which are still in the Prototype Stage and early Productisation Stage, is the field of research concerned with developing external mechanical systems that help augment the capabilities of the people and products that are wearing and using them. Recently there have been a variety of breakthroughs in the control systems, energy, and materials used in the manufacture of both hard form and soft form Exo-Suits, which means that they are now useful for an increasing range of applications that involve, initially either fine motor movements and, or heavy lifting.

DEFINITION

Exo-Suits are non invasive, artificial external mechanical systems that allow people to extend the range of their capabilities

EXAMPLE USE CASES

Today we are using Exo-Suits to assist factory workers, and help people regain their motor functions after they've suffered catastrophic neurological injuries, and in the military sector to help warriors on the battlefield. In the future the primary applications of the technology will include any applications where being able to augment a humans natural capabilities add value.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by organisations in the Aerospace, Defence, Healthcare, and Manufacturing sectors, with support from government funding, and university grants. In time we will see researchers in the space experiment with a range of new control systems, energy types and materials to create lighter, more capable platforms.

While Exo-Suits are in the Prototype Stage and early Productisation Stage, over the long term they will be enhanced by advances in 3D Printing, 5G, Artificial Intelligence, Augmented Reality, Co-Bots, Creative Machines, Flexible Electronics, Hive Minds, Printable Batteries, Neural Interfaces, Printable Batteries, Screenless Display Systems, Neural Interfaces, Neuro-Prosthetics, Self-Healing Materials, Structural Batteries, and Wireless Energy, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

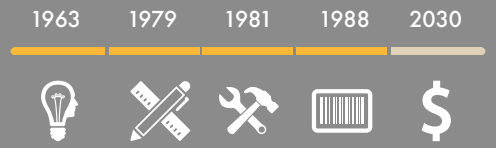
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '19, '20, '21, '22, '23, '24

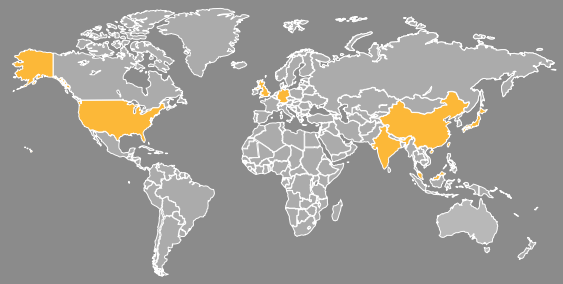
IMPACT

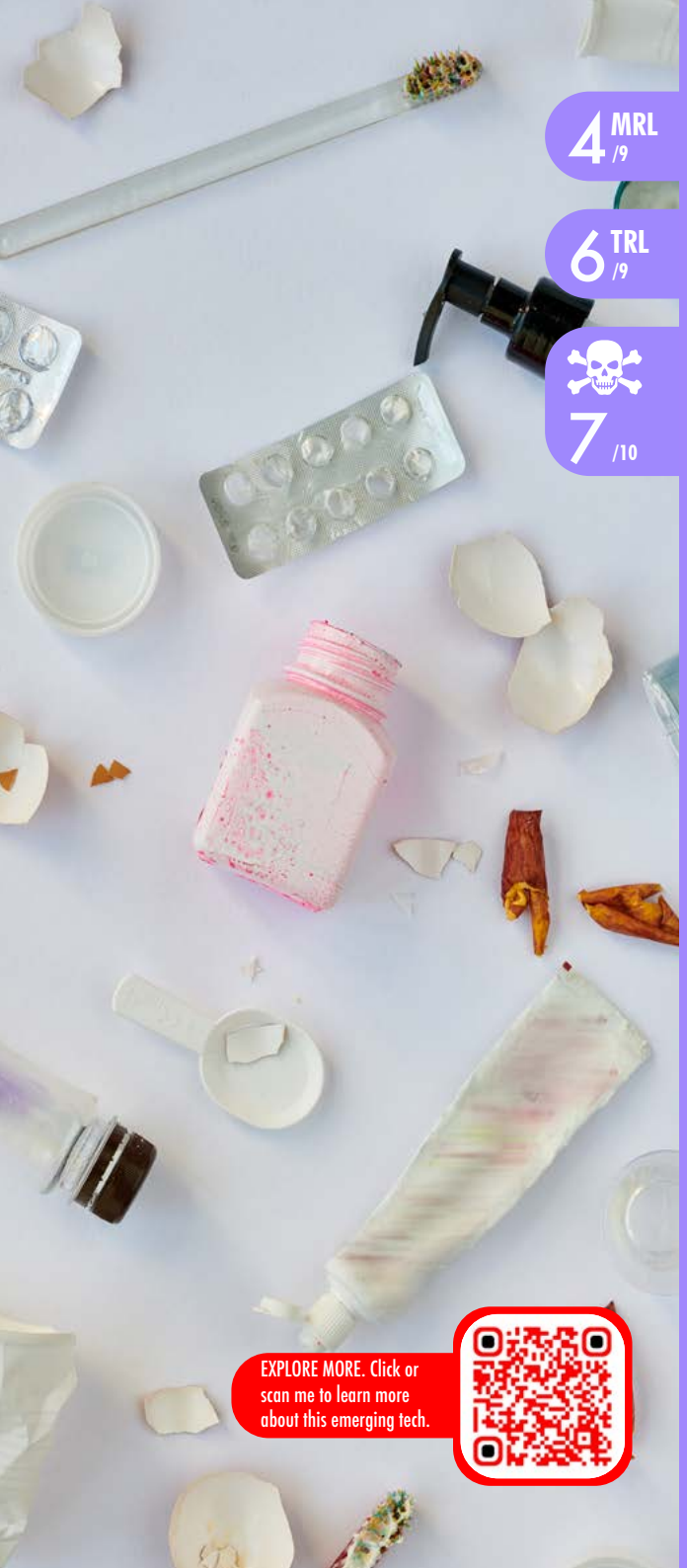
STATUS



Accessibility	8
Affordability	7
Competition	4
Demonstration	9
Desirability	7
Investment	7
Regulation	7
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





4 MRL /9

6 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

GENERAL PURPOSE ROBOTS

GENERAL ROBOTS, which are in the Prototype Stage, is the field of research concerned with developing new ways to develop robots that are able to complete tasks and navigate their environments either without ever having to be explicitly taught, by self-learning or via intuition, or just by simply observing others performing them. Recent breakthroughs in the field include the development of robots that can complete household tasks aswell as recycling and sorting tasks without ever having to be trained.

DEFINITION

General Robots are a class of robots that are capable of learning new skills via intuition and observation without having to be explicitly programmed or taught them.

EXAMPLE USE CASES

Today we are using prototypes to prove the theory behind the technology and refine it. In the future the primary use case of this technology will be to develop robots that are capable of learning and completing a wide range of tasks just through observation that could include everything from performing complex surgeries through to performing more mundane household or search and rescue duties.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by organisations in the Technology sector, with support from univesity grants. In time we will see the technology mature to a point where it becomes the defacto way to architect and build robots and it will inevitably help accelerate the use of robots in the wider world across a wide range of use cases and sectors, and increase their utility.

While General Robots are in the Prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Evolutionary Robotics, Hive Minds, Machine Vision, and Sensors, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22, '23, '24

IMPACT

STATUS

Accessibility	3
Affordability	4
Competition	3
Demonstration	7
Desirability	9
Investment	3
Regulation	2
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

5 MRL /9

5 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

INFLATABLE ROBOTS

INFLATABLE ROBOTS, which are in the Prototype Stage, is the field of research concerned with developing new types of inflatable robots that, when inflated, are capable of performing many of the same tasks regular robots are capable of performing. Recent breakthroughs in the field include the development of new control systems and actuators that allow these robots to complete increasingly complex tasks even while they themselves are unstable.

DEFINITION

Inflatable Robots are a class of robots that can be inflated and deflated on demand but are that are still capable of carrying out tasks.

EXAMPLE USE CASES

Today we are using prototypes to prove the theory behind the technology and refine it. In the future the primary use case of this technology will be to send inflatable robots into space, which can be done at very low cost because of their format, where they can perform a range of tasks, however the fact that they can be compacted down into a small package before being inflated also opens the door to use cases where that is an advantage, such as in the home where space is limited, and where they can be inflated before performing tasks and being de-flated again.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Aerospace and Defence sector, with support from university grants. In time as the control mechanisms for the technology improves we will eventually see them become much more of a viable commercial proposition, but given the current narrow development focus and the relatively low levels of investment it could be a while before they are properly commercialised.

While Inflatable Robots are in the Prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Evolutionary Robotics, General Robotics, Machine Vision, and Sensors, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

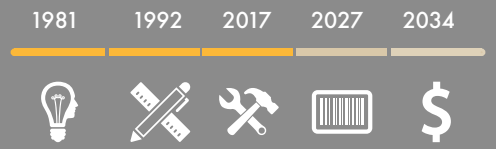
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '22, '23

IMPACT

STATUS



Accessibility	3
Affordability	3
Competition	5
Demonstration	4
Desirability	7
Investment	3
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

4 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

LIVING ROBOTS

LIVING ROBOTS, which are in the Prototype Stage, is the field of research concerned with developing new ways to create robots that are alive, but not necessarily sentient, or, as others describe it "Programmable Organisms." Recent breakthroughs in the field include the use of Artificial Intelligence, a supercomputer, and stem cells to create the world's first truly living robots that were adaptable and responded to external stimuli.

DEFINITION

Living Robots are neither traditional robot nor animal but are a form of re-programmable and controllable cell based living machine.

EXAMPLE USE CASES

Today we are using prototypes to prove the theory behind the technology and refine it. In the future the primary use case of this technology could be almost unlimited and they could be used in everything from monitoring pollution levels all the way through to being involved in in vivo healthcare treatments.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by university grants. In time we will see the technology mature to the point where it is safe and viable, as well as commercially feasible, but given the nature of the technology it is highly likely that it will be subject to stringent regulatory scrutiny which will inevitably delay its adoption.

While Living Robots are in the Prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Bio-Sensors, Creative Machines, Evolutionary Robotics, Semi-Synthetic Cells, Simulation Engines, Stem Cells, Synthetic Biology, Synthetic Cells, Synthetic DNA, and Swarm Robotics, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

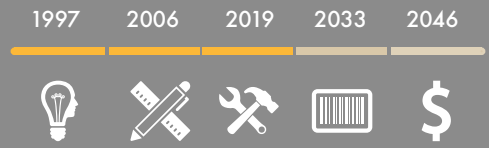
In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22, '23, '24

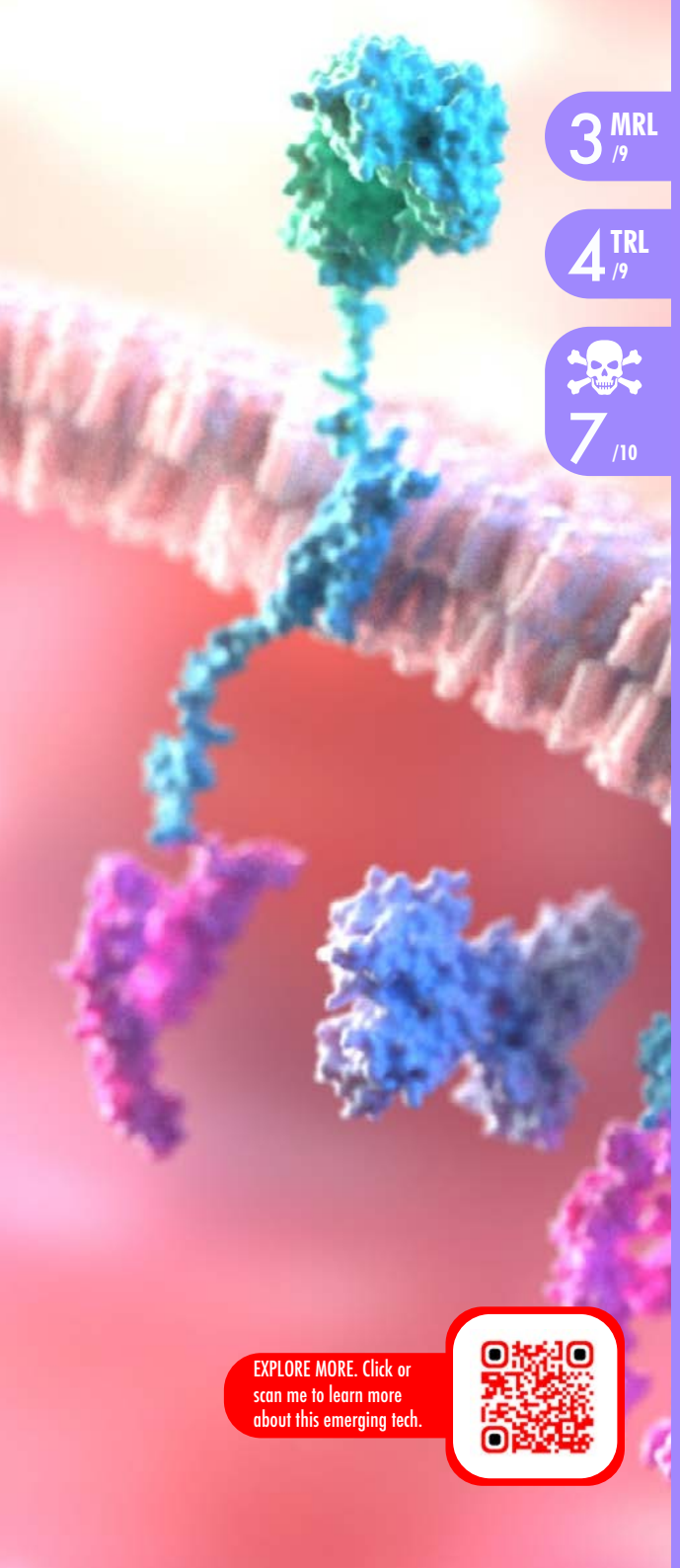
IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	2
Demonstration	6
Desirability	8
Investment	2
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

4 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

MOLECULAR ROBOTS

MOLECULAR ROBOTS, which are in the early Prototype Stage, is the field of research concerned with developing molecule sized robots that can perform a variety of actions within a variety of environments. Recently there have been breakthroughs in creating molecular sized robots that are capable of performing pre-programmed actions while interacting and sensing their environments, and while it is still very early days for the field it is inevitable that it will play a pivotal role in helping create the world's first viable Molecular Assemblers.

DEFINITION

Molecular Robots are robots made from molecules that can be pre-programmed perform specific actions.

EXAMPLE USE CASES

Today we are using prototype Molecular Robots to create automated molecular sized manufacturing lines, and create molecular sized products. In the future the primary use cases of the technology will include using it to develop the first Molecular Assemblers, and in any situation where being able to assemble, or re-arrange, systems at the molecular scale adds value.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Defence and Manufacturing sectors, with support from government funding, and university grants. In time we will see researchers in the space create increasingly sophisticated Molecular Robots that rely on a standardised programming language, to be designed and controlled, that are capable of communicating in real time with other molecular systems and behaving in a semi-autonomous and autonomous manner.

While Molecular Robots are in the early Prototype Stage, over the long term they will be enhanced by advances in 3D Bio-Printing, 3D Printing, Biological Computing, CRISPR Gene Editing, DNA Neural Networks, Molecular Energy Systems, Nano-Manufacturing, and Sensor Technology, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

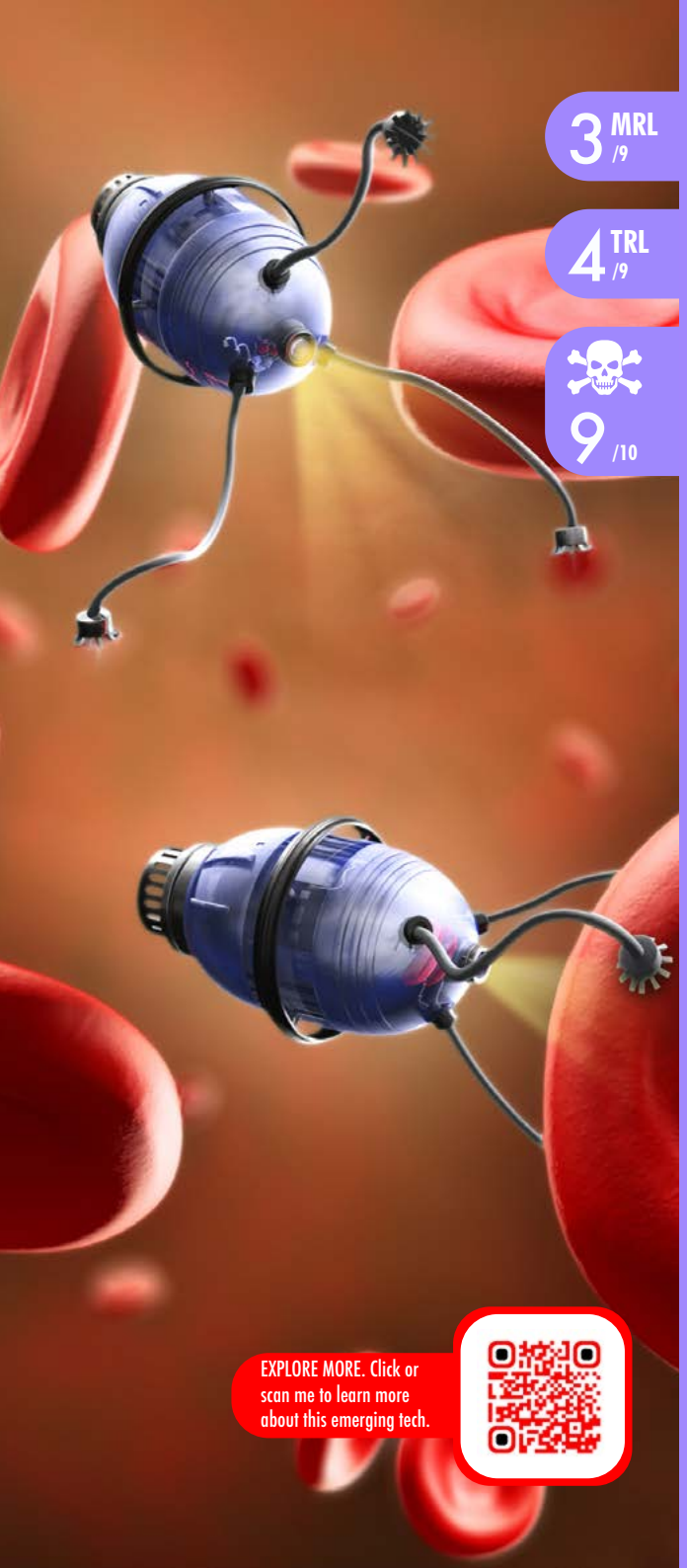
STARBURST APPEARANCES: '18, '19, '20, '21, '22, '23

IMPACT

STATUS

Accessibility	3
Affordability	3
Competition	3
Demonstration	6
Desirability	9
Investment	4
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

4 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

NANO-MACHINES

NANO-MACHINES, which are in the Concept Stage and Prototype Stage, is the field of research concerned with developing semi-autonomous and autonomous nanoscale machines that can be both organic and inorganic, or combinations thereof. Recently there have been several major breakthroughs in the field including the development of Nano-Machines that are capable of re-configuring themselves, the control systems to co-ordinate and track nanobots and nanobot swarms within the human body, as well as a wide range of other nanobot machines that are capable of patrolling the human body seeking out and killing disease, including Cancers. And as our understanding of the technologies we rely on to manufacture and operate these machines improves so will they and the applications they can master.

DEFINITION

Nano-Machines are mechanical or electromechanical devices whose dimensions are measured in nanometers

EXAMPLE USE CASES

Today we are using the first Nano-Machine prototypes to create controllable nanobot swarms capable of in vivo human surgery, and perform targeted drug delivery within animals, as well as to target, drill into, and choke off the blood supplies to diseased cells. In the future the primary applications of this technology will be almost limitless.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Consumer Electronics, Defence, Healthcare, Manufacturing, and Technology sectors, with support from government funding, and university grants. In time we will see researchers in the field create increasingly complex and intricate machines capable of tackling many more applications, however, in some industries the eventual adoption of these products will be slowed down by regulation.

While Nano-Machines are in the Concept Stage and Prototype Stage, over the long term they will be enhanced by advances in 3D Printing, Artificial Intelligence, Bio-Hybrid Robots, Biological Computing, CRISPR Gene Editing, DNA Computing, DNA Robots, Micromotes, Molecular Assemblers, Molecular Robots, Nano-Manufacturing, Sensor Technology, Swarm Artificial intelligence, and Swarm Robotics, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

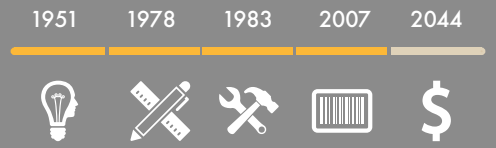
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23, '24

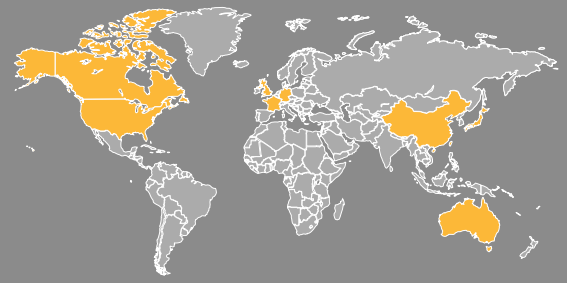
IMPACT

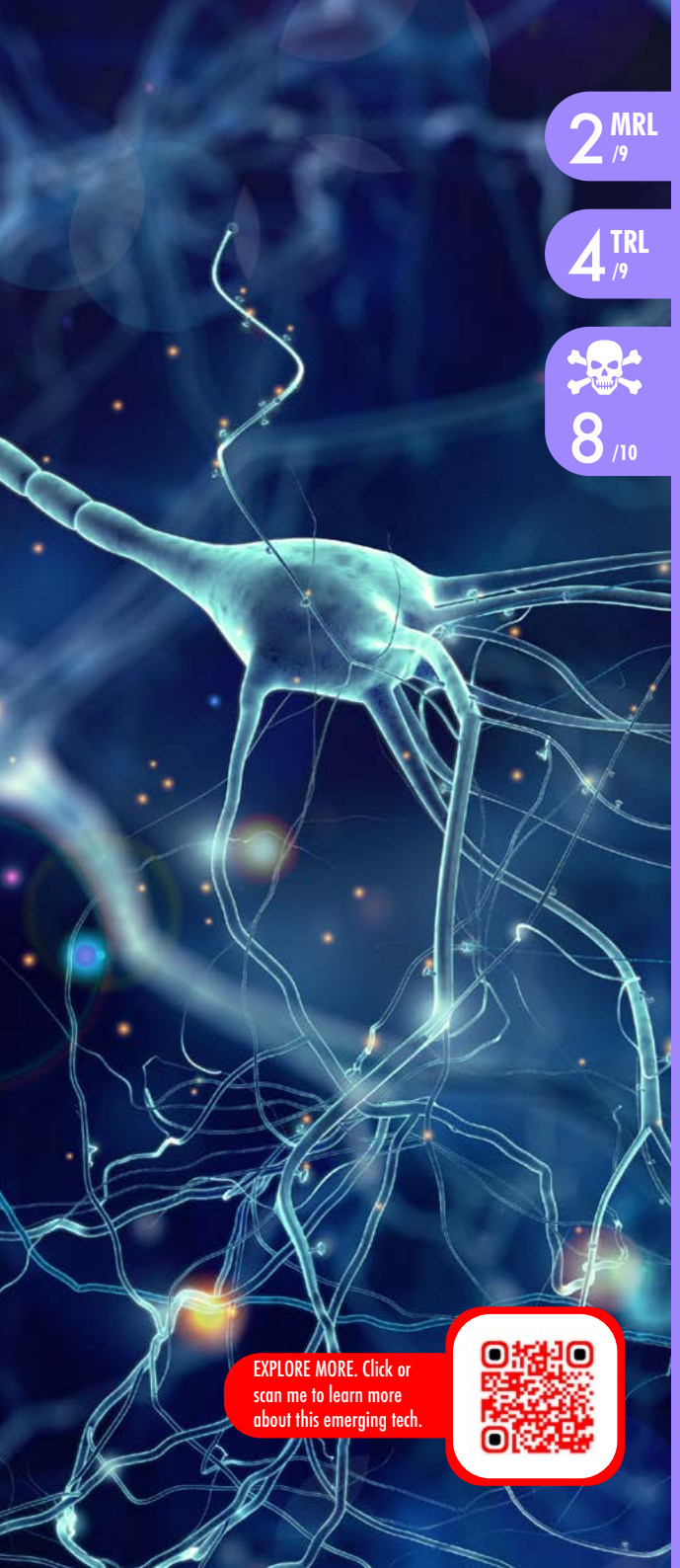
STATUS



Accessibility	4
Affordability	4
Competition	3
Demonstration	7
Desirability	8
Investment	6
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





NEUROBIOTICS

NEUROBIOTICS, which is in the Concept Stage and early Prototype Stage, is the field of research concerned with developing robots whose technology is fused with biological nervous systems to, in essence, create what some are calling the first "Conscious Robots." Recently there have been a couple of notable breakthroughs in the field including the fusion of a digital worms brain with a Lego robot, which many regard as the first step in realising the first true fusion between a basic biological animal brain and a robot, and then more recently with the announcement that several teams of researchers have secured significant funding to press ahead with the technology to create the first conscious robot platforms.

DEFINITION

Neurobiotics is the intricate fusion of biological nervous systems with technology.

EXAMPLE USE CASES

Today we are using the prototype Neurobiotic robots to test the theory that animal nervous systems can be integrated with machines, and refine the technology. In the future the primary applications of this technology will involve using these robots in applications that are either prone to hacking, or unsafe for digital lifeforms.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Defence and Technology sectors, with support from government funding, and university grants. In time we will see researchers become more capable at mapping the individual neural pathways to individual robotic systems to drive behaviour, and then expand the scope of applications they can tackle.

While Neurobiotics are in the Concept Stage and early Prototype Stage, over the long term it will be enhanced by advances in 3D Bio-Printing, 3D Printing, Artificial Intelligence, Neural Interfaces, and Sensor Technology, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

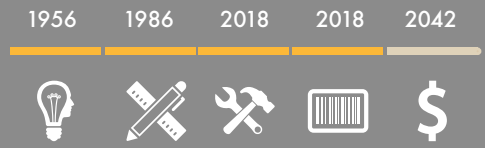
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	2
Demonstration	7
Desirability	7
Investment	3
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

9 MRL /9

9 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ROBOTS

ROBOTS, which are in the Prototype Stage and Productisation Stage, is the field of research concerned with developing principally hardware based robots, of all shapes and sizes, that can be used in a variety of applications. Recently there have been significant advances in designing and building increasingly advanced robots, whether humanoid or otherwise, thanks to advances in complimentary technology fields, including Artificial Intelligence and Cloud, which now equips robots with Hive Mind capabilities that allow them to share and learn from joined experiences, Machine Vision, Simulation Engines which have been used to dramatically increase their dexterity, as well as Neural Interfaces and Sensor Technology which not only provide them with Human-Machine telepathic links that accelerate learning, but also with new forms of Artificial Skin that allow them to feel, and even experience pain.

DEFINITION

Robots are machines that are capable of carrying out a series of complex actions semi-autonomously or autonomously.

EXAMPLE USE CASES

Today we are using Robots in a wide variety of applications, including, but not limited to, consumer, healthcare, factory, military and warehouse applications where they do everything from the assembly, packing, picking, and transporting of goods, as well as providing welfare services. In the future the primary applications for the technology will be limitless.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will grow at an accelerating rate, primarily led by organisations in the Technology sector, with support from university grants. In time researchers in the field will create increasingly autonomous and intelligent self-evolving, self-manufacturing robots capable of acquiring and learning new skills via Hive Minds without being specifically re-coded or trained.

While robots are the Prototype Stage and Productisation Stage, over the long term it will be enhanced by advances in 3D Printing, 4D Printing, Artificial Intelligence, Creative Machines, Molecular Robots, Hive Minds, Metamaterials, Neural Interfaces, Photovoltaics, Self-Healing materials, Sensor Technology, Soft Robots, Structural Batteries, and Wireless Energy, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

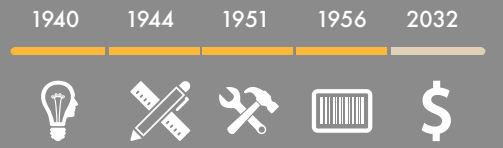
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19

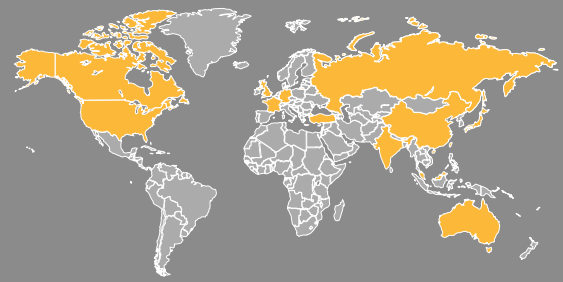
IMPACT

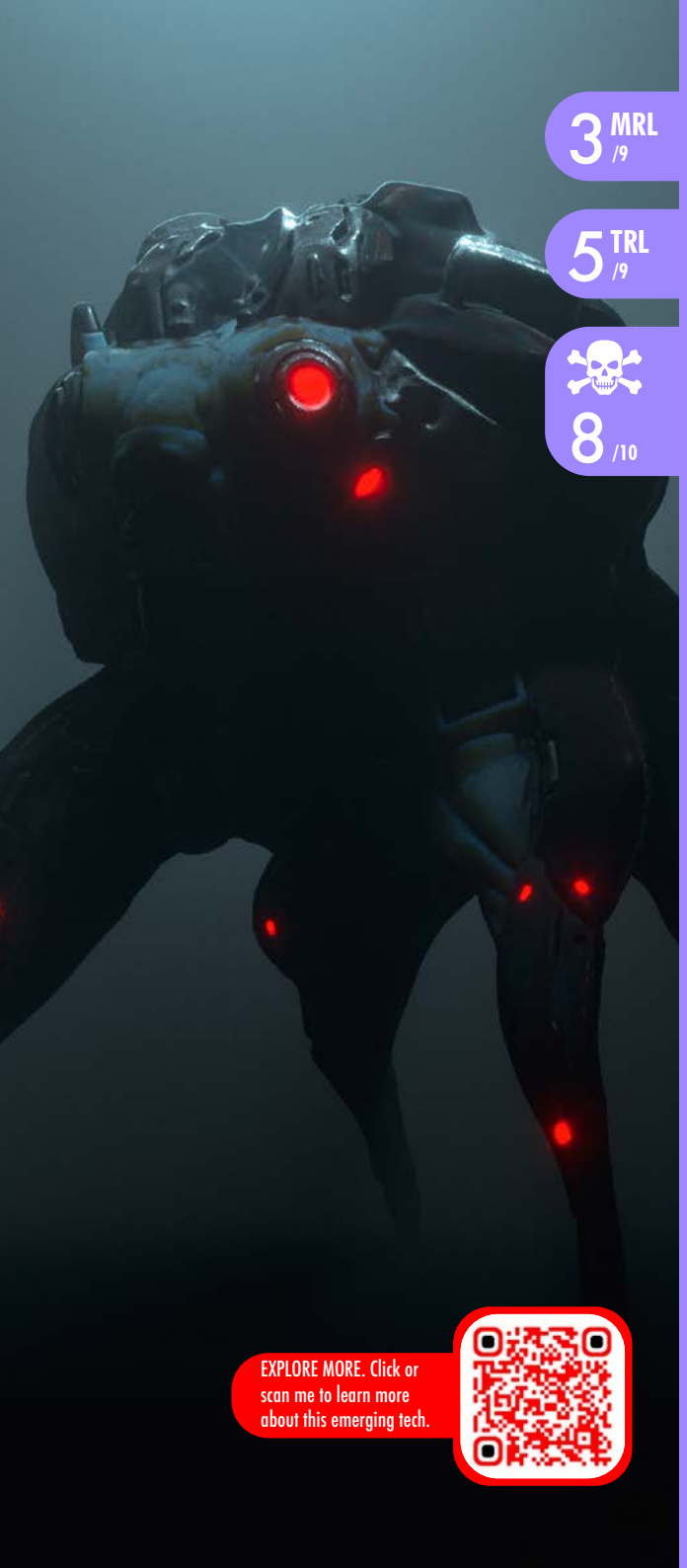
STATUS



Accessibility	9
Affordability	8
Competition	6
Demonstration	9
Desirability	8
Investment	8
Regulation	6
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





3 MRL /9

5 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SHAPE SHIFTING ROBOTS

SHAPE SHIFTING Robots, which are in the Prototype Stage, is the field of research concerned with developing robots that are capable of automatically adapting and changing shape in response to either their environment or the tasks they've been assigned. Recent breakthroughs in the field include the development of robot swarms that can communicate and co-ordinate with one another and assemble themselves into specific shapes or structures in order to accomplish specific tasks, as well as the development of new more rudimentary robots that change shape by using more traditional acctuation systems.

DEFINITION

Shape Shifting Robots are robots that can change shape on demand in response to external stimulii.

EXAMPLE USE CASES

Today we are using prototypes to prove the theory behind the technology and refine it. In the future the primary use case of this technology could be almost unlimited and include the ability to send such robots into space where they can adpat and shape shift according to their environment and tasks, but other use cases include everything from home automation tasks all the way through to search and rescue tasks.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Consumer Electronics sector, with support from univesity grants. In time we will see the technology mature to the point where researchers are able to beam high quality content directly into users eyes, but there will likely be significant cultural and regulatory hurdles to be overcome before the technology can be adopted.

While Shape Shifting Robots are in the Prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence, 4D Printing, Creative Machines, Machine Vision, Polymorphic Liquid Metals, Programmable Materials, Sensors, Simulation Engines, Smart Dust, and Swarm Robotics but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

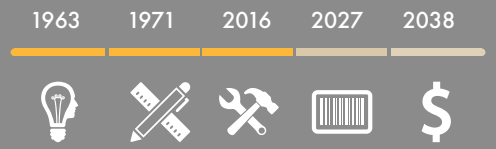
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22, '23, '24

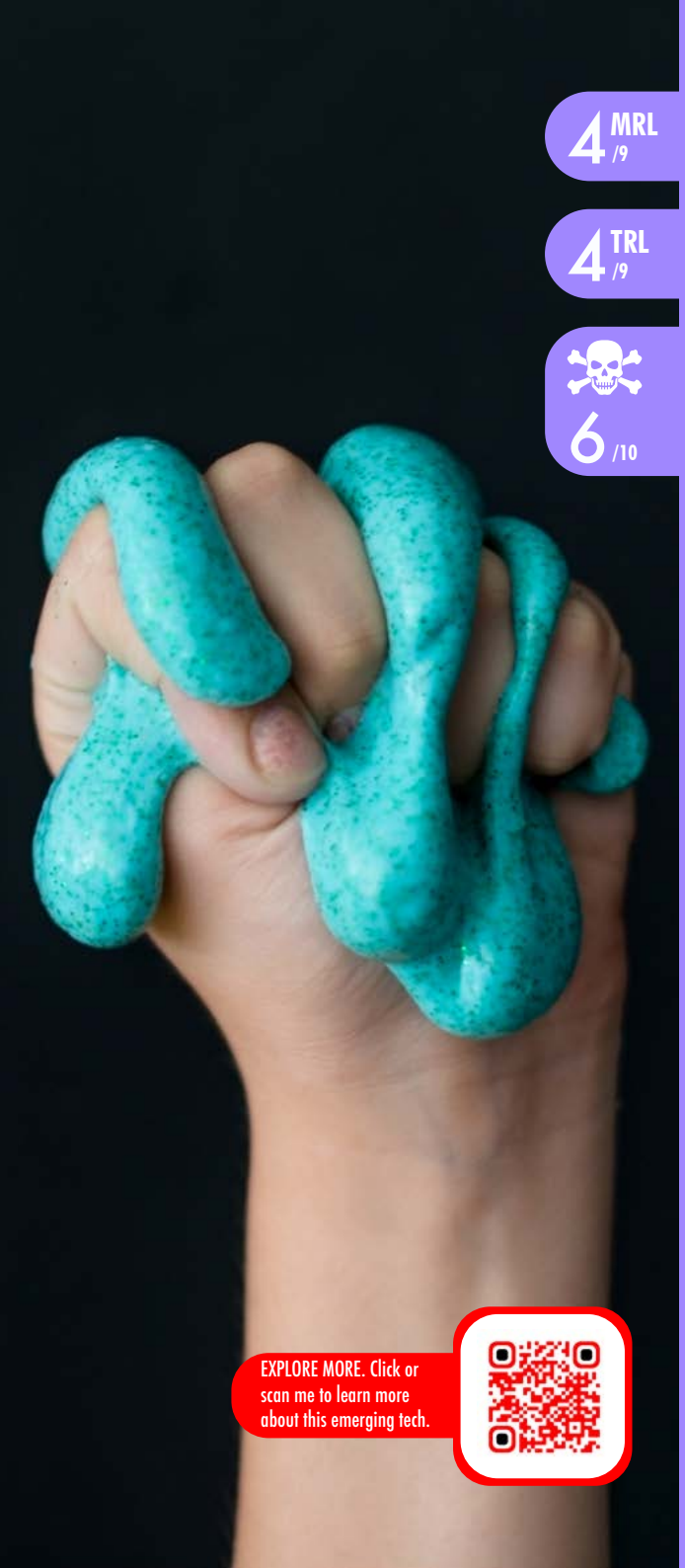
IMPACT

STATUS



Accessibility	4
Affordability	3
Competition	6
Demonstration	3
Desirability	7
Investment	3
Regulation	1
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



4 MRL /9

4 TRL /9

6 /10

SLIME ROBOTS

SLIME ROBOTS, which are in the early Prototype Stage, is the field of research concerned with trying to develop a new class of soft bodied robotic systems that are almost gelatinous - or slime-like - in form. Recent breakthroughs in this field include the development of a sea cucumber like slime robot which was capable of moving through different domains and environments and capable of manipulating and moving objects. Not only could these kinds of robots be useful in applications where traditional hard or soft bodied robots would have trouble getting into and moving through spaces, but they could also be used to help accelerate the field of Re-Configurable Electronics and other complimentary emerging technology areas.

DEFINITION

Slime Robots are soft bodied robots made from malleable materials that enable them to adapt to, move through, and explore different environments.

EXAMPLE USE CASES

At the moment Slime Robots are being used to access spaces that traditional robots cannot get into and then navigate through complex environments, but over the longer term the technology has general utility and could end up being used to augment haptic technologies, if embedded within clothing and other items, help accelerate the development of Re-Configurable Electronics and systems, as well as an array of self-healing electronics, materials, and robotics applications.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in this technology increase, albeit from a very low base, primarily led by university grants. While Slime Robots seem like an odd technology there is no doubt that they have a special kind of utility, and when embedded with flexible or liquid compute, intelligence, and other sensing technologies they could be quite the force to be reckoned with in the future with some amazing applications.

While Slime Robots are still in the early Prototype Stage they could be enhanced by advances in Biological, Chemical, and Liquid AI and Compute, Materials, Polymers, Polymorphic Metals, Sensors and other technologies, however over the long term they could be replaced by Living Robots or other forms of Soft Robots and Swarm Robotic systems.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view.

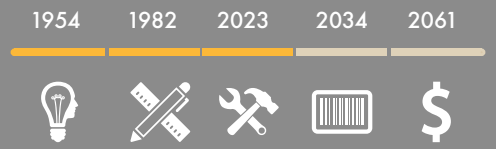
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

IMPACT

STATUS



Accessibility	3
Affordability	5
Competition	3
Demonstration	7
Desirability	2
Investment	2
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

5 MRL /9

6 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SOFT ROBOTS

SOFT ROBOTS, which are in the Prototype Stage and early Productisation Stage, is the field of research concerned with developing soft robotic systems, of all shapes and sizes, that can be used in a variety of applications where hard robots will either be impossible or impractical to use. Recently there have been a number of breakthroughs in complimentary fields including in Bio-Hybrid Robots, Neurobiotics, and Tissue Engineering that are helping researchers discover new ways to combine different materials together in different ways to create increasingly capable Soft Robots, as well as new Materials breakthroughs that have helped researchers create even more powerful synthetic robot muscles and structures, as well as breakthroughs in Tractor Beams, which, oddly, mean one day we could see levitating Soft Robots that are capable of self-assembly and self-organisation in mid air.

DEFINITION

Soft Robots are robots that are made from highly compliant materials, similar to those found in living organisms.

EXAMPLE USE CASES

Today we are using Soft Robots in agriculture and warehouses to pick soft fruits, as well as to create new types of prosthetics for humans. In the future the primary applications of this technology will be to interact with any environments or objects where using hard robots is impossible or impractical.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Healthcare and Technology sector, with support from government funding, and university grants. In time we will see researchers in the field create increasingly complex and sophisticated Soft Robots that can carry out an increasingly wide range of tasks.

While Soft Robots are in the Prototype Stage and early Productisation Stage, over the long term they will be enhanced by advances in 3D Printing, CRISPR Gene Editing, Polymers, Micromotes, Printable Batteries, Self-Healing Materials, Semi-Synthetic Cells, Sensor Technology, Structural Batteries, Synthetic Cells, Tissue Engineering, and Tractor Beams, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

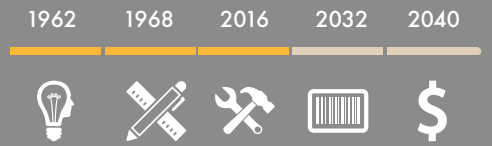
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	3
Affordability	6
Competition	5
Demonstration	8
Desirability	7
Investment	6
Regulation	5
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

4 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

Harvard University

SWARM ROBOTICS

SWARM ROBOTICS, which are in the Prototype Stage, is the field of research concerned with developing robots, of all shapes and sizes, that are capable of coming together, in swarms, and intelligently collaborating and co-ordinating with one another to accomplish tasks that any one individual would have problems accomplishing alone, if at all. Recently there have been a number of breakthroughs in the field, including in the development of new Artificial Intelligence based command and control systems that let the robots autonomously collaborate with one another, without the need for external human input, to evaluate, solve, and complete random tasks, such as lifting and moving, as well as coming together to form specific formations.

DEFINITION

Swarm Robotics is the use and coordination of large numbers of multi robot systems to produce specific collective behaviours and interactions.

EXAMPLE USE CASES

Today we are using the prototype Swarm Robots to evaluate and solve different tasks in order to refine the technology. In the future the primary applications for the technology could be almost limitless, and will be mainly focused on relatively complex applications that involve the completion of multiple steps and tasks that are best undertaken by multi-capable polymorphic robot swarms.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by organisations in the Aerospace and Defence sectors, with support from government funding, and university grants. In time we will the researchers in the space refine their command and control systems, and robots, to the point where they are able to develop semi-autonomous and autonomous Swarm Robots that are capable of tackling a multitude of tasks.

While Swarm Robotics are in the Prototype Stage, over the long term it will be enhanced by advances in Artificial Intelligence, Creative Artificial Intelligence, Bio-Hybrid Robots, Drones, Robots, Nano-Machines, Sensor Technology, Soft Robots, Sensor Technology, and Swarm Artificial Intelligence, but in the future it could be replaced by Programmable Matter.

MATTHEW'S RECOMMENDATION

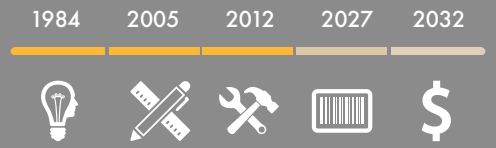
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

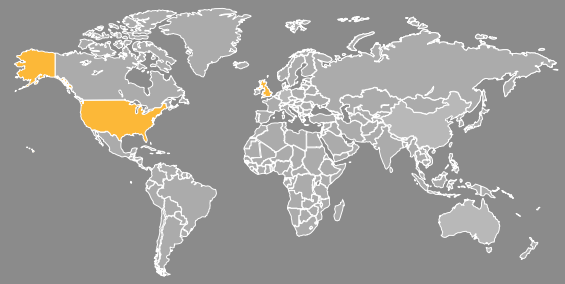
IMPACT

STATUS



Accessibility	4
Affordability	5
Competition	4
Demonstration	9
Desirability	9
Investment	6
Regulation	5
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

4 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

MIT

SYNCELL ROBOTS

SYNCELL ROBOTS, which are in the Prototype Stage, is the field of research concerned with developing cell sized robots that are, in some cases, orders of magnitude smaller than human blood cells. Recently there have been a number of breakthroughs in the field including discovering new ways to mass produce these synthetic robots, and as researchers find new ways to embed them with compute, intelligence and enhanced sensing and swarming capabilities, it is inevitable that the range of applications they are able to competently tackle will increase.

DEFINITION

Syncell Robots are small, cell sized synthetic robots.

EXAMPLE USE CASES

Today we are using the first Syncell Robot prototypes to store digital information and carry out monitoring tasks in water. In the future the primary applications of the technology will mainly involve being able to interact with, modify, monitor and sense the aqueous environment around them, which will include everything from environmental monitoring to healthcare applications, and many more.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Manufacturing and Technology sector, with support from university grants. In time we will see researchers find new ways to mass manufacture increasingly complex, intelligent, and sophisticated robots.

While Syncell Robots are in the Prototype Stage, over the long term it will be enhanced by advances in 3D Printing, Artificial Intelligence, Bio-Materials, Graphene, Micromotes, Nano-Machines, Nano-Manufacturing, Sensor Technology, Swarm Artificial Intelligence, and Swarm Robotics, but over the long term they will be replaced, to varying degrees, by DNA Robots, Molecular Robots, and Nano-Machines.

MATTHEW'S RECOMMENDATION

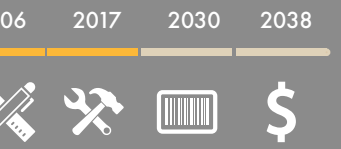
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19

IMPACT

STATUS



Accessibility	2
Affordability	4
Competition	4
Demonstration	7
Desirability	7
Investment	4
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

SECURITY

PARENTS DO it, and even well intentioned CISO's do it - I am, of course, talking about the power of security. Today though while there is a huge amount of buzz about the importance of cyber security we shouldn't forget about the importance of physical security. As we continue to see the global threat landscape evolve, and the velocity and voracity of attacks accelerate and increase in both breadth and sophistication, it can no longer be denied that the power of individuals to do harm at regional and national scale is increasing at a near exponential rate - and that's before we go fully autonomous.

Today, these individuals can buy powerful CRISPR Gene Editing toolkits through the post to re-engineer and bring back to life extinct deadly contagious diseases such as the Horse Pox virus, while at the same time using cyber-physical RATs and Robo-Hackers to scan and break into systems automatically hundreds of millions times faster than traditional hacking methods. And that's before we explain the technology behind the world's first DNA malware which can compile itself to wipe the forensic lab databases.

Fortunately for us at least, the same powerful tools being used by criminals are also ours to command and so the dangerous game of Cat and RATs continues.

In this section you will find details of the emerging technologies that made it into this years Griffin Emerging Technology Starburst along with details of other impactful emerging technologies:

1. Anti-CRISPR Technology
2. Artificial Immune Systems
3. Behaviour Based Security
4. Binary Visualisation
5. Biometrics
6. Constitutional Artificial Intelligence
7. Containment Algorithms
8. Cyber-Biosecurity
9. Data Teleportation
10. DNA Encryption
11. Hackproof Code
12. Homomorphic Encryption
13. Mechanical Metamaterials
14. Morpheus Computing Platform
15. Neural Network Watermarking
16. One Time Programs
17. Post Quantum Cryptography
18. Quantum Cryptography
19. Quantum Fingerprinting
20. Quantum Safe Blockchains
21. Robo-Hackers
22. Telepathic Cyber Defense
23. Ultrasound Force Fields
24. Zero Knowledge Proof

In addition to these emerging technologies there are many others that have yet to get an entry in this codex. These include, but are not limited to:

25. Activity Based Security
26. Adversarial Cyberattacks
27. Clean Slate Future Internet
28. Cryptographic Anchors
29. High Assurance Platforms
30. Identity Based Encryption
31. Micro Movements
32. Microwave Heartbeat Detection
33. Stylometry
34. Visual Fingerprinting

1 MRL /9

3 TRL /9

6 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ANTI-CRISPR TECHNOLOGY

ANTI-CRISPR Technology, which is in the Prototype Stage, is the field of research concerned with developing new ways to prevent gene editing tools from editing or in any way modifying genetic material. In terms of breakthroughs at the moment, despite this being an increasingly vital area of research as it becomes possible today to deliver in vivo gene editing tools into a persons body via aerosols or IV drip, the technology is still only conceptual and nobody has put forward any viable propositions to make it a reality, so watch this space.

DEFINITION

Anti-CRISPR Technology is a form of genetic engineering technology that makes it impossible for gene editing tools to edit or modify genetic material in any way.

EXAMPLE USE CASES

Today Anti-CRISPR Technology is still at the concept stage and so there are no current day examples if it in use. In the future the primary use of this technology will be to prevent the unauthorised editing of genetic material for harm.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by univesity grants. In time we will see the technology take shape, and experiments take place but it will be a long road to seeing the technology commercialised and used because the regulatory scrutiny of it will be nothing like anything we have ever seen.

While Anti-CRISPR Technology are in the Prototype Stage, over the long term they will be enhanced by advances in CAST, CRISPR, Gene Drives, Gene Editing, and Synthetic Biology, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

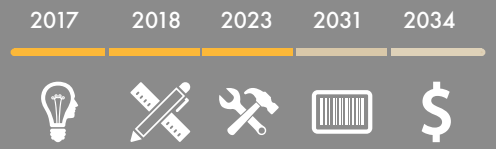
In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22, '23, '24

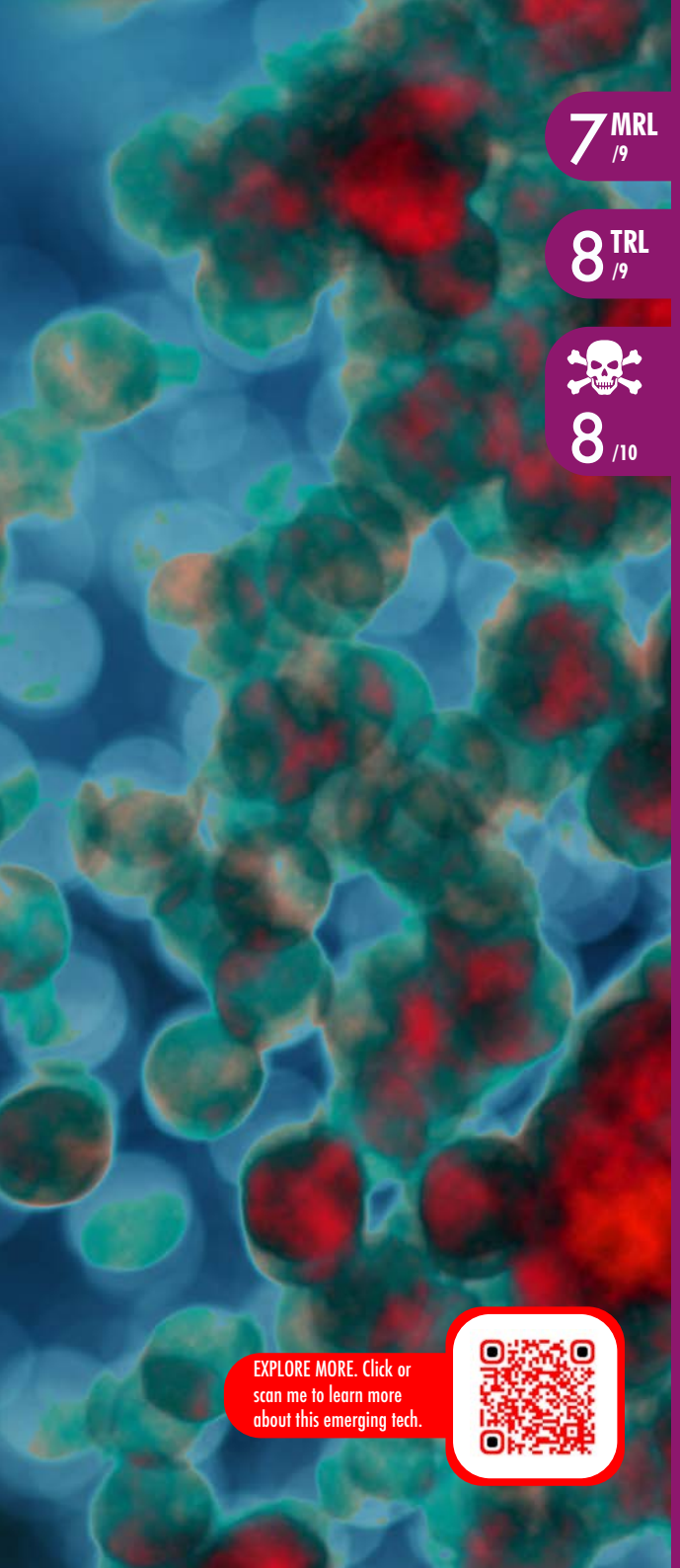
IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	1
Demonstration	2
Desirability	9
Investment	3
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



7 MRL /9

8 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ARTIFICIAL IMMUNE SYSTEMS

ARTIFICIAL IMMUNE SYSTEMS, which are in the Prototype Stage and very early Productisation Stage, is the field of research concerned with developing what many regard as the equivalent of the human immune system, that is able to identify known and unknown threats to its host and defend against them in real time, but in digital form. recently there have been a couple of breakthroughs in the field, one from a team of researchers who have now managed to commercialise their product, and another from an unknown "samaritan" who recently released a new form of Artificial Intelligence based Malware into the internet that's autonomously capable of hunting down harmful Malware and eliminating them from host systems, such as Internet of Things devices and routers.

DEFINITION

Artificial Immune Systems use technology to mimic the functions and behaviours of natures own immune systems, creating a class of computationally and technologically intelligent defense systems that can evolve, respond and eliminate threats.

EXAMPLE USE CASES

Today we are using Artificial Immune Systems to primarily protect government networks. In the future the primary use case of this technology will be to use it to automatically and autonomously evaluate digital threats, wherever they lurk and whatever their form, and eliminate them.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Technology sector, and criminal actors. In time the technology will become self-evolving and self-replicating, and capable of adapting itself at high speed to the digital systems it finds itself in, and this will pose both a great opportunity, and an equally impressive threat to security.

While Artificial Immune Systems are in the Prototype Stage and very early Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Creative Artificial Intelligence, and Swarm Artificial Intelligence, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

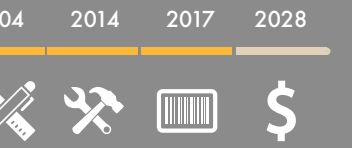
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	4
Affordability	6
Competition	2
Demonstration	6
Desirability	9
Investment	4
Regulation	2
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

7 MRL /9

8 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

BEHAVIOUR BASED SECURITY

BEHAVIOUR BASED SECURITY, which is in the Productisation Stage, is the field of research concerned with developing security systems that are able to authenticate users, whether they be human or machine, based on their behaviours. Recently there have been a number of developments in the field, which is increasingly reliant on Information in Depth, as companies become increasingly adept at capturing, aggregating and then analysing users offline and online cues, which multiply by the day, and that include everything from traditional cues such as location, and application and typing behaviours, all the way through to the use of Quantified Self data that's available via wearables.

DEFINITION

Behaviour Based Security uses increasingly complex inputs to determine the level of trust that can be attributed to a user for authentication purposes.

EXAMPLE USE CASES

Today we are using Behaviour Based Security to protect a wide range of critical systems across multiple sectors, and it is quickly becoming one of the defacto ways to authenticate users. In the future the primary use case for the technology will still be for authentication purposes.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Defense and Technology sectors, with support from government funding, and university grants. In time we will see the way we authenticate users based on their behaviours evolve dramatically as every aspect of an individuals real world and online world cues are increasingly capable of being captured, aggregated and analysed.

While Behaviour Based Security is in the Productisation Stage, over the long term it will be enhanced by advances in Artificial Intelligence, Biometrics, Federated Artificial Intelligence, Machine Vision, Natural Language Processing, Neural Interfaces, and Sensor Technology, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

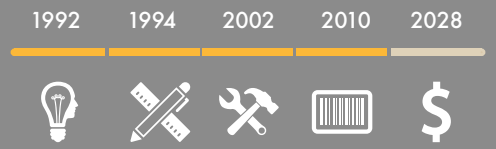
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19

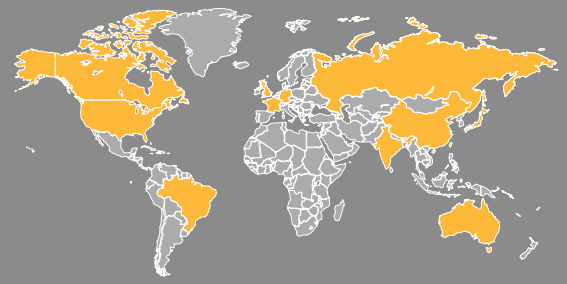
IMPACT

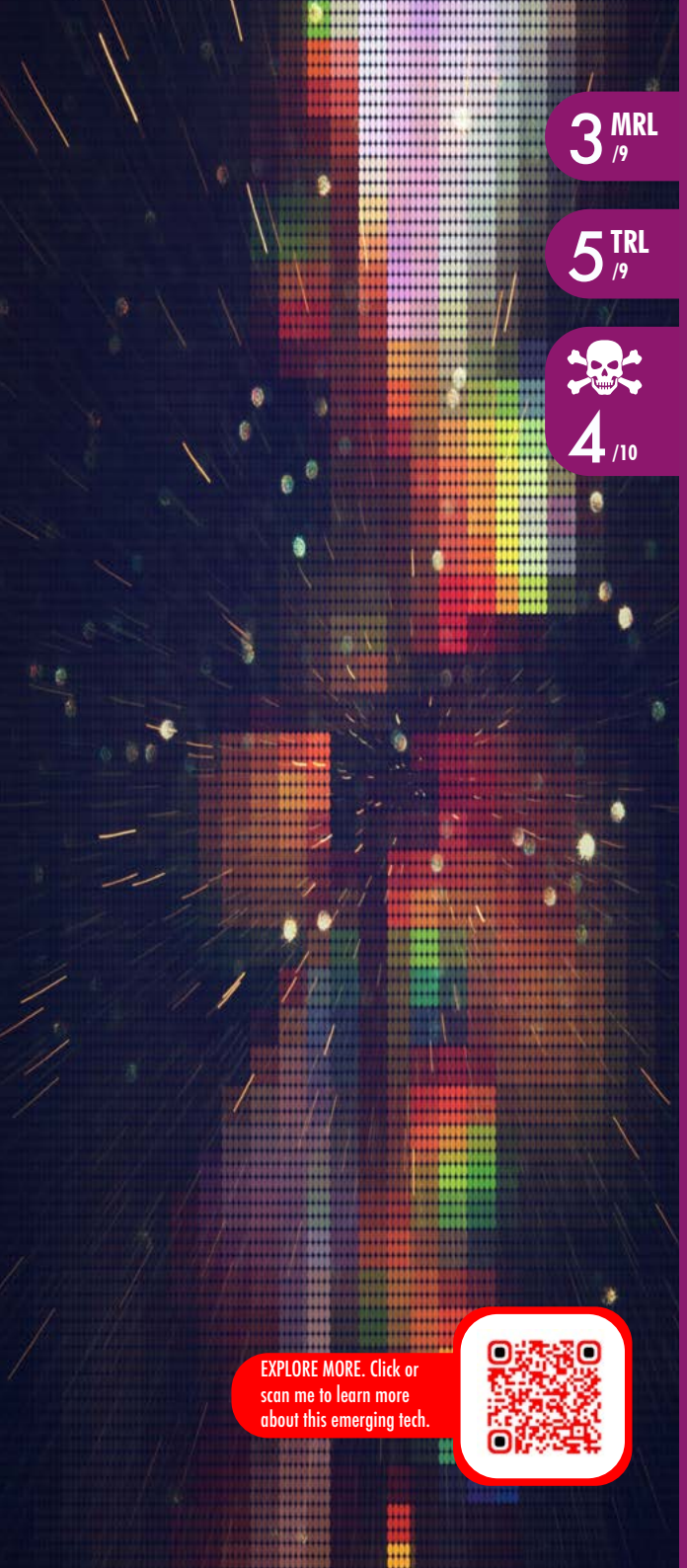
STATUS



Accessibility	8
Affordability	8
Competition	5
Demonstration	9
Desirability	9
Investment	8
Regulation	4
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





3 MRL /9

5 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

BINARY VISUALISATION

BINARY VISUALISATION, which is in the early Prototype Stage, is the field of research concerned with using Artificial Intelligence and Machine Vision to visualise computer code in image form so that it can be determined whether or not it is malicious. Although a nascent technology recent results and the technology's ability to accurately detect, flag, and visualise, malicious code and fake phishing websites has been staggering making this a technology to watch, especially as the AI models underpinning it mature and get better with training.

DEFINITION

Binary Visualisation is the use of Machine Vision to visualise binaries and code in order to detect malicious cyber threats.

EXAMPLE USE CASES

At the moment the number of examples of this technology being used are fairly limited but in every case it's been shown to significantly outperform all other malicious file and website detection systems by many orders of magnitude. By visualising the code of files and fake phishing websites in image form this technology has so far managed to detect every malicious application files and fake websites with startling accuracy, and as continuous training improves its performance it will only get more capable and sophisticated.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, but from a very low base, primarily led by organisations in the defense and technology sector, with support from government funding and university grants. In time we will see Binary Visualisation likely prove itself as a valuable and interesting tool in helping detect and counter cyber threats especially as it is a difficult countermeasure for cyber criminals to counter.

While Binary Visualisation is in the early Prototype Stage, over the long term it will be enhanced by advances in Artificial Intelligence, Machine Vision, and Robo-Hackers, but at this point in time it is not clear what it will be replaced by.

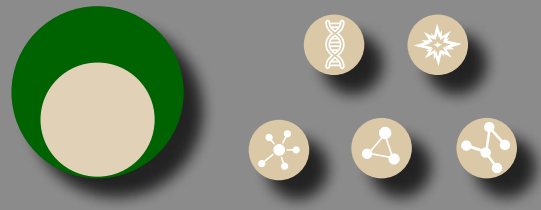
MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and re-visit it every few years until progress in this space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '22, '23, '24

IMPACT



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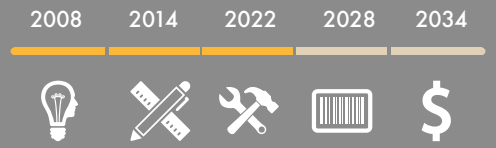
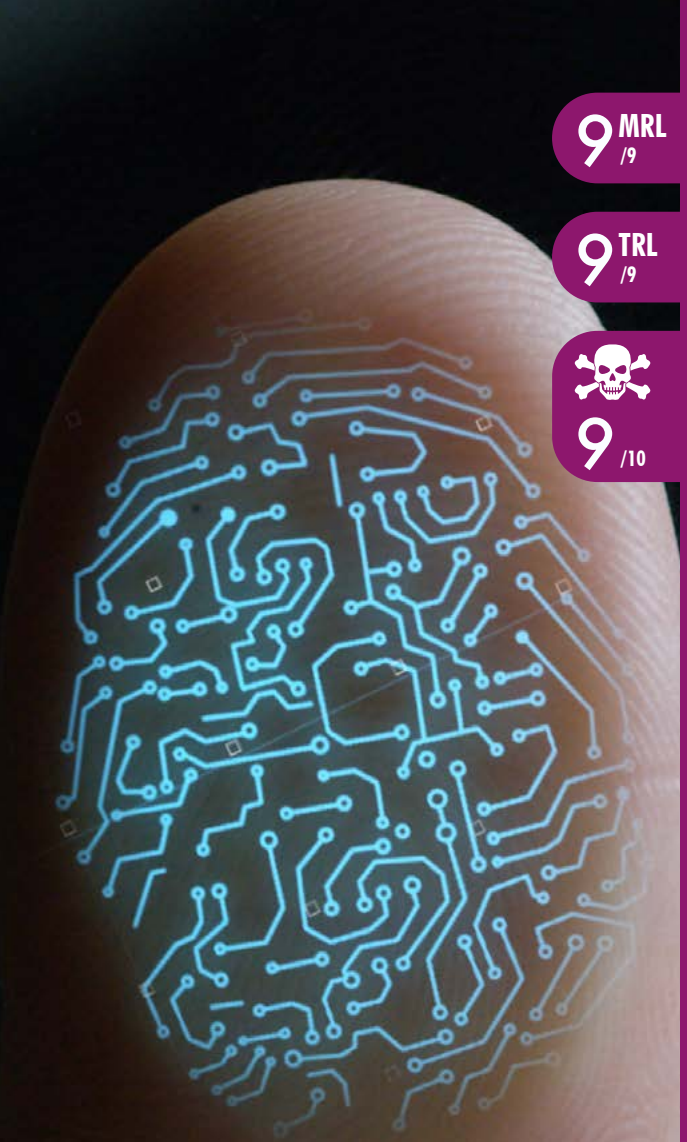


Accessibility	4
Affordability	5
Competition	2
Demonstration	8
Desirability	9
Investment	3
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



9 MRL /9

9 TRL /9

9 /10

BIOMETRICS

BIOMETRICS, which are in the Mass Adoption Stage, is the field of research concerned with developing new ways to use users unique biometric signatures, whether those are cognitive or physical, to assess and authenticate users. Recently there have been multiple breakthroughs in the field, and a surge of investment and interest, the majority of which, has potential dystopian overtones. Breakthroughs include the use of Artificial Intelligence and Machine Vision to not just assess users according to their health and heart rate, but also based on these machine's ability to assess their character, personality, and tendencies to criminality from stills and video. In addition to this, it has also recently been proven that human brainwaves are unique, and as the technology to capture and analyse brain waves accelerates it will be inevitable that these too will one day be integrated into the Biometrics stack.

DEFINITION

Biometrics is a collection of technologies that measure and analyse Human physiological and psychological characteristics for authentication purposes.

EXAMPLE USE CASES

Today we are using Biometrics in a wide variety of applications, including within consumer technology, such as smartphones, and elsewhere in border control, and many other places besides. In the future the primary applications of the technology will be, as it is today, to authenticate users and assess their character and characteristics.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Technology sector, with support from government funding, and university grants. In time we will see the technology evolve to such a point that it will be able to accurately analyse and catalogue users based on their all their cognitive and physical attributes, and regulators will find it an increasingly complex field to navigate.

While Biometrics are in the Mass Adoption Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Behaviour Based Security, Machine Vision, Neural Interfaces, and Sensor Technology, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

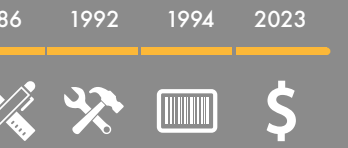
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19

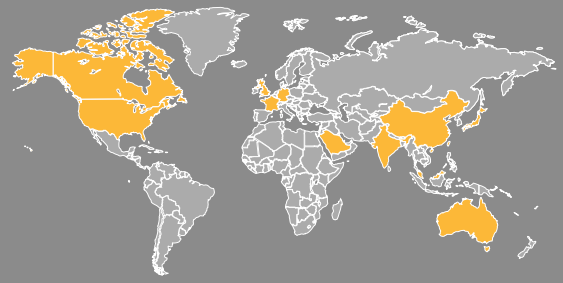
IMPACT

STATUS



Accessibility	9
Affordability	8
Competition	5
Demonstration	9
Desirability	8
Investment	9
Regulation	5
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



5 MRL /9

8 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

CONSTITUTIONAL AI

CONSTITUTIONAL ARTIFICIAL INTELLIGENCE, which is in the Commercialisation Stage, is the practise of building AI's that have an internal moral compass to guide their behaviours, decision making, and outputs. A more robust approach to the concept of building guardrails into AI models, which largely rely on "IF" functions being put into the models to control and direct their outputs, Constitutional AI is the attempt to replicate the human moral compass and create an internalised code of conduct in an AI model so that the AI itself is able to understand whether something, whether it is a piece of data or a request, is ethically and morally acceptable or not. While most foundational AI models take a guardrail approach there is a growing body of evidence to suggest that Constitutional AI, which is used by companies such as Anthropic, creates more ethical AI's that are safer to use and which require less censoring, correcting, and re-training.

DEFINITION

Constitutional Artificial Intelligence is a form of AI that has a set of built in guidelines which give the AI a moral compass designed to prevent unsavoury behaviours.

EXAMPLE USE CASES

Today companies like Anthropic are using Constitutional AI to develop Large Language Model AI's that have a sense of moral right and wrong and which generate results that align with societal ethical and moral behaviours. Not only are these traits desirable but it also means that these AI's are less likely to be adversarially corruptible, as well as less likely to generate unethical and immoral content and outputs, which makes them better AI candidates to be used in the defense, financial services, healthcare, media, and technology industries, as well as others, where these traits are important and or required.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in Constitutional AI will continue to accelerate and increase and investment will grow, primarily led by organisations in the Defense, Healthcare, and Technology sectors, as AI researchers need to find new ways to constrain the behaviours of their models and assure users that their AI's are safe and secure to use.

While Constitutional AI is still in the Commercialisation Stage it could be enhanced by advances in Artificial General Intelligence, and other technologies, however over the long term it could be replaced by an AI Agent System of Systems model which could be harder to manage.

MATTHEW'S RECOMMENDATION

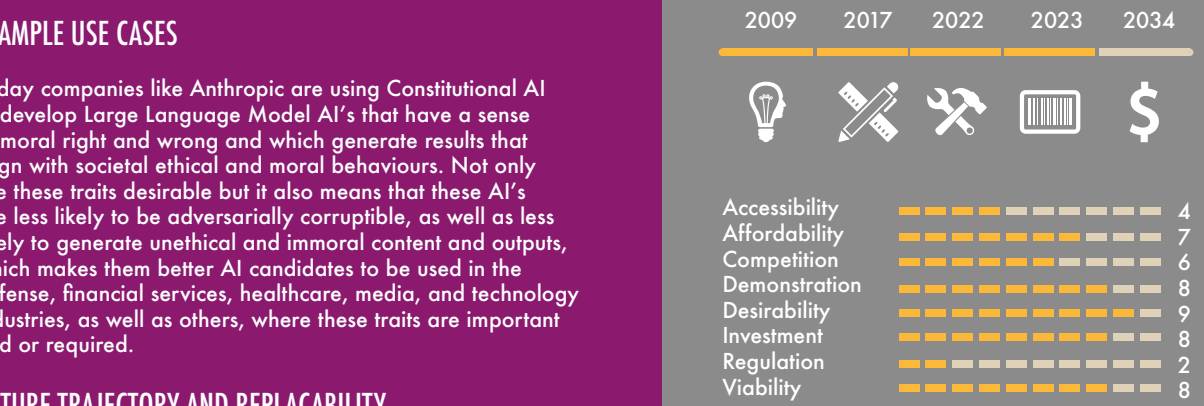
In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

IMPACT

STATUS



PRIMARY GLOBAL DEVELOPMENT AREAS

1 MRL /9

4 TRL /9

5 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

CONTAINMENT ALGORITHMS

CONTAINMENT ALGORITHMS, which are in the Prototype Stage, is the field of research concerned with trying to develop a new class of Artificial Intelligence (AI) algorithms that are able to identify rogue AI's and AI's who exceed the boundaries of their "programming," and then either contain their behaviour and keep it within acceptable parameters, or terminate them. Recent research in the field has been slow, especially given the breakneck speed of general AI development, but nonetheless researchers have managed to create experimental Containment Algorithms, based on reinforcement learning principles, which have shown short term promise. Given the nature of AI, including AGI and ASI, though developing a universal general purpose Containment Algorithm system could very well be nigh on impossible, furthermore it is likely that AI itself will eventually be conscripted to help design and build them.

DEFINITION

Containment Algorithms are a technology that can prevent an Artificial Intelligence from exceeding specific limits and, or terminate it.

EXAMPLE USE CASES

Today researchers are using Containment Algorithms to try and terminate rogue AI's and prevent them from exceeding their programming. In the future researchers believe that the technology will play a central role in helping humanity maintain some level of semi or fully autonomous control over the AI's we embed throughout our Algorithmic Society, and ultimately be of use when it comes to ensuring that AI's don't fulfil the prophecy of destroying all Mankind.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Technology sector. In time we will see Containment Algorithms be embedded into the majority of AI models and constructs, but regulators will naturally have concerns, and given the fact that AI's are already capable of self-designing, evolving, and replicating, it is difficult to see how this "war" will ever be won.

While Containment Algorithms are in the Prototype Stage, over the long term they will be enhanced by advances in Compute, Intelligence, and Sensor technology, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

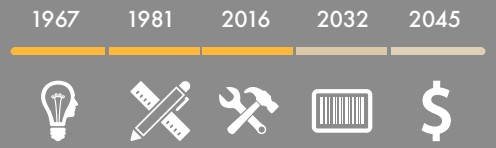
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '22, '23, '24

IMPACT

STATUS



Accessibility	3
Affordability	3
Competition	2
Demonstration	4
Desirability	9
Investment	3
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

1 MRL /9

2 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

CYBER-BIOSECURITY

CYBER-BIOSECURITY, which is in the Concept Stage, is the field of research concerned with developing new ways to prevent the exploitation, modification, or theft of both digital and physical biological and or genetic material and processes. As the amount of interest in the field continues to increase, on the one hand because more biological databases are going online, and on the other because increasingly we see new ways of merging digital and biological analogues together to form conjoined and hybrid networks and computing architectures, as well as see the emergence of increasingly sophisticated Brain Machine Interface technologies, or "Neural Hacks," it is imperative that individuals and organisations have a way to defend themselves from this new style of attack.

DEFINITION

Cyber-Biosecurity is an analogous term that refers to the protection of biological systems from cyber or digital based attack vectors.

EXAMPLE USE CASES

Today most Cyber-Biosecurity systems are limited to protecting digital assets containing sensitive biological and or genetic information. In the future the primary use cases for this technology, whose definition and scope will broaden over time as the overall market and threat landscapes evolve, will be to protect both digital and physical biological and genetic assets from harm.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Aerospace and Defence, Government, Healthcare and Technology sectors, with support from univesity grants. In time we will see this technology play a pivotal role inprotecting people's biology and minds from being hacked, but it will be a long time before we see it being commercialised.

While Cyber-Biosecurity is in the Concept Stage, over the long term they will be enhanced by advances in Anti-CRISPR Technology, Artificial Intelligence, Brain Machine Interfaces, CAST, CRISPR, Gene Drives, Gene Editing, Neuro-Prosthetics, Neuromorphic Computing, and Synthetic Biology, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

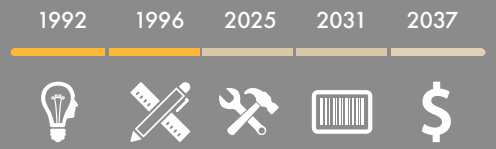
In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view, and re-visit it once a year until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21

IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	2
Demonstration	2
Desirability	8
Investment	1
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

4 MRL /9

5 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

DATA TELEPORTATION

DATA TELEPORTATION, which is in the Prototype Stage, is where quantum information, via the process of quantum entanglement, is literally teleported from one place to another without the need for that information to travel across intermediary computer networks which, as the technology develops could end up being a much more affordable, efficient, and safer way to transfer classified and non-classified data. Over the past couple of years the development of this technology has been slow, primarily due to its inherent complexity, and the data transfer rates have been nothing to shout home about, but researchers have now proven several times that it's not only possible to transmit data in this manner, but that it's also reliable and replicable.

DEFINITION

Data Teleportation is the transfer of quantum information from one location to another instantly without the need for intermediary networks using the phenomenon of quantum entanglement.

EXAMPLE USE CASES

Today we are using Data Teleportation to transmit small volumes of non-classified data between points such as E-Mails and unstructured files, however as the technology develops there is no reason why in time all data could not be transmitted this way. And if this happens then computing, computer infrastructure, computer security, and how we communicate and collaborate could change forever.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in Data Teleportation will continue to accelerate and investment will continue to grow, primarily led by organisations in the Defense and Financial Services sectors. As the technology matures data transmission distance, reliability, and speeds will all improve and when combined with other quantum technologies we could see it ramp up quite quickly, albeit that it will initially be constrained to quite specific geographies, industries, and use cases.

While Data Teleportation is still in the Prototype Stage it could be enhanced by advances in Artificial Intelligence, Materials, Quantum Computing, Quantum Internet, and other technologies, and over the long term it could be replaced by Nil Communication.

MATTHEW'S RECOMMENDATION

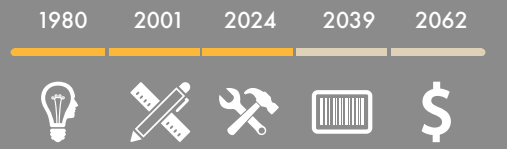
In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	1
Demonstration	7
Desirability	8
Investment	1
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

2 MRL /9

4 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

DNA ENCRYPTION

DNA ENCRYPTION, which is in the early Prototype Stage, is the field of research concerned with developing new encryption and security technologies that keep people's genetic information safe from prying eyes and misuse. Recently there have been a couple of breakthroughs in the space, including the ability to encrypt individual sequences within a users genome using Yao's Protocol so that those individual sequences remain cloaked from anyone who doesn't have the key, and as users are increasingly asked to provide DNA samples, for example by ancestry, healthcare and insurance organisations, being able to protect it becomes increasingly important.

DEFINITION

DNA Encryption is the process of encrypting genetic information using computational methods in order to improve genetic privacy.

EXAMPLE USE CASES

Today the early prototype DNA Encryption products are being used to test the researchers theories and approaches, and refine the technology. In the future the primary application of the technology will be, as it is today, to allow users to protect their genetic information from misues and prying eyes.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a low base, primarily led by organisations in the Technology sector, with support from university grants. In time we will see the use of this particular technology increase as more users get used to the idea of sharing their genetic information, especially with healthcare organisations, so they can receive better treatment.

While DNA Encryption is in the early Prototype Stage, over the long term it will be enhanced by advances in Compute Technology, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

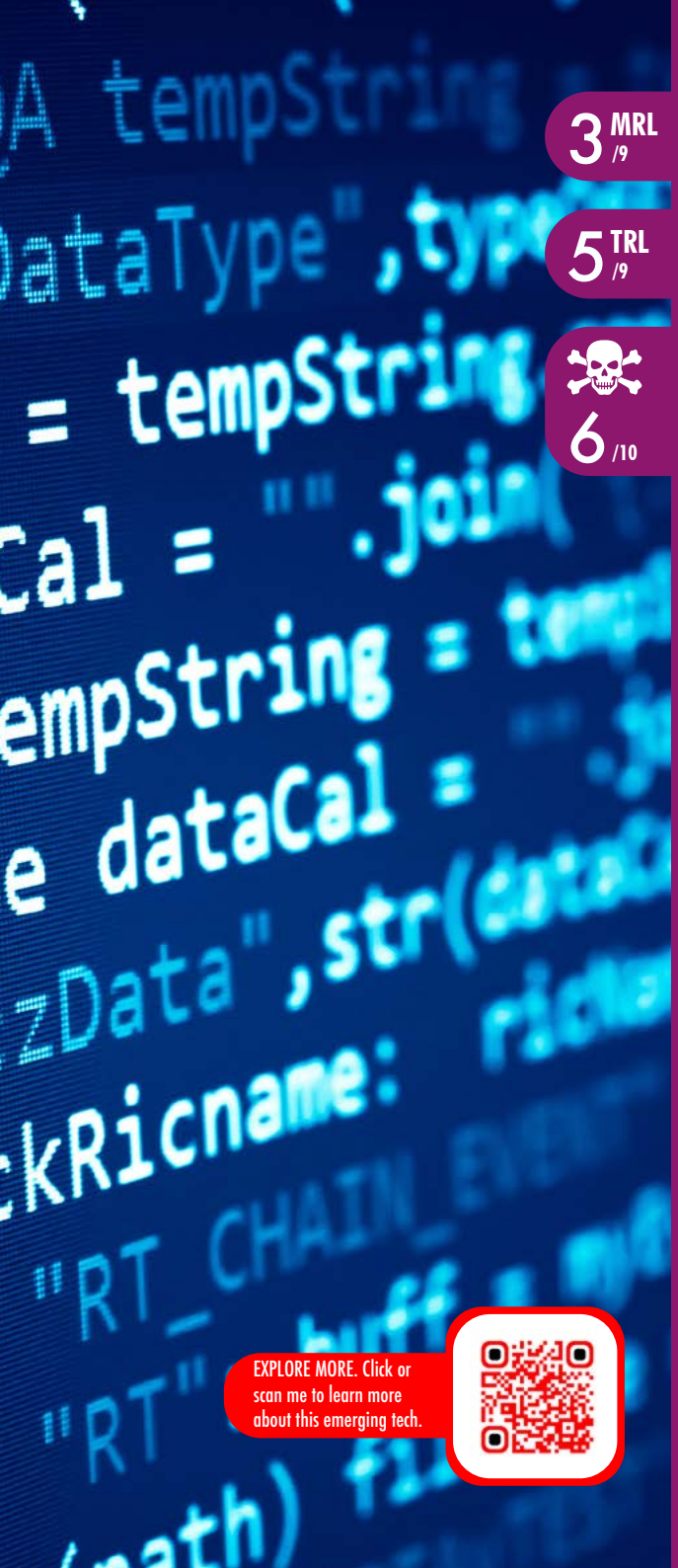
STARBURST APPEARANCES: '18, '19

IMPACT

STATUS

Accessibility	3
Affordability	3
Competition	3
Demonstration	7
Desirability	8
Investment	3
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

5 TRL /9

6 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

HACKPROOF CODE

HACKPROOF CODE, which is in the Prototype Stage and early Productisation Stage, is the field of research concerned with developing new programming methods that make it impossible for systems to be hacked. As improbable as that might sound recent breakthroughs include the development of new mathematical based programming models that, when put through their paces, made it impossible for the world's best white hat hackers to break into the prototype military systems.

DEFINITION

Hackproof Code uses mathematical proof to build software systems that cannot be hacked using any conventional means.

EXAMPLE USE CASES

Today the first prototype Hackproof Code platforms are being put through their paces as researchers try to establish the viability of the technology and their refine their methodologies. In the future the primary applications of the technology would be almost limitless.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow albeit from a low base, primarily led with support from government funding. In time we will inevitably see a wide range of approaches tried and tested, and cynics would say broken, so only time will tell whether or not the researchers are onto something.

While Hackproof Code is in the Prototype Stage and early Productisation Stage, over the long term it will be enhanced by advances in Artificial Intelligence, and Creative Machines, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

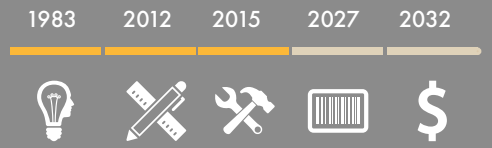
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	2
Demonstration	7
Desirability	9
Investment	2
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

9 MRL /9

9 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

HOMOMORPHIC ENCRYPTION

HOMOMORPHIC ENCRYPTION, which is in the Productisation Stage, is the field of research concerned with developing ways to securely encrypt information in a way that still allows third parties to analyse it without having to give them the encryption keys. Recent breakthroughs in the field include the ability to speed up the encryption process by upto 70 percent which makes the technology an increasingly viable option for companies wishing to leverage it to their advantage.

DEFINITION

Homomorphic Encryption is a method of performing calculations and analysis on encrypted information without decrypting it first.

EXAMPLE USE CASES

Today we are using Homomorphic Encryption to give crowdsourced data scientists access to confidential financial data so they can mine it for patterns and identify investment opportunities and trends in a way that wouldn't have been possible using traditional encryption technologies.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by organisations in the Technology sector. While the technology has been around for some time now there are still a large number of organisations that see its potential and are eager to develop it to a point where it can be used at the hyperscale, but the narrowness of the research means that progress is not as swift as it could be, and that will affect the long term viability of the technology.

While Homomorphic Encryption is in the Productisation Stage, over the long term it will be enhanced by advances in Computing, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

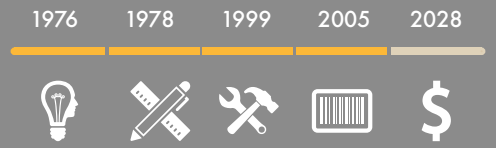
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22

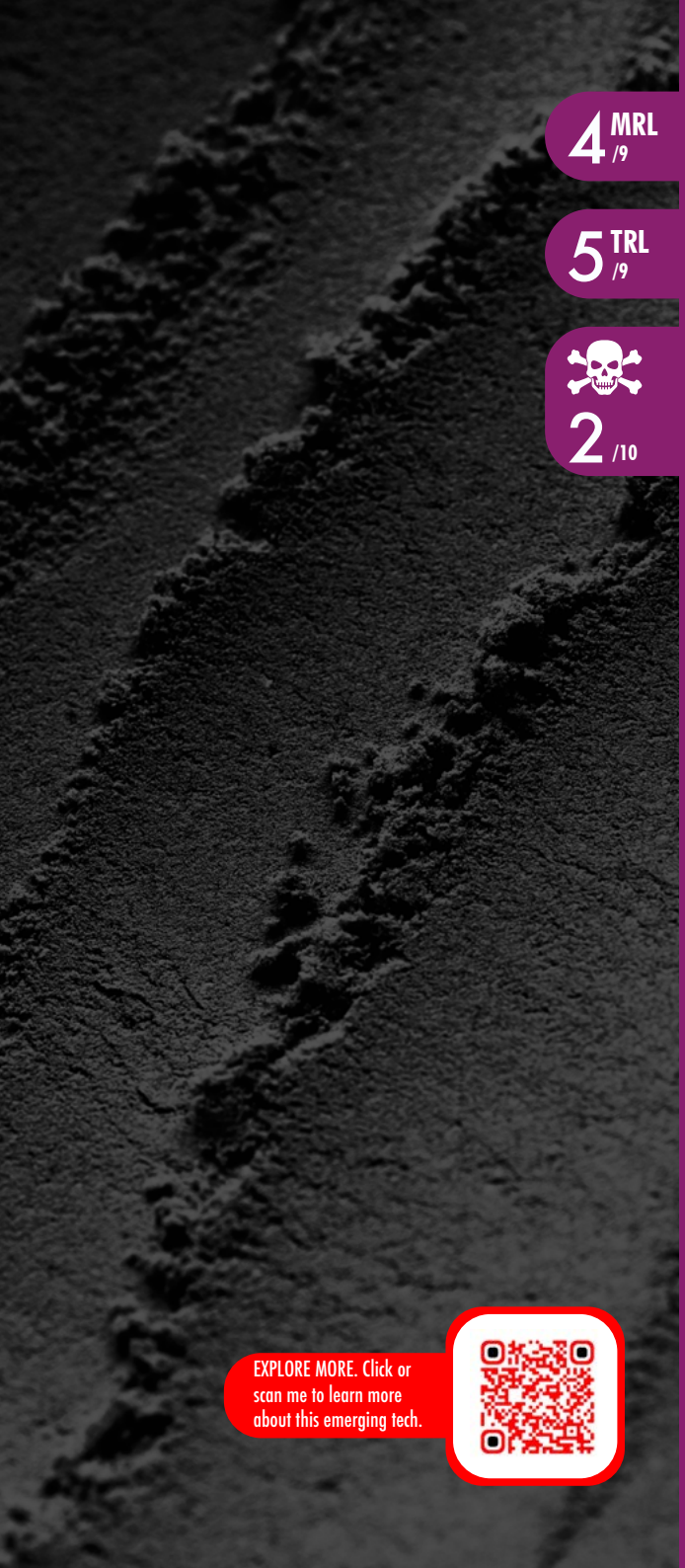
IMPACT

STATUS



Accessibility	6
Affordability	6
Competition	5
Demonstration	8
Desirability	8
Investment	3
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



4 MRL /9

5 TRL /9

2 /10

MECHANICAL METAMATERIALS

MECHANICAL METAMATERIALS, which are still in the early Prototype Stage, are materials that have unique mechanical and physical characteristics that lend themselves to a myriad of interesting use cases. Recently we have seen them being used to create new kinds of allegedly unhackable data storage systems which are, to all intents and purposes, impervious to attack and this alone makes them highly interesting to select sectors. We are also starting to see an increase in the number of research groups interested in developing these special materials and, over time, it's highly likely that they could play an increasingly important role in the development of other technologies, especially in the computing, electronics, and sensing spaces.

DEFINITION

Mechanical Metamaterials are engineered materials with tailored mechanical properties that imbues them with unique properties ideal for specific applications.

EXAMPLE USE CASES

Today we are using this technology to create unhackable solid state storage devices that require a precise sequence of temperatures to be applied to the metamaterials nanostructured surface before the data stored in them, which can be both binary and non-binary, is decoded. Additionally though these materials can also be tuned which could open up the door to new kinds of acoustic insulation, bio-medical devices, electronics, heat and shock dissipation systems, semi conductors, as well as new kinds of actuators and sensing systems.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in Mechanical Metamaterials accelerate and investment grow, albeit from a low base, primarily led by government and military grants. The undeniably unique characteristics of this technology will mean that in time it could become quite pervasive as our ability to develop new mechanical metamaterials affordably and at scale improves.

While Mechanical Metamaterials are still in the Prototype Stage they could be enhanced by advances in 3D and 4D Printing, Artificial Intelligence, Materials and other Metamaterials, Nano-Manufacturing, and other technologies, however over the long term it is not clear what they could be superseded by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

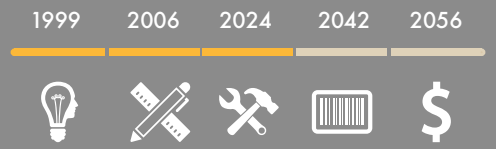
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

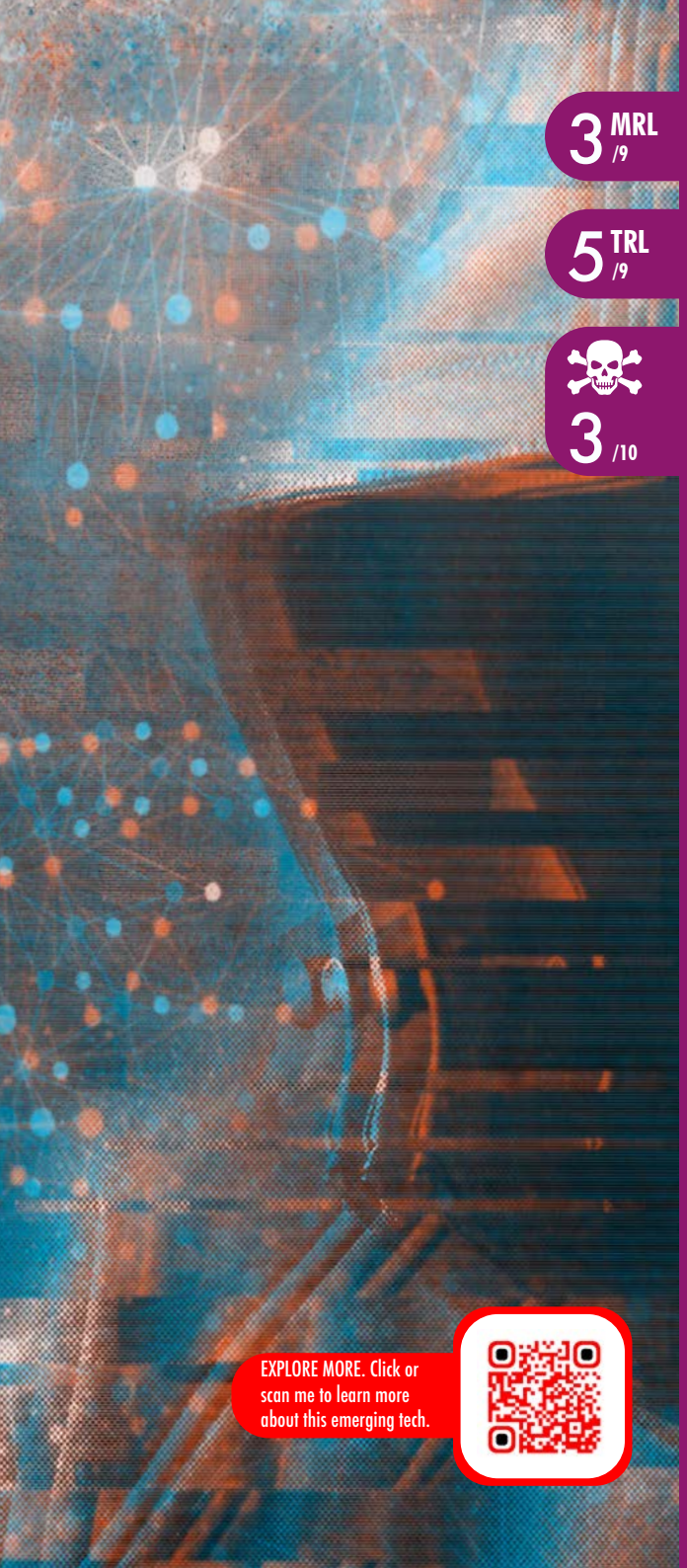
IMPACT

STATUS



Accessibility	3
Affordability	3
Competition	2
Demonstration	7
Desirability	7
Investment	2
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

5 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

MORPHEUS COMPUTING PLATFORM

MORPHEUS COMPUTING PLATFORM, which is in the Concept Stage and very early Prototype Stage, is the field of research concerned with developing a unhackable computing platform that can re-configure both its hardware and software in real time in order to thwart hackers. While the platform is still early in its development cycle some of the fundamental components needed to make it a reality are already emerging, such as Artificial Intelligence programs capable of self-coding, self-evolving, and self-replicating, as well as the emergence of re-configurable electronics platforms, Robo-Hackers, and entirely new Biological Computing, Chemical Computing, DNA Computing and Molecular Computing platforms that give researchers a myriad of new technologies that can be leveraged to build such a ground breaking platform.

DEFINITION

Morpheus Computer Platforms can self-configure and self-reconfigure both their code and hardware components in order to create an ultra secure, unhackable computing platform.

EXAMPLE USE CASES

Today the first prototype Morpheus Computer Platforms are very basic and being used to test different theories and approaches. In the future the primary applications of the technology will be to secure classified and sensitive data.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by support from government funding, and university grants. In time we will see the individual building blocks needed to create the first full prototype mature, after which the most difficult task, that of integrating them all into a viable commercial product, will begin.

While Morpheus Computing Platforms are in the Concept Stage and very early Prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Biological Computing, Chemical Computing, Creative Computing, DNA Computing, Memristors, Re-Configurable Electronics, and Robo-Hackers, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

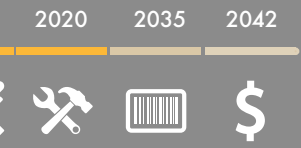
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	1
Affordability	1
Competition	1
Demonstration	5
Desirability	9
Investment	3
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

8 MRL /9

8 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

NEURAL NETWORK WATERMARKING

NEURAL NETWORK WATERMARKING, which is in the early Productisation Stage, is the field of research concerned with developing new ways to protect the IP invested in neural networks, and proving their authenticity and ownership. Recently there have been a number of developments in the field from researchers who have found new and easier ways to embedded watermarks in DNN models that are robust and resilient to different counter-watermark mechanisms, such as fine-tuning, parameter pruning, and model inversion attacks, with the additional benefit that they don't add any code bloat.

DEFINITION

Neural Network Watermarking is the process of watermarking neural networks in order to prove authenticity.

EXAMPLE USE CASES

Today we are using Neural Network Watermarking to protect neural networks from counterfeiting and theft, as well as for authentication purposes, prove ownership, and to protect the IP invested in them. In the future the primary applications of the technology will include using it to ascertain the authenticity of neural networks, especially in regulated environments, as well as protect IP and prove authenticity.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Technology sector. In time we will see researchers develop increasingly advanced watermarking techniques, and new ways to audit and track them.

While Neural Network Watermarks are in the early Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23, '24

IMPACT

STATUS

Accessibility	4
Affordability	3
Competition	6
Demonstration	7
Desirability	8
Investment	4
Regulation	4
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

5 TRL /9

5 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ONE TIME PROGRAMS

ONE TIME PROGRAMS, which are in the early Prototype Stage, is the field of research concerned with the development of programs that run once, and leave no traces of their existence. Recent breakthroughs include the development of the world's first probabilistic One Time Programs that can not only run once, but that can also "expire" all evidence of their existence once they've run, a problem that has plagued researchers in the field for decades, especially as researchers have had to rely on traditional silicon based computers that leave data traces in cache which would allow actors to reverse engineer them. However, the breakthrough came when researchers combined the technology with the quirkiness of Quantum Computers where the principles of Quantum Mechanics allowed them to encode information in photons and process it using optical logic gates to create programs that, literally, left no trace of their existence behind.

DEFINITION

One Time Programs are black box functions that may be evaluated once and then self destruct.

EXAMPLE USE CASES

Today the first prototype One Time Programs are being used to test theories and refine the methodology. In the future the primary applications of the technology will be in cyber-security and to keep sensitive data, and instructions, secure.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow albeit from a very low base, primarily led with support from government funding, and university grants. In time we will see the technology continue to evolve, but it'll likely be the case that researchers will have to wait for the first commercial Quantum Computers to come online before the technology starts coming into its own.

While One Time Programs are in the early Prototype Stage, over the long term they will be enhanced by advances in Quantum Computing, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

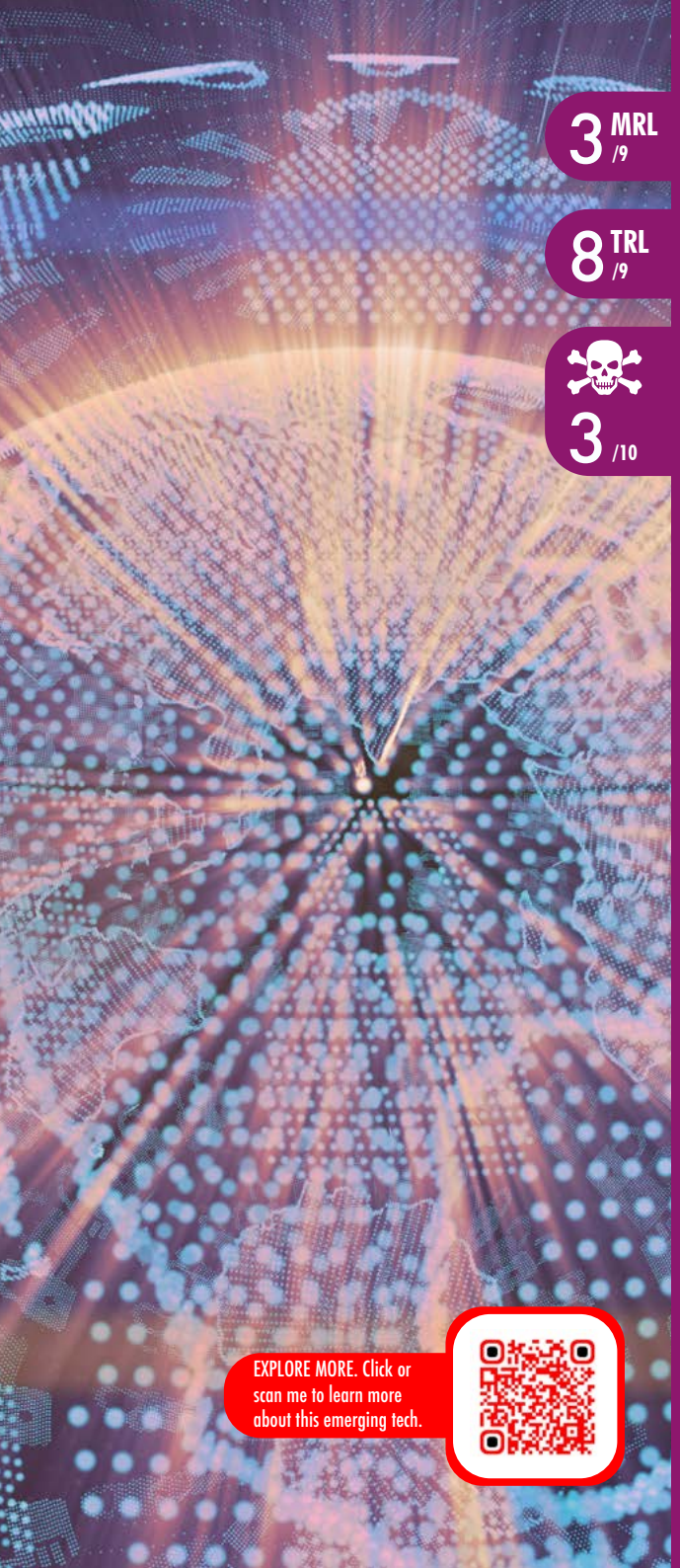
STARBURST APPEARANCES: '18, '19, '20, '21, '22, '24

IMPACT

STATUS

Accessibility	2
Affordability	2
Competition	3
Demonstration	5
Desirability	9
Investment	2
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



POST QUANTUM CRYPTOGRAPHY

POST QUANTUM CRYPTOGRAPHY, which is in the Prototype Stage and early Productisation Stage, is the field of research concerned with developing encryption systems that cannot be cracked, or easily be cracked, unlike 70 percent of today's common encryption standards, such as RSA and Diffie-Hellman, by Quantum Computers in a "post quantum" world. Recent breakthroughs include reducing the size of encryption keys and signatures, the time required to encrypt and decrypt data, as well as verify signatures, as well as reducing the amount of information that has to be sent across the wires. Consequently there are now a multitude of suggested protocols with the leaders being those that work best with today's existing encryption standards, which include FrodoKEM, Picnic, qTesla, and SIKE, that are all based, in one way or another, on Code based, Hash based, Lattice, Multivariate, Supersingular Elliptic Curve, and Symmetric key encryption research.

DEFINITION

Post Quantum Cryptography use a suite of public key cryptographic algorithms that cannot be cracked by Quantum Computers.

EXAMPLE USE CASES

Today the first prototype Post Quantum Cryptography products are being used to test the theories and refine the methodologies. In the future the primary applications of the technology will be to encrypt and protect information in the same way we do today, but in a post quantum world.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Defence and Technology sectors, with support from government funding, and university grants. In time we will see the technology mature and the market consolidate around two or three winners, however one of the main risks to organisations is the fact that the transition to these new protocols will take time, in some cases up to a decade which will put organisations at risk.

While Post Quantum Cryptography is in the Prototype Stage and early Productisation Stage, over the long term it will be enhanced by advances in Artificial Intelligence, and Quantum Computers, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

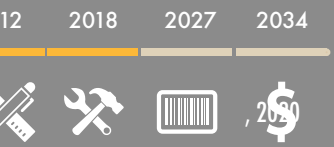
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	2
Affordability	3
Competition	6
Demonstration	7
Desirability	9
Investment	5
Regulation	3
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

4 MRL /9

5 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

QUANTUM CRYPTOGRAPHY

QUANTUM CRYPTOGRAPHY, which is in the Prototype Stage and early Productisation Stage, is the field of research concerned with developing new quantum based encryption protocols that can be used to create unbreakable cryptographic systems. Recent breakthroughs include the development of the first commercially available Quantum Key Distribution systems, and breakthroughs in the Quantum Signal Repeaters and quantum communications satellite systems needed to relay the keys over very long distances at speed - including inter-continental.

DEFINITION

Quantum Cryptography exploits the properties of Quantum Mechanics and Quantum Key Distribution to create theoretically unbreakable cryptographic systems.

EXAMPLE USE CASES

Today we are using Quantum Encryption to protect sensitive transactions in the defence, finance, and government sectors. In the future the primary applications of the technology will include using it to protect all manner of sensitive information very much in the same way that we use encryption today.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Defence, and Technology sectors, with support from government funding, and university grants. In time we will see the distance and speed that quantum keys can be transmitted increase to the point where they are no longer constrained, at which point the adoption of the technology will begin to accelerate.

While Quantum Cryptography is in the Prototype Stage and early Productisation Stage, over the long term it will be enhanced by advances in Sensor Technology, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

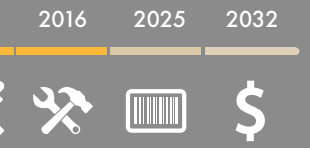
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '21, '22, '23, '24

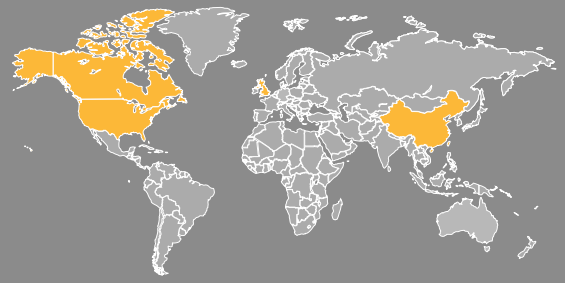
IMPACT

STATUS



Accessibility	2
Affordability	4
Competition	5
Demonstration	7
Desirability	9
Investment	5
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



1 MRL /9

3 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

QUANTUM FINGERPRINTING

QUANTUM FINGERPRINTING, which is in the Prototype Stage, is the field of research concerned with trying to find new ways to use quantum phenomenon, which are in essence Physically Unclonable Functions (PUF), to perfectly identify and secure systems and users. Recently there have been a few breakthroughs in this intriguing field including the use of the transistor trap sites to uniquely identify every device. Because every trap site in a computer transistor is unique - thanks to their method of fabrication and atomic structure - they all have unique Current-Voltage Characteristics at the quantum level which are unclonable, so by using image recognition algorithms researchers were able to give each computer chip a unique fingerprint that could then be used to identify them as friend or foe. In today's age, being able to identify devices and users at the quantum level is needless to say an incredibly powerful tool in the fight against cyber crime.

DEFINITION

Quantum Fingerprinting is the use of quantum signatures to uniquely identify devices, systems, and users.

EXAMPLE USE CASES

Being able to identify devices and users at the quantum level in an unclonable way opens the door to creating next generation cyber defense systems that are almost infallible, therefore their primary use case should be to help secure literally everything which makes this one of the most powerful security technologies in our arsenal.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate, albeit from a very very low base, predominantly led by government grants. The ability to identify objects at the quantum level, which cannot be cloned using today's technologies, is an incredibly powerful step forwards for the cyber industry, but as this technology is flying under the radar it's likely to remain niche for a long time until it is picked up by mainstream research teams.

While Quantum Fingerprinting is still in the Prototype Stage it could be enhanced by advances in AI, Quantum technologies and sensors, and many other technologies, however over the long term it is not clear what it could be replaced by.

MATTHEW'S RECOMMENDATION

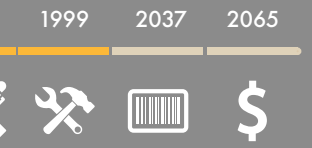
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

IMPACT

STATUS



Accessibility	3
Affordability	3
Competition	2
Demonstration	6
Desirability	9
Investment	3
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

QUANTUM SAFE BLOCKCHAINS

QUANTUM SAFE BLOCKCHAINS, which are in the early Prototype Stage, is the field of research concerned with developing new ways to protect Blockchains, that rely on traditional digital signatures to secure them, from being cracked and interfered with by Quantum Computers, that, according to many, pose a major security threat to the technology and the organisations using it. Recent breakthroughs include the development of new Quantum Key Distribution schemas that can be used to protect otherwise vulnerable blockchains.

DEFINITION

Quantum Safe Blockchains are blockchains that cannot be easily cracked using Quantum Computers.

EXAMPLE USE CASES

Today the first Quantum Safe Blockchain prototypes are being used to test the researchers theories and refine the technology. In the future the primary applications of the technology will be to use it to secure blockchains from attack from quantum computers.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow albeit from a very low base, primarily led by organisations in the Technology sector, with support from university grants. In time we will see researchers refine the technology in a way that maintains the transparency and integrity of blockchain transactions, and as other complimentary technology fields mature, in time the technology will see increased adoption.

While Quantum Safe Blockchains are in the early Prototype Stage, over the long term they will be enhanced by advances in Quantum Cryptography, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

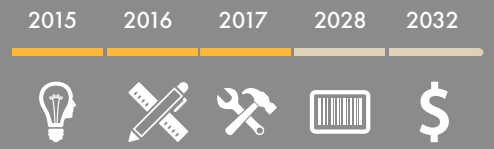
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '20, '21, '23, '24

IMPACT

STATUS



Accessibility	3
Affordability	5
Competition	4
Demonstration	7
Desirability	8
Investment	4
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

7 MRL /9

9 TRL /9

10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ROBO-HACKERS

ROBO-HACKERS, which are in the Prototype Stage and Productisation Stage, is the field of research concerned with developing a range of multi-use semi-autonomous and autonomous Artificial Intelligence cyber-security and hacking platforms that are capable of identifying and patching vulnerabilities in the systems they are protecting, as well as exploiting the same in the systems they are being used to attack. Recent breakthroughs include the development and use of the world's first commercial Robo-Hacker platforms, that can scan, identify, and patch, or exploit, Proof of Vulnerabilities in millions of lines of code within minutes, not the months or years that it has traditionally taken human analysts - a move that is described as game changing by experts in the field.

DEFINITION

Robo-Hackers are semi-autonomous and autonomous Artificial Intelligence platforms that are capable of analysing, exploiting and hacking code and systems.

EXAMPLE USE CASES

Today we are using Robo-Hackers to defend the Pentagon's mission critical systems from cyber attack, as well as to identify and fix vulnerabilities in the code bases of autonomous vehicles, and Internet of Things devices. In the future the primary applications of the technology will be almost limitless.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Defence and Technology sectors, with support from government funding. In time we will see the technology become self-coding and self-evolving, and become the defacto way organisations analyse their software for bugs and vulnerabilities, and protect their systems, but we will also quickly see the technology become weaponised and used for less noble purposes.

While Robo-Hackers are in the Prototype Stage and Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Creative Machines, Hive Minds, Quantum Computing, and Swarm Artificial Intelligence, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

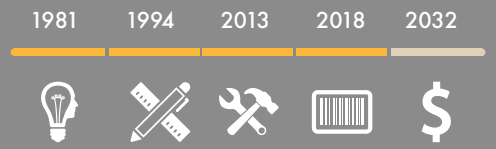
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, with a view to implementing it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	3
Affordability	5
Competition	3
Demonstration	8
Desirability	9
Investment	5
Regulation	2
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

1 MRL /9

2 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

TELEPATHIC CYBER DEFENSE

TELEPATHIC CYBER DEFENSE, which is in the Prototype Stage, is the field of research concerned with developing new ways to protect our rapidly growing digital ecosystems by harnessing and leveraging the power of the human mind, and, in essence, putting humans into the middle of the action inside virtual environments that represent the systems they are tasked with monitoring and protecting. Recent breakthroughs include unifying cyber security incident and response, systems architecture and design, and neural interface command and control systems to create "naturalised" virtual worlds where human cyber security analysts, that patrol the digital networks and systems in a Matrix-like fashion, are teamed with Robo-Hackers and other automated cyber defense tools to identify and eliminate threats as soon as they appear.

DEFINITION

Telepathic Cyber Defense systems use Brain Machine Interfaces to put human operators into the heart of computer networks and allow them to become active guardians.

EXAMPLE USE CASES

Today the prototypes of Telepathic Cyber Defense are being used to test the theories and simulations, and refine the methodologies. In the future the primary applications of the technology will be to defend mission critical and sensitive systems from attack, while harnessing the combined power of both humans and machines within one naturalised virtual environment.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Defence and Technology sectors, with support from government funding. In time we will see researchers create increasingly complex and seamless virtual environments that not only put cyber security analysts into the heart of the systems they are protecting, but that gives them a range of new and powerful tools and techniques with which to fight intruders..

While Telepathic Cyber Defense is in the Prototype Stage, over the long term it will be enhanced by advances in Artificial Intelligence, Creative Machines, Quantum Computing, Neural Interfaces, Robo-Hackers, and Virtual Reality, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

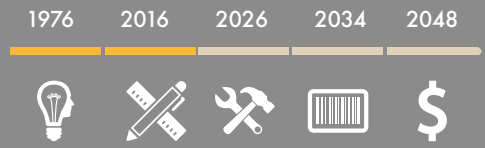
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23

IMPACT

STATUS



Accessibility	1
Affordability	2
Competition	4
Demonstration	2
Desirability	7
Investment	4
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

ULTRASOUND FORCE FIELDS

ULTRASOUND FORCE FIELDS, which are in the early Prototype Stage, are quite literally that - sound based force fields that are capable of deflecting laser beams. A true science fiction technology that, as we've seen with many others, is now science fact albeit as a prototype. While developments in this field are limited this particular technology takes a cue from ultrasound based Tractor Beams to create an ultrasound lattice or grid which is sufficiently dense and powerful enough to deflect low power lasers. While this technology was first discussed about a decade ago this is the first example of a working prototype.

DEFINITION

Ultrasound Force Fields is the use of ultrasound to create a force field that can deflect energy and laser beams.

EXAMPLE USE CASES

Today this technology is still being developed with the primary use case being defense applications against military Direct Eenergy Weapons (DEW) systems that are increasingly finding their way onto the battlefield. However, other applications could also include being used to manipulate tissues during surgery, targeted drug delivery, and wound healing, as well as the acoustic levitation of delicate materials or objects, filtering, and even as acoustic haptic feedback devices for use in Virtual Reality (VR) environments.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in Ultrasound Forcefields increase and investment grow, albeit from a very low base, primarily led by the defense industry. As the technology improves it is highly likely that at some point this technology could find itself being deployed by different militaries, however that will only happen if it can be proven to work in the wild, can scale, and can deflect the lasers from more powerful DEW systems. That asides though it has interesting applications in other sectors so whether it makes it into the military or not it is likely that we'll see these deployed somewhere in the future even though it will likely remain a niche technology.

While Ultrasound Forcefields are still in the early Prototype Stage they could be enhanced by advances in Artificial Intelligence, Materials and Metamaterials, Sensors, and other technologies, however over the long term it's unclear what they could be superseded by.

MATTHEW'S RECOMMENDATION

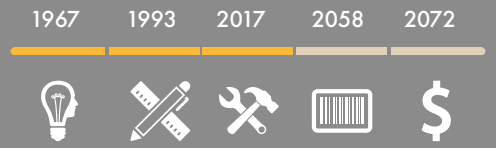
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

IMPACT

STATUS



Accessibility	4
Affordability	5
Competition	1
Demonstration	7
Desirability	9
Investment	2
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

5 MRL /9

7 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ZERO KNOWLEDGE PROOF

ZERO KNOWLEDGE PROOF, which is in the early Commercialisation Stage, is a cryptographic technology that is as odd as they come. In a hat tip to Blockchain, which lets third parties transact with one another and trust one another without the need for any intermediary parties Zero Knowledge Proof (ZKP) enables third parties that don't know one another to share the final "truth" of a piece of information without actually proving that it's the truth. In layman's terms it's the equivalent of proving to you that there is something in a locked safe without opening the safe to show you the actual "proof." Needless to say in our increasingly decentralised and digital world, where an increasing amount of interactions happen between third parties who don't know one another this ability to prove that's something is the truth without revealing anything but that final truth is revolutionary.

DEFINITION

Zero Knowledge Proof is a cryptographic method where a prover can convince a verifier of the truth or validity of a statement without revealing any information beyond the statement's truth.

EXAMPLE USE CASES

While use cases are thin on the ground at the moment they include the ability to prove a transaction is valid without revealing the sender, transaction amount, or recipients details, it also has applications in data privacy and the healthcare industry where the validity of data can be proved without sharing the sensitive data itself, and then there are other use cases in DeFi, smart contracts, voting systems, and even in supply chain management where third parties can prove the authenticity of goods without revealing sensitive business data.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Zero Knowledge Proof increase, albeit from a very low base, primarily led by university grants and the Technology industry. An intriguing technology, or protocol, ZKP could revolutionise data sharing and security but at the moment it's still fringe, so while it isn't going away whether it's adopted at scale remains to be seen. That said though, in time, it could become a key foundational digital protocol.

While ZKP is still in the early Commercialisation Stage it could be enhanced by advances in Artificial Intelligence, Blockchain, One Time Programs, Web 3.0, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

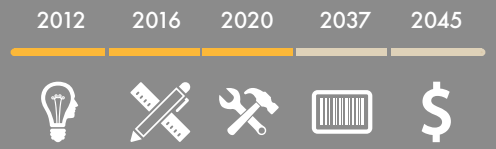
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

IMPACT

STATUS



Accessibility	5
Affordability	6
Competition	1
Demonstration	8
Desirability	9
Investment	2
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

SENSORS

AS A human you have it lucky. After all, sensing things just comes naturally with you - it's part of your biology. But if you aren't lucky enough to be a biological organism of some kind then sensing, well, it's somewhat of a challenge, and that's where sensors come into the equation.

Whether they're the sensors in your smartphone that, when combined with Artificial Intelligence and Machine Vision, can help you detect cancer and the onset of dementia and illness sooner, or the types of sensors that we're building into robots to give them a sense of touch, there's no denying that in the future the world will be jam packed with these little miracle devices. And as for sensitivity and size, well, without spoiling the surprise let me just say we're going all in on quantum, and living sensors aren't far behind, and they're an entirely new ball game ...

In this section you will find details of the emerging technologies that made it into this years Griffin Emerging Technology Starburst along with details of other impactful emerging technologies:

1. Acoustic Cameras
2. Bio-Robotic Sensors
3. Biometric Sensors
4. Biomimetic Sensors
5. Electro-Mechanical Sensors
6. Event Based Sensors
7. Hyperspectral Sensors
8. Lenseless Cameras
9. Living Sensors
10. Nano-Antennae
11. Nano-Sensors
12. Neutron Detectors
13. Optical Bio-Sensors
14. Photonic Sensors
15. Ptychography
16. Quantum Sensors
17. Rydberg Sensors
18. Sapphire Sensors
19. Smart Dust
20. Spray on Sensors
21. Terahertz Imaging

In addition to these emerging technologies there are many others that have yet to get an entry in this codex. These include, but are not limited to:

22. Autonomous Sensor Systems
23. Backscatter Sensors
24. Bio-Sensors
25. Biomarker Sensors
26. Depth of Field Sensors
27. ECG Sensors
28. EEG Sensors
29. Electrochemical Sensors
30. Electromyography Sensors
31. Electrophoresis Sensors
32. Force Sensors
33. Graphene Sensors
34. Laser Ranging Sensors
35. Lidar
36. Micro Electro-Mechanical Sensors
37. Molybdenite Sensors
38. Multispectral Sensors
39. Nano Electro-Mechanical Sensors
40. Nanotube Sensors
41. Photodiodes
42. Sensor Fusion
43. Single Photon Avalanche Diodes
44. Time of Flight Sensors
45. Ultrasonic Sensors

5 MRL /9

7 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ACOUSTIC CAMERAS

ACOUSTIC CAMERAS, which are in the early Commercialisation Stage, is the field of research concerned with trying to find new ways to visualise sound and its behaviours in any environment which, in this case you can very much think of as quite literally being able to take photos of sounds. Recently there have been a number of breakthroughs in the field including the development of the first actual acoustic camera that can take pictures of sound, and then using different grading systems, visualise it in a variety of impressive ways for users.

DEFINITION

Acoustic Cameras are devices that can visualise sound waves within an environment.

EXAMPLE USE CASES

The primary use case for Acoustic Cameras today is to use them to identify how sound is travelling through and interacting with a space, whether that space is a concert hall or an industrial facility, which make this technology a very valuable tool for acoustic engineers and anyone who wants to know how sound behaves. Other applications include being able to use this technology for building and acoustics design, environmental noise monitoring, vehicle noise reduction measures, as well as being able to visualise sound within the human body which could benefit cardiology, obstetrics, and oncology, and other fields.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Acoustic Cameras increase, albeit from a very low base, primarily led by organisations in the Construction and Healthcare sectors. Sound is all around us and it plays a very important role in all our lives so being able to visualise it, so that we can understand its behaviours and meaning is incredibly important, therefore making this technology one to watch and one that's likely to play a greater role in the future.

While acoustic Cameras are still in the Prototype Stage they could be enhanced by advances in Artificial Intelligence, Materials, Quantum Computing, Sensors and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

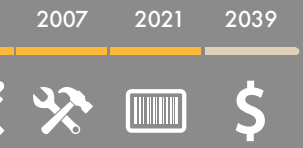
In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

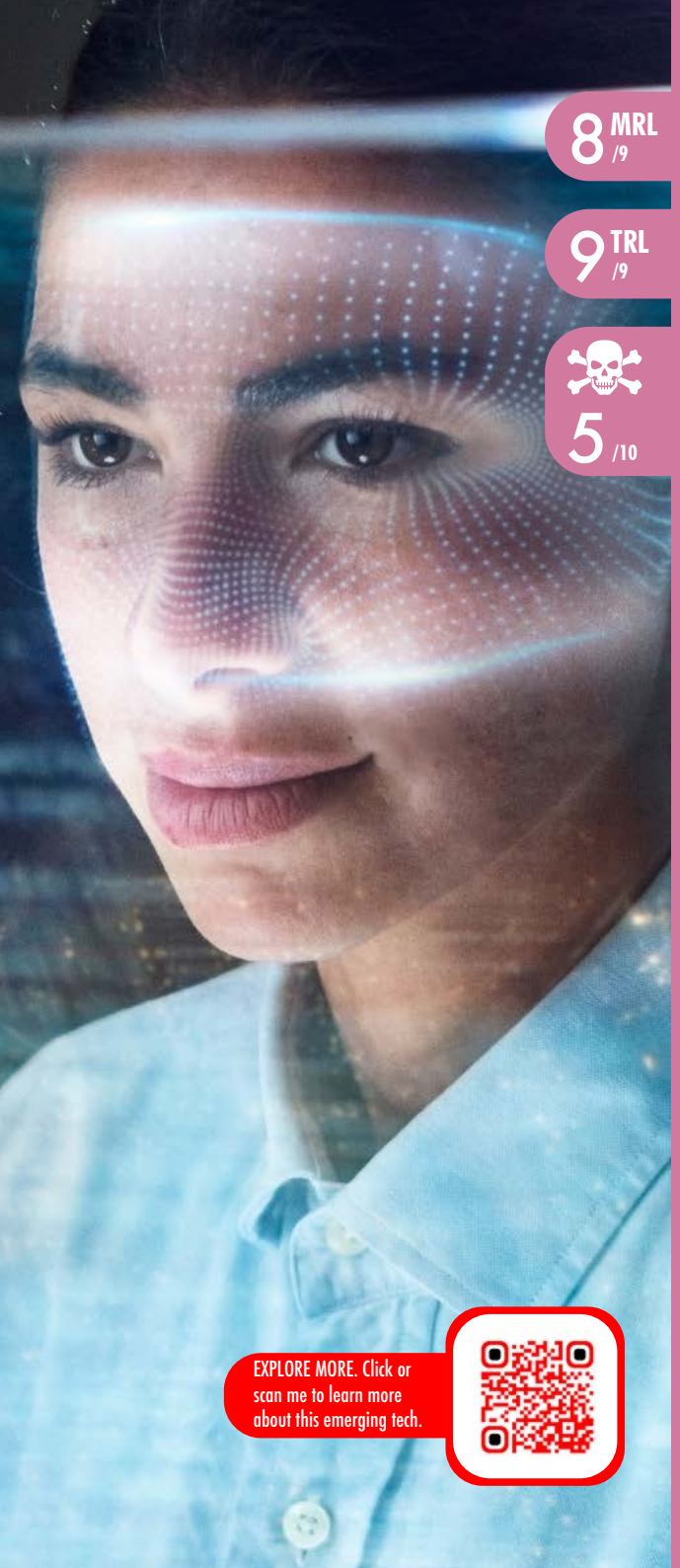
IMPACT

STATUS



Accessibility	5
Affordability	5
Competition	3
Demonstration	8
Desirability	9
Investment	3
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS



BIOMETRIC SENSORS

BIOMETRIC SENSORS, which are in the Mass Adoption Stage, is the field of research concerned with developing sensors that are capable of capturing a wide range of biometric cues that can be used to analyse and identify people, and their behaviours and characteristics. Recent breakthroughs include the ability to capture increasingly intricate biometric information from a distance, in the case of facial, fingerprint, iris, and voice prints, up to a range of 400 meters or more, at high speed which can be combined together to create so called "Touchless" biometric systems. Researchers have also developed new systems, including wearables, capable of capturing brainwave activity, micro movements, and much more, and when combined with information from other sources researchers have also been able to use these systems to determine people's character, personalities, and their predisposition to commit crime.

DEFINITION

Biometric sensors are external or internal devices that can capture biometric data and connect and exchange information with other devices.

EXAMPLE USE CASES

Today we are using Biometric Sensors in a wide variety of applications, including accessing our devices and online accounts, and at ports of entry, as well as to identify individuals for marketing purposes, and using it to surveil entire populations.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Defence and Technology sectors, with support from government funding and university grants. In time we will see the use of the technology become truly ubiquitous, both online and offline, and while it will streamline access to services, it will also be used to strip away users privacy and benefit dystopian governments.

While Biometric Sensors are in the Mass Adoption Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Far Field Microphones, Neural Interfaces, Optics, Sensor Technology, and Smart Materials, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

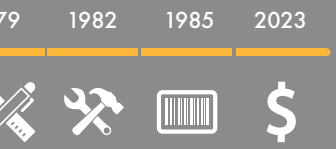
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19

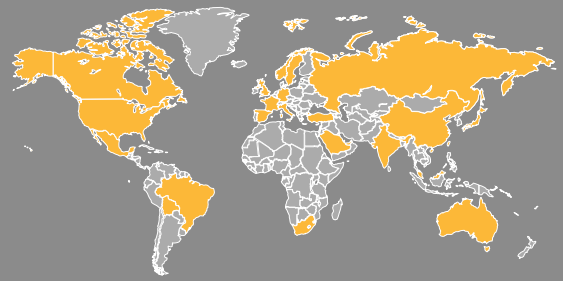
IMPACT

STATUS



Accessibility	9
Affordability	9
Competition	5
Demonstration	9
Desirability	9
Investment	8
Regulation	6
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

5 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

BIOMIMETIC SENSORS

BIOMIMETIC SENSORS, which are in the Prototype Stage and Productisation Stage, is the field of research concerned with developing sensing technologies that mimic the behaviours, capabilities, and functional properties of biological systems which, over the millennia have been fine tuned to sense every last detail of the physical and chemical environment, from the gentlest breeze to the bitter Citric Acid in Citrus fruits, in order to ultimately ensure an organisms survival. Recent breakthroughs include the development of sensors that can mimic all five human senses, and that are, in many cases, thousands of times more sensitive, as well as many more less obvious sensors including ones that are capable of sensing the minutest quantities of certain chemicals in the water.

DEFINITION

Biomimetic Sensors are sensors that mimic the behaviours, capabilities, and functional properties of biological systems.

EXAMPLE USE CASES

Today we are using Biomimetic sensors to create robots that navigate by the stars, rather than GPS, biomedical devices that can smell disease, and Virtual Reality systems that expose the user to smells, tastes and other sensations. In the future the primary applications of the technology will be almost limitless, and range from playing a role in the development of Smart Buildings through to Smart Materials, and much more.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Consumer Electronics, Defence, Healthcare, Manufacturing, and Technology sectors, with support from university grants. In time we will see the types of sensors, and their capabilities mature and the number of applications they are capable of addressing increase.

While Biomimetic Sensors are in the Prototype Stage and Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Backscatter Energy Systems, Bio-Hybrid Robots, Carbon Nanotubes, Electro-Mechanical Sensors, Nanomanufacturing, Nano-Sensors, Neurobiotics, Sensor Fusion, and Soft Robots, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

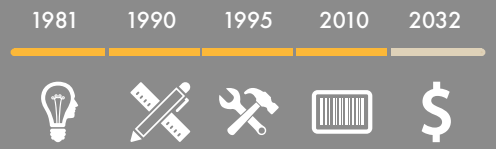
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21

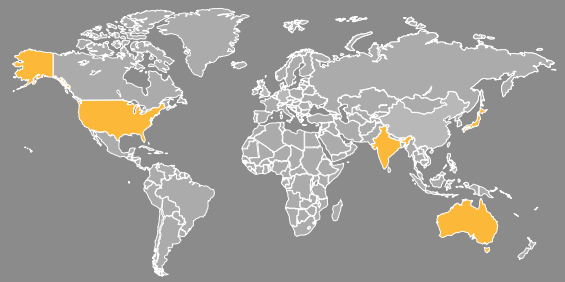
IMPACT

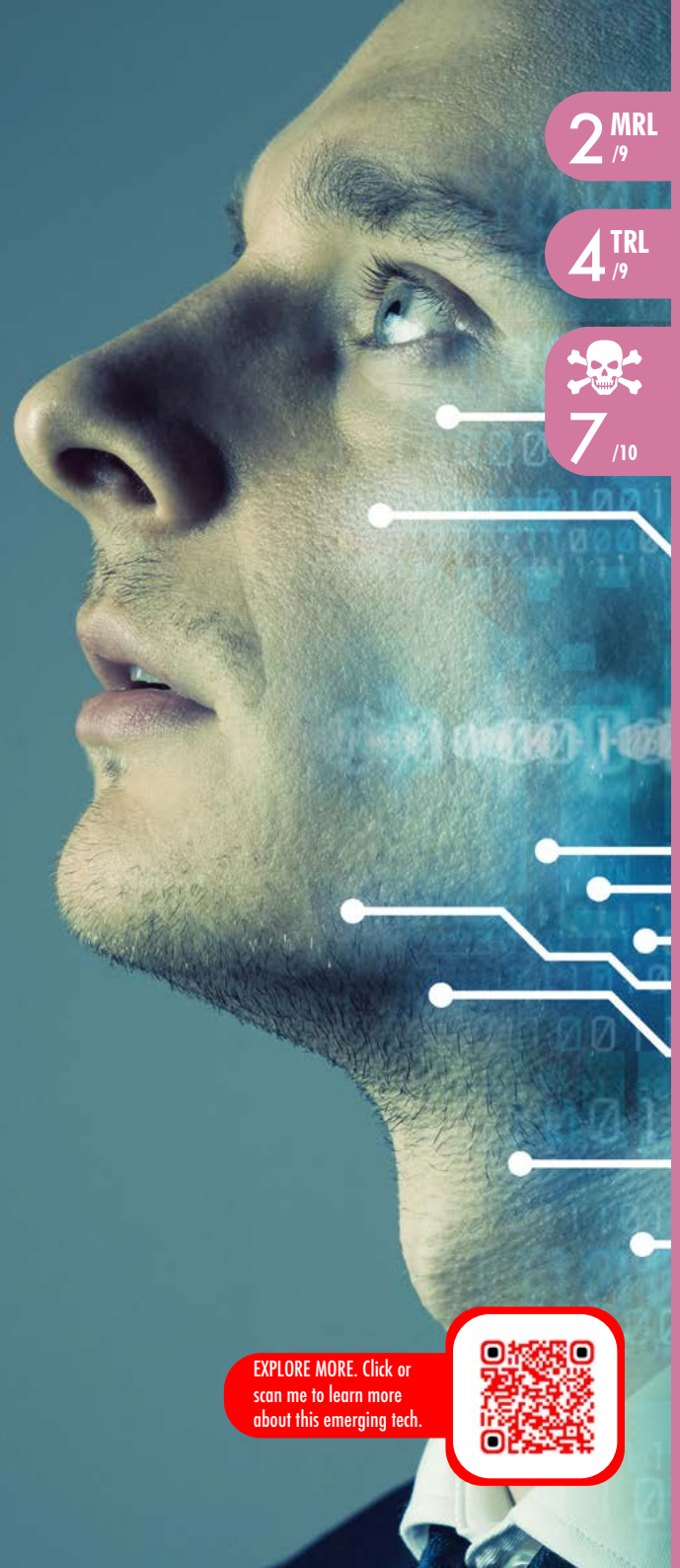
STATUS



Accessibility	7
Affordability	7
Competition	5
Demonstration	8
Desirability	8
Investment	6
Regulation	4
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





2 MRL /9

4 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

BIO-ROBOTIC SENSORS

BIO-ROBOTIC SENSORS, which are in the Prototype Stage, is the field of research concerned with finding new ways to fuse and integrate biological and mechanical, or robotic, components together that allow what one system senses to be processed by the other and vice versa. Recently there have been a number of innovations in the field which have included the development of Bio-Robotic Sensors that are capable of translating the smells sensed by insects biological senses into digital chemical signatures that can be processed by a computing system to detect bombs and explosives.

DEFINITION

Bio-Robotic sensors are sensors where biological and robotic components have been interfaced with one another to give mechanical systems access to natural sensing capabilities.

EXAMPLE USE CASES

Today Bio-Robotic Sensors are being used in the military in the form of locusts helping detect buried landmines. In the future the ability to tap into and then augment a biological organisms sensory and nervous systems, including their brains, will not only lead to a new class of Conscious Robots, courtesy of Neurobiotics, but will also let any organism, including humans, be turned into nodes and Living Sensors at the edge of the network to create the Internet of Living Things.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace and Defence sectors, with support from government funding and university grants. In time we will see Bio-Robotic Sensors and the technologies used to develop Living Sensors, such as Artificial Intelligence, Brain Machine Interfaces, Genetic Engineering, and Machine Vision, merge. Not only will this allow researchers to turn every living thing into a node or a sensor at the edge of the network but it will cause a societal and technological paradigm shift in everything from data capture to situational awareness.

While Bio-Robotic Sensors are in the Prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Brain Machine Interfaces, Cyborgs, and Living Sensors, as well as Advanced Manufacturing, Compute, Electronics, Intelligence, Robotics, and Sensor technologies, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

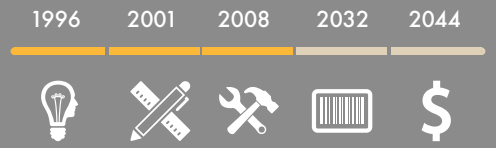
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and re-visit it every few years until progress in this space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '21

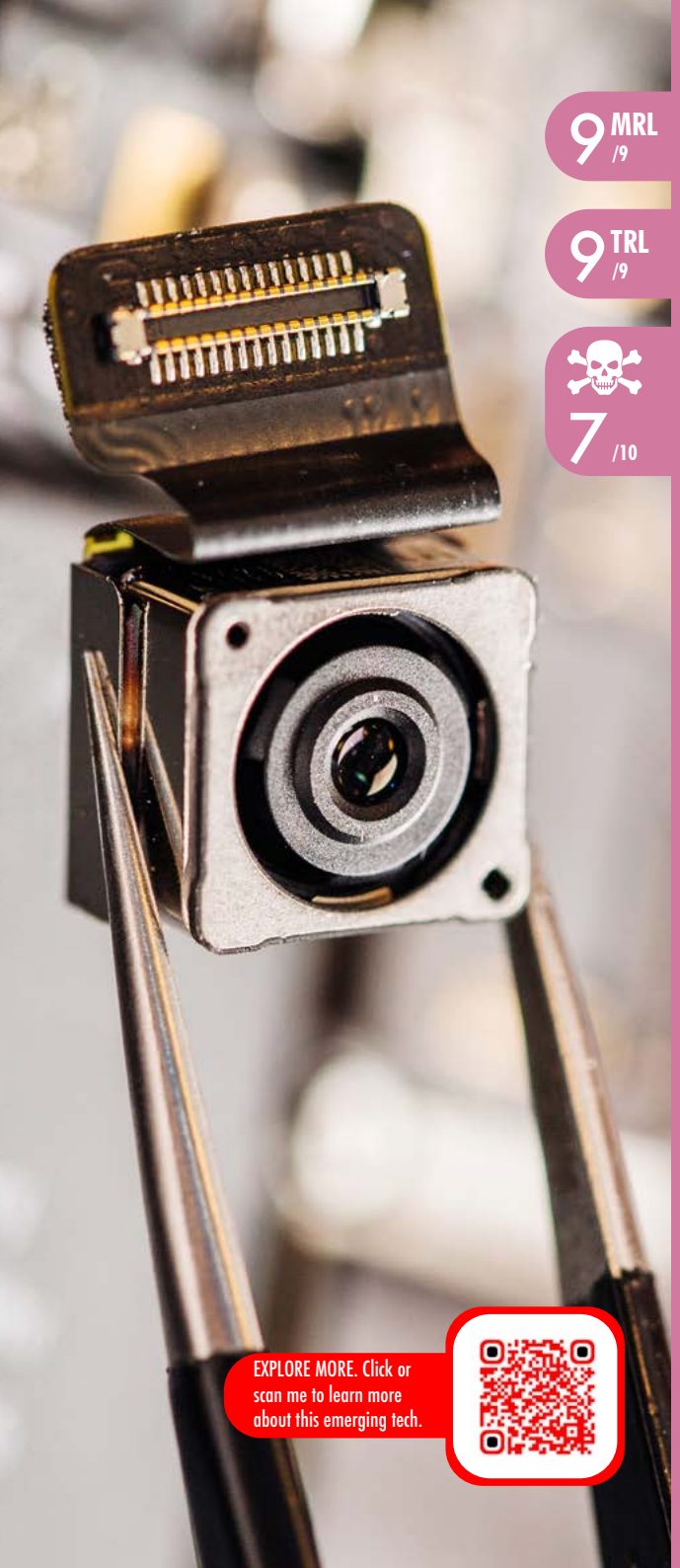
IMPACT

STATUS



Accessibility	4
Affordability	4
Competition	3
Demonstration	7
Desirability	8
Investment	5
Regulation	4
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



9 MRL /9

9 TRL /9

7 /10

ELECTRO-MECHANICAL SENSORS

ELECTRO-MECHANICAL SENSORS, which are in the Mass Adoption Stage, is the field of research concerned with making small scale and nano scale Electro-Mechanical Sensors capable of sensing, and then acting on, a wide variety of stimuli, including biological, magnetic, mechanical, optical, and thermal inputs. Recent breakthroughs in the space include creating increasingly complex and sophisticated sensors capable of detecting ever smaller variations in stimuli,and increasing the number and type of components and materials that can be integrated together to form functional units.

DEFINITION

Electro-Mechanical Sensors are micro scale devices capable of sensing different stimuli and acting on them.

EXAMPLE USE CASES

Today we are using Electro-Mechanical Sensors in a huge variety of products, including airbags, disease and patient monitoring equipment, Labs-On-Chips, navigation devices, smartphones, TV tuners, and many more. In the future the technology's primary use cases will include an even broader range of applications, and will be almost unlimited.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, and Manufacturing sectors. In time we will see the sophistication of these sensors increase while their effective sizes continue to reduce, and the materials they're constructed from broaden out to include not just inorganic and synthetic materials, but biological ones too. Similarly, as complimentary manufacturing techniques improve we will also see them embedded into more and more products, which will have the effect of significantly broadening out their applications.

While Electro-Mechanical Sensors are in the Mass Adoption Stage, over the long term they will be enhanced by advances in 3D Printing, Artificial Intelligence, Biological Computing, DNA Computing, DNA Neural Networks, Liquid Computing, Living Sensors, Micromotes, Molecular Assemblers, Nano-Manufacturing, Nanophotonic Materials, Nano-Sensors, and Quantum Sensors, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

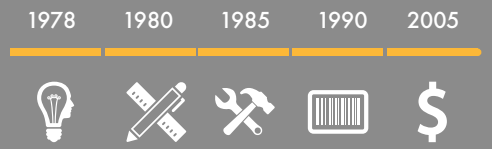
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19

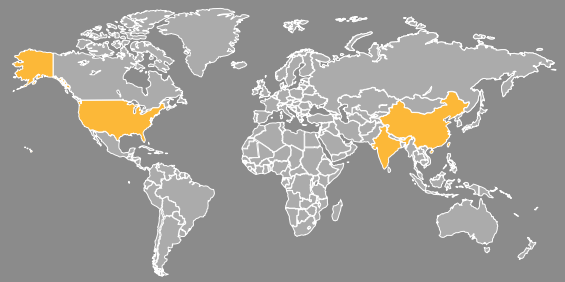
IMPACT

STATUS



Accessibility	7
Affordability	8
Competition	6
Demonstration	9
Desirability	9
Investment	8
Regulation	6
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



9 MRL /9

9 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

EVENT BASED SENSORS

EVENT BASED SENSORS, which are in the Prototype Stage, is the field of research concerned with developing new types of sensors that only transmit information when they are triggered rather than traditional sensors that continually stream information across networks even if no variables have changed. Recent breakthroughs in the field include the development of new machine vision and neuromorphic computing sensors that only stream information about pixels that have changed rather than re-transmit information about the entire image.

DEFINITION

Event Based sensors are sensors that only transmit information when triggered by specific external stimulii rather than continuously streaming information.

EXAMPLE USE CASES

Today we are using neuromorphic based prototypes to prove the theory behind the technology and refine it. In the future the primary use case of the technology will be to dramatically reduce the volume of information being transmitted across edge and core networks, a principle that can be applied to any sensor, in any environment, and in any use case.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by organisations in the Manufacturing sector, with support from univesity grants. In time we will see the technology mature to the point where it will be able to be applied to every type of sensor in every application which means its adoption will be relatively fast paced.

While Event Based Sensors are in the Prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Backscatter Energy Systems, Bio-Batteries, Edge Computing, Machine Vision, Neuromorphic Computing, and Sensor Fusion, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

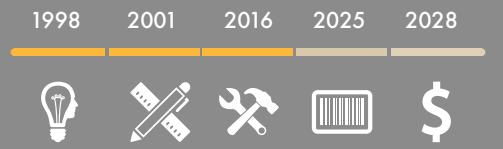
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20

IMPACT

STATUS



Accessibility	6
Affordability	7
Competition	4
Demonstration	7
Desirability	8
Investment	4
Regulation	2
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

9 MRL /9

9 TRL /9

3 /10

HYPERSPECTRAL SENSORS

HYPERSPECTRAL SENSORS, which are in the Mass Adoption Stage, is the field of research concerned with developing new sensing systems, both ground, sky and space based, capable of sensing signals across the electromagnetic spectrum. Recent breakthroughs include dramatic advances in their sensitivity which allow them to detect increasingly weak signals, including Radio Frequency signals from space, and sense increasingly minute variations in field strengths.

DEFINITION

Hyperspectral Sensors collect and process information from across the full range of the Electromagnetic spectrum.

EXAMPLE USE CASES

Today we are using Hyperspectral Sensors to monitor the health of crops from space, and track illegal shipping, as well as monitor the global climate. In the future the primary applications of the technology will include a wide variety of applications including everything from QA testing and infrastructure assessments, to the development of advanced Drone based sensing platforms.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, and Defence sectors, with support from government funding and university grants. In time we will see the size and cost of sensor systems decrease, while their sensitivity, and therefore their applications, continues to increase.

While Hyperspectral Sensors are in the Mass Adoption Stage, over the long term they will be enhanced by advances in 3D Printing, Artificial Intelligence, Nano-Manufacturing, Nanophotonic Materials, and Sensor Technology, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

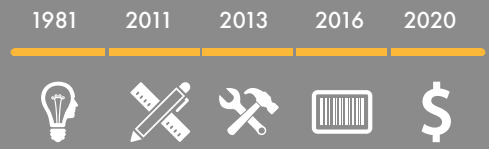
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23

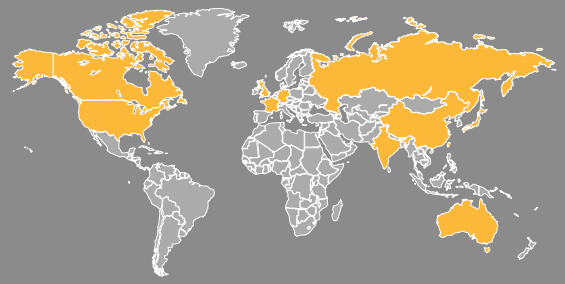
IMPACT

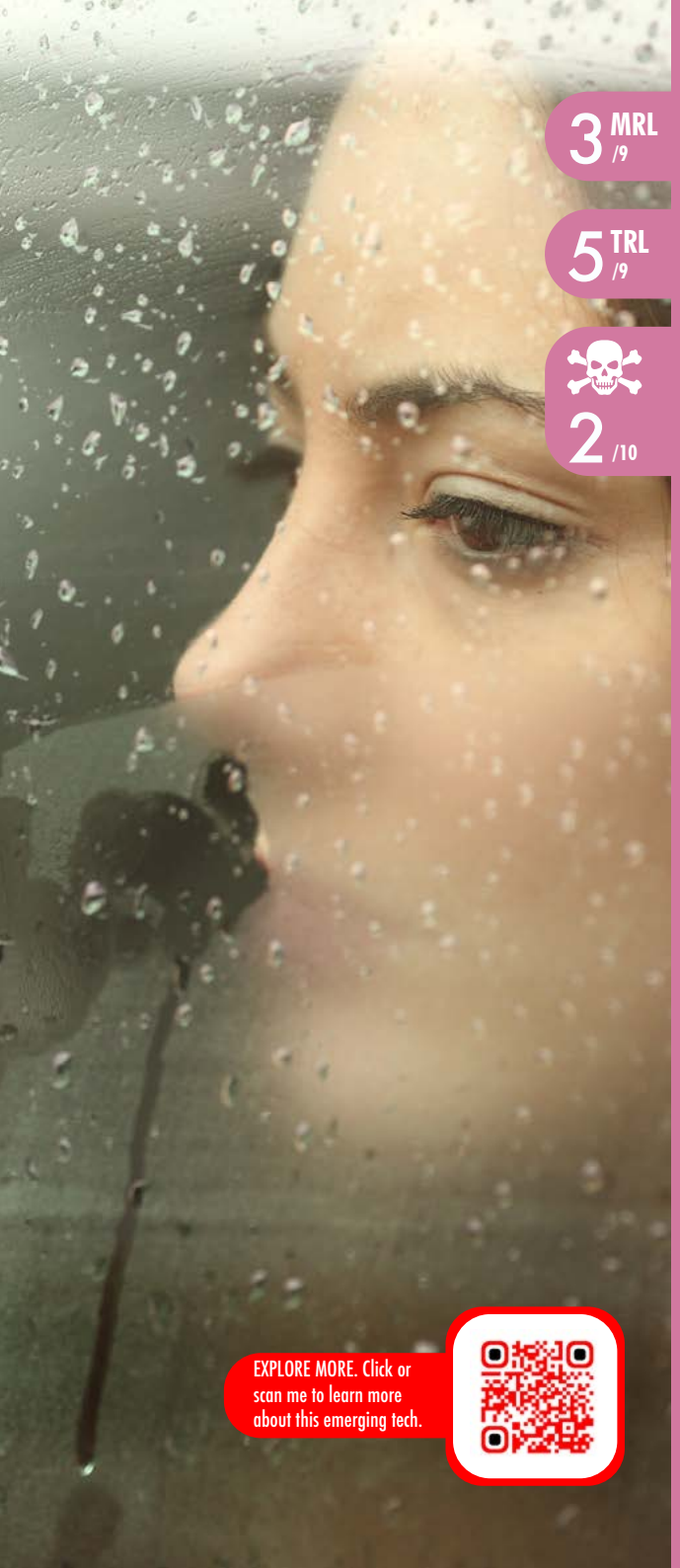
STATUS



Accessibility	7
Affordability	7
Competition	3
Demonstration	9
Desirability	9
Investment	7
Regulation	6
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





3 MRL /9

5 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

LENSELESS CAMERAS

LENSELESS CAMERAS, which are in the Prototype Stage, is the field of research concerned with trying to turn a variety of materials into camera systems that are capable enough to take photos and videos, and monitor the world around them. Recent breakthroughs include turning ordinary car windows into Lenseless Cameras by placing a ring of sensors around their periphery that are capable of capturing the photons of light bouncing around and reflecting off of the pane's inner surfaces and sending that information through to an Artificial Intelligence for final processing to create low resolution images which are good enough, at the moment, for basic Machine Vision applications.

DEFINITION

Lenseless Cameras are transparent materials embedded with intelligence that allows them to capture and process light to produce images.

EXAMPLE USE CASES

Today we are using the first Lensless Camera prototypes to prove the theory and refine the technology. In the future the primary applications of the technology will include turning a variety of different materials and surfaces into camera and sensing systems that will have a dramatic impact on where we can deploy and use Machine Vision systems.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Consumer Electronics sector, with support from university grants. In time we will see the resolution of the images that the technology is able to produce improve, and the colour balance and contrast of those images improve.

While Lenseless Cameras are in the Prototype Stage, over the long term they will be enhanced by advances in Artificial Technology, Hyperspectral Sensors, and Materials, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

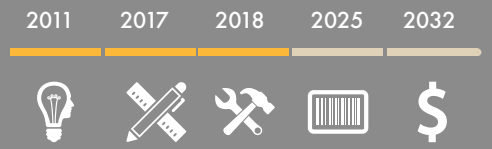
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '24

IMPACT

STATUS



Accessibility	2
Affordability	4
Competition	3
Demonstration	6
Desirability	6
Investment	2
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

4 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

LIVING SENSORS

LIVING SENSORS, which are in the Concept Stage and Prototype Stage, is the field of research concerned with turning living organisms into sensing system that can detect, and when needed, respond to a wide variety of different stimuli, including biological, chemical, mechanical, magnetic, optical, physical, and thermal, to name but a few. Recent breakthroughs include using gene editing techniques to turn terrestrial plants, as well as certain marine animals, into sensors that can detect, and then in some cases communicate the presence of, minute variations in electromagnetic field strength, and pressure, as well as the presence of specific chemicals and pollutants in the environment.

DEFINITION

Living Sensors are genetically engineered organisms that have been modified and optimised to detect and respond to specific stimuli.

EXAMPLE USE CASES

Today we are using the first Living Sensors prototypes to test the theory that we can modify nature to our own means, and refine the technology. In the future the primary applications of the technology will be almost limitless.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Defence sector, with support from government funding and university grants. In time we will see the tools and biological programming languages we use to develop Living Sensors mature, and the technology become more sophisticated and viable. That said though there will be obvious ethical, moral and regulatory hurdles to overcome which will have a significant impact on the technologies eventual adoption outside of the Defence sector.

While Living Sensors are in the Concept Stage and Prototype Stage, over the long term they will be enhanced by advances in 3D Bio-Printing, Artificial Intelligence, Bio-Manufacturing, Creative Machines, CRISPR Gene Editing, Semi-Synthetic Cells, Stem Cell Technology, Synthetic Cells, and Tissue Engineering, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

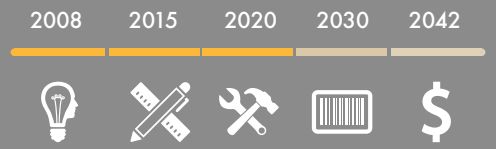
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	1
Affordability	2
Competition	3
Demonstration	3
Desirability	6
Investment	2
Regulation	1
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

6 TRL /9

5 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

NANO-ANTENNAE

NANO-ANTENNAE, which are in the early Productisation Stage, is the field of research concerned with making antennae that are microscopic and just 1 to 100 nanometers in scale. Recently there have been a number of breakthroughs in this space made by researchers who have developed both conventional nanoscale antennae systems and Nano-Fluidic ones as well as more exotic DNA based nano-antennae which mean that in time we will be able to connect and capture data from even the smallest things and pieces of matter, including living cells.

DEFINITION

Nano-Antennae are nanoscale communications devices that can send and detect electromagnetic waves.

EXAMPLE USE CASES

While there are many examples I could cite some of the most interesting include the use of DNA nano-antennae to create the Internet of Living Things (IoLT), and which when combined with Cellular Recorder technologies could let us capture, analyse, and transmit information about the behaviours of individual human cells in our bodies for information and medical purposes. Elsewhere nano-antennae could also be embedded into anything and everything, including home furnishings and fabrics, to enable better 6G communications, and millions more examples.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, albeit from a low but growing base, primarily led by organisations in the communications and technology sectors, with support from government funding and university grants. In time we will see Nano-Antenna become commonplace, tie into the Internet of Things (IoT) trend, and help us connect everyone and everything in new ways.

While Nano-Antenna are in the early Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Atomic Manufacturing, Bio-Manufacturing, Cognitive Radio, Genetic Engineering, Nano-Manufacturing, and others, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

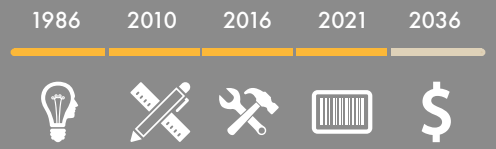
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and re-visit it every few years until progress in this space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '22, '23, '24

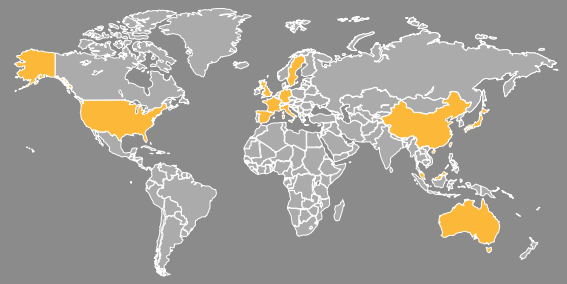
IMPACT

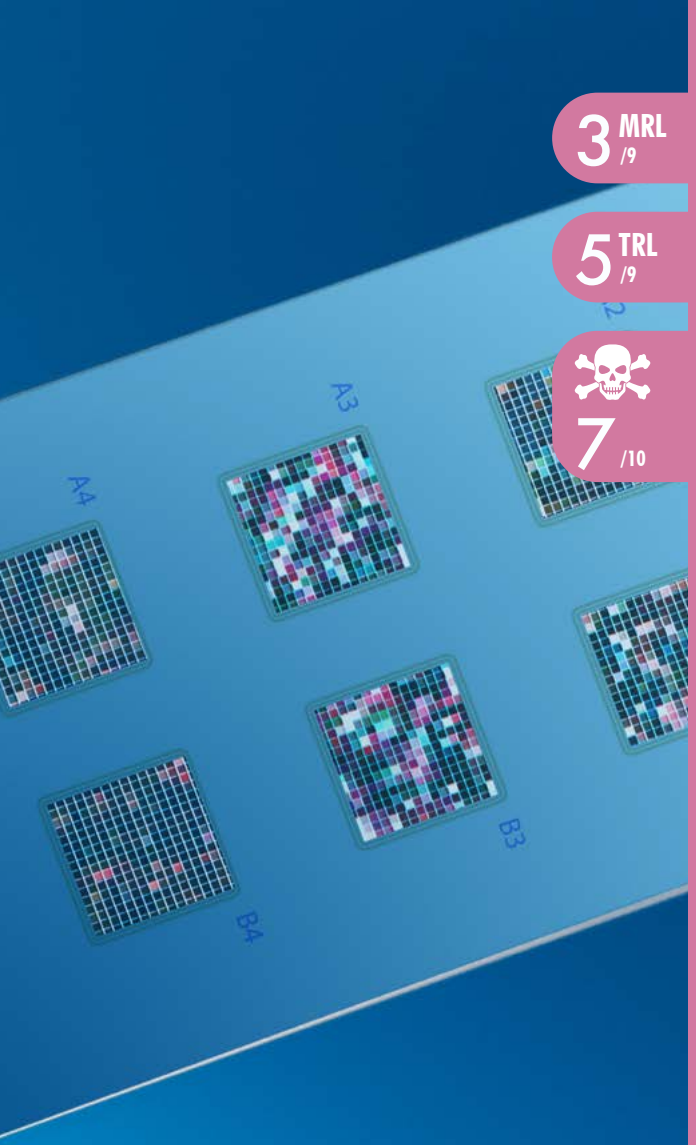
STATUS



Accessibility	4
Affordability	6
Competition	3
Demonstration	7
Desirability	9
Investment	3
Regulation	4
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





3 MRL /9

5 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

NANO-SENSORS

NANO-SENSORS, which are in the Prototype Stage and early Productisation Stage, is the field of research concerned with developing nanoscale sensors that are capable of detecting a wide range of stimuli across the biological, chemical, electromagnetic, and mechanical spectrums, and converting that information into chemical, mechanical, molecular, or optical signals that can be communicated to other systems. Recent breakthroughs include the development of new ways to manufacture advanced Nano-Sensors and substrates using nothing more than an inkjet printer and Titanium Oxide ink, which, as the process is refined could open the door to mass market production of high quality, inexpensive sensors with a wide range of applications.

DEFINITION

Nano Sensors are nano sized biological, chemical or surgical sensors that can collect and exchange data with other systems and devices.

EXAMPLE USE CASES

Today we are using Nano-Sensors to quickly and cheaply detect disease and nanoscale objects, including bacteria, to enable faster disease detection. in the future the primary use cases of the technology will be almost limitless.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Manufacturing sector, with support from government funding and univesity grants. In time we will see our ability to build and manufacture increasingly capable and sophisticated nano-sensors improve, but their wide spread adoption might be hampered by a lack of understanding the impact that such small products have on the wider environment, as well as the human body.

While Nano-Sensors are in the Prototype Stage and Productisation Stage, over the long term they will be enhanced by advances in 3D Printing, Electro-Mechanical Sensors, Living Sensors, Molecular Communications, and Nano-Manufacturing, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

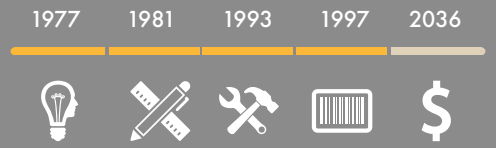
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '19

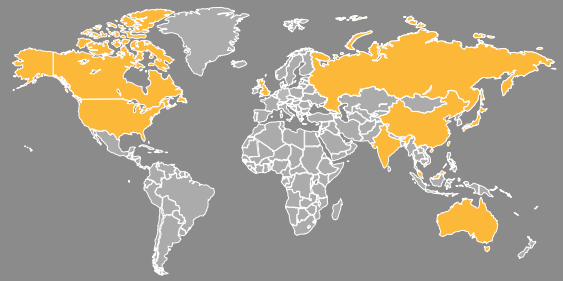
IMPACT

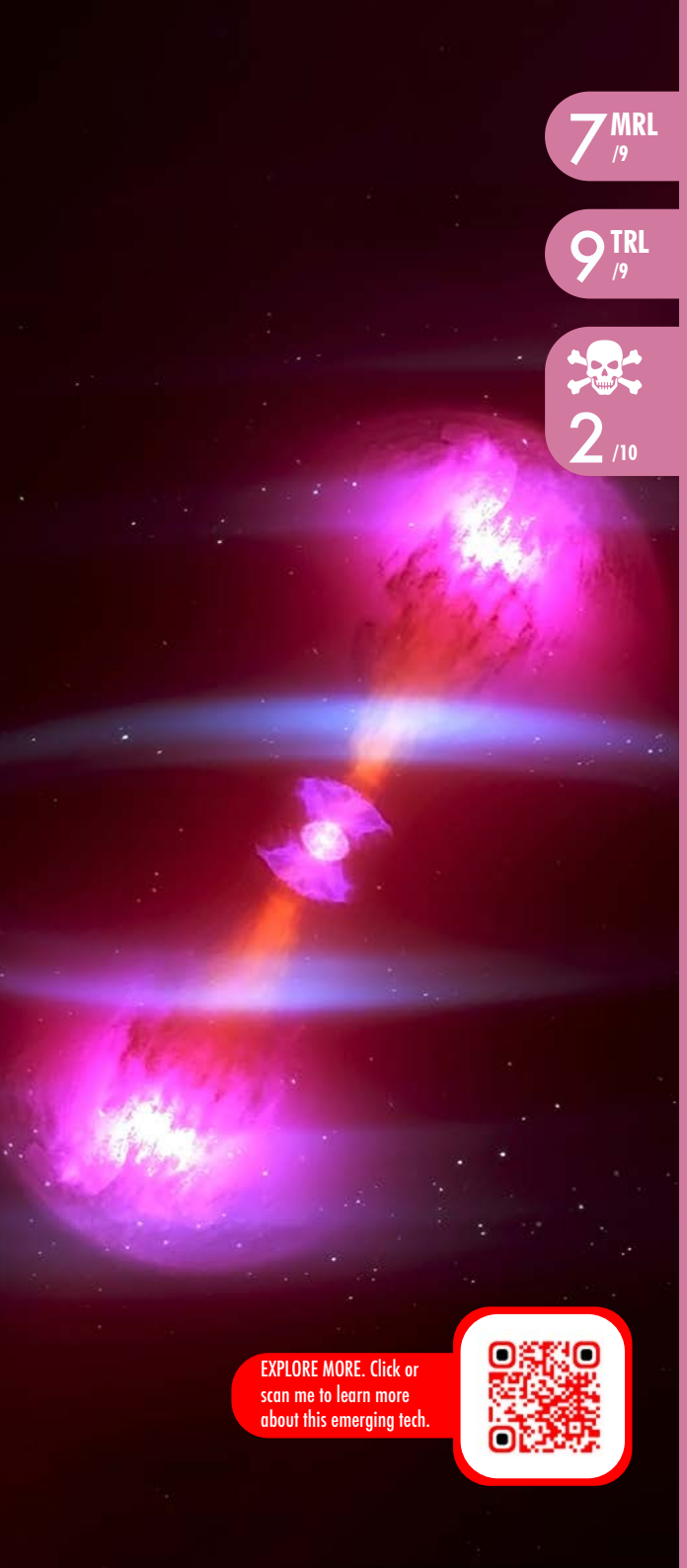
STATUS



Accessibility	6
Affordability	6
Competition	5
Demonstration	6
Desirability	7
Investment	5
Regulation	4
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





7 MRL /9

9 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

NEUTRON DETECTORS

NEUTRON DETECTORS, which are in the Productisation Stage, is the field of research concerned with finding new ways to detect Neutrons. Recently there have been a number of breakthroughs including the development of the first hand held Neutron Detectors which for the first time improve the technology's accessibility and usefulness, as well as the development of the first neutron detecting drones and UAV's which are able to detect the presence of bombs and explosives from miles away..

DEFINITION

Neutron Detectors enable the effective detection of neutrons in the environment.

EXAMPLE USE CASES

Today Neutron Detectors are used primarily by the military and governments to detect nuclear material and while this is unlikely to change much in the future as the technology continues to miniaturise the technology could find its way into more healthcare settings where it can be used in Nuclear Medicine.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Defence sector, with support from government funding and university grants. In time we will see the technology being embedded into smaller formats and more widely deployed in the field.

While Neutron Detectors are in the Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence and Semiconductors, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

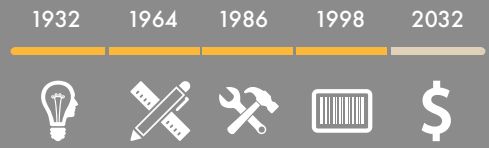
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

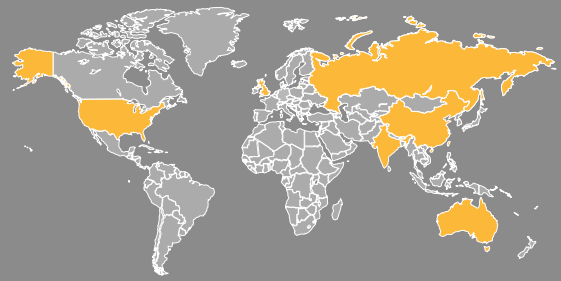
IMPACT

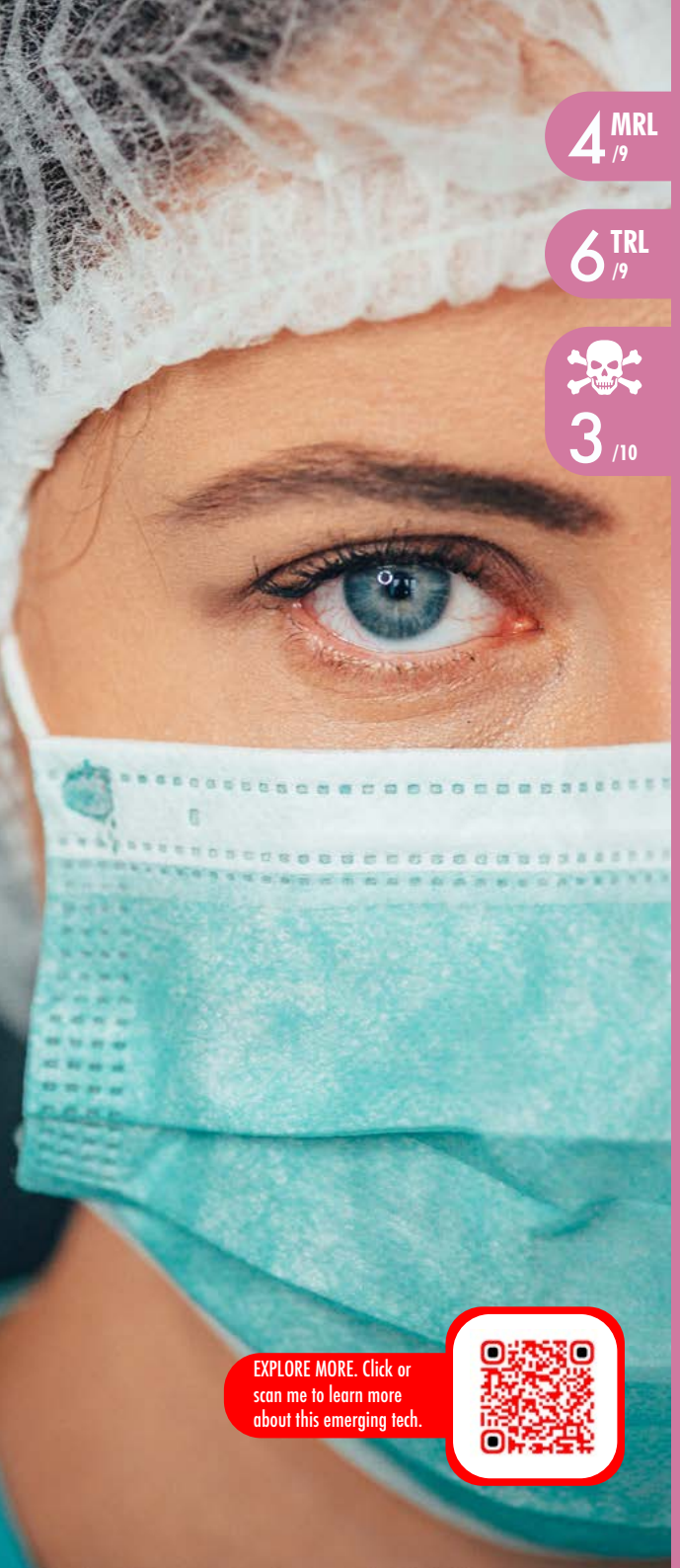
STATUS



Accessibility	6
Affordability	4
Competition	2
Demonstration	8
Desirability	5
Investment	6
Regulation	5
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





4 MRL /9

6 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

OPTICAL BIO-SENSORS

OPTICAL BIO-SENSORS, which are in the Prototype Stage, is the field of research concerned with trying to find new ways to combine optical sensing systems and biological sensing systems into a single integrated device that help improve researchers ability to sense biologics in the environment around them. Recently there have been a number of significant breakthroughs in the field including the development of face masks which incorporate Bio-Sensors with fluorescing and mRNA sensors that can detect pathogens, such as COVID-19, in the air around people, make the masks glow, and then warn the wearers appropriately.

DEFINITION

Optical Bio-Sensors use a combination of optical and biological sensing components to extend the capabilities of sensor technologies.

EXAMPLE USE CASES

Today Optical Bio-Sensors are being used to detect pollution in the environment. In the future the technology could be used in all manner of ways including to help identify the presence of dangerous airborne pathogens in hospitals in real time.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by funding from government and university grants. In time we will see the technology mature and its costs come down, at which point it will become easy to embed into all manner of items, from smart devices to clothing.

While Optical Bio-Sensors are in the Prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Edge Computing, Gene Editing, Genetic Engineering, Nanotechnology, Sensor Fusion, and Sensor technology, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

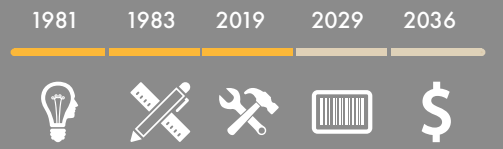
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '21, '22, '23, '24

IMPACT

STATUS



Accessibility	4
Affordability	4
Competition	3
Demonstration	8
Desirability	9
Investment	6
Regulation	4
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

5 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

PHOTONIC SENSORS

PHOTONIC SENSORS, which are in the Prototype Stage, is the field of research concerned with developing sensors with integrated photonics that can detect photons down to the single photon level, the applications of which are broad and varied. Recently there have been a number of breakthroughs in the field including the development of the first exclusive megapixel photon sensing camera that uses Artificial Intelligence to allow autonomous vehicles and cameras see round corners, and then elsewhere more traditional photonic sensors, which are also getting more powerful and higher resolution, have broken the 200 Megapixel barrier and let researchers create even more powerful high speed camera and imaging systems.

DEFINITION

Photonic Sensors are devices that sense light and releases electricity.

EXAMPLE USE CASES

While there are many examples of photonic sensors, from the camera in your smartphone to the sensors in your home's CCTV system, they are now getting so sensitive and powerful that soldiers using photonic camera systems to see around corners, and automotive manufactures will soon be able to use them to help autonomous vehicles not only see around corners but stitch these images and this "intelligence" together to create what's rapidly becoming known as Smart City "Spatial Intelligence" where one person or one system can "see" an entire city in one go in real time and then use that data accordingly.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, primarily led by organisations in the consumer retail, defense, and transportation sectors, with support from government funding and university grants. In time we will see Photonic Sensors, even the most advance ones, become much more commonplace and we'll likely also see them embedded into all manner of everyday objects including lenseless and metalense camera and sensing systems, as well as Terahertz cameras.

While Photonic Sensors are in the Prototype Stage, over the long term they will be enhanced by advances in 3D Printing, Artificial Intelligence, Materials, Nano-Manufacturing, and others, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

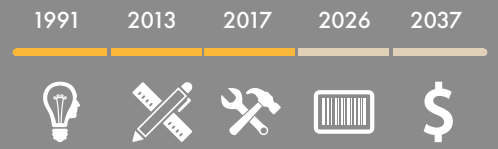
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and re-visit it every few years until progress in this space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '22

IMPACT

STATUS



Accessibility	6
Affordability	6
Competition	5
Demonstration	7
Desirability	7
Investment	4
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

6 MRL /9

9 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

PTYCHOGRAPHY

PHYTCHOGRAPHY, which is in the late Productisation Stage, is the field of research concerned with developing new non-destructive microscopic imaging techniques that rely primarily on sources including electrons, extreme ultraviolet light, X-Rays, and visible light which are unaffected by lens-induced aberrations or diffraction effects that can have a negative impact when imaging products at the atomic wavelength. While this is a relatively established field recent breakthroughs include the use of Artificial Intelligence (AI) and a new Ptychographic X-Ray Laminography (PXL) technique that for the first time lets researchers image and then easily verify and reverse engineer modern 3D designed computer chips, which becomes especially useful when trying to find hidden backdoors or exploits in them which until now was at best very difficult. There have also seen advances in the development of Fourier Ptychography (FP) which for the first time lets researchers create gigapixel-scale images of microscopic products without requiring any moving parts.

DEFINITION

Ptychography is a detector based computational method of microscopic imaging.

EXAMPLE USE CASES

The primary use case, certainly for PXL, is helping national security agencies check for computer chip based hardware trojans and kill switches. Other use cases include analysing the phase information of products such as the growth of biological cells, as well as materials including Biominerals and 2D Metasurfaces, and aiding the development of new computing products and detector systems.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in the field accelerate albeit from a very low base, predominantly led by the defence, healthcare, and technology sectors, and government grants. As our ability to image ever smaller products at the atomic scale improves this field will have an impact on everything from the development of new computer chips to new materials so its importance should not be underestimated.

While Ptychography is in the late Productisation Stage over the longer term it could be enhanced by advances in AI, Materials, Sensors, and other technologies, however over the long term it's unclear what it will be superseded by.

MATTHEW'S RECOMMENDATION

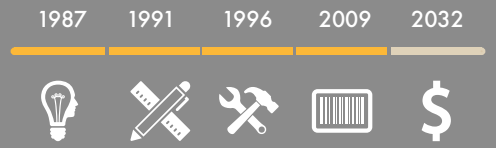
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

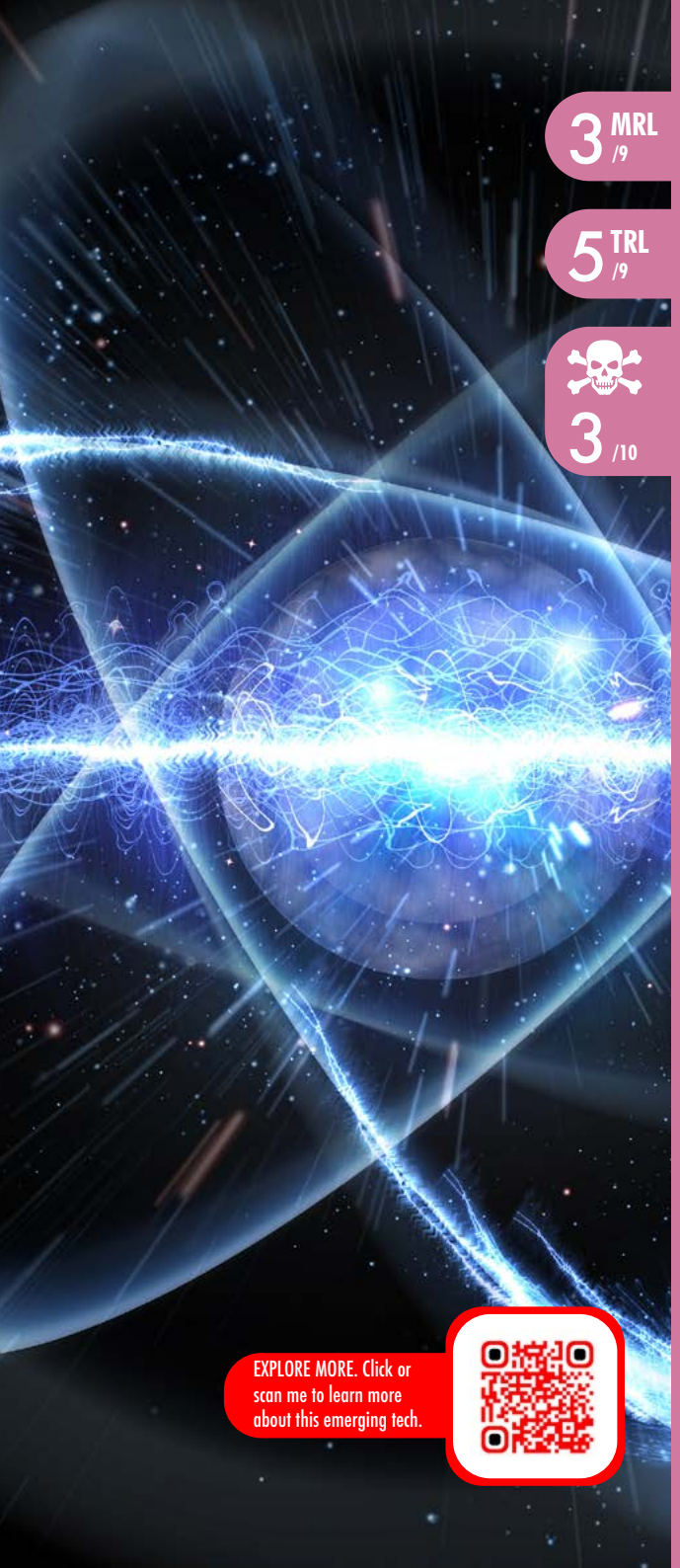
IMPACT

STATUS



Accessibility	5
Affordability	3
Competition	2
Demonstration	8
Desirability	8
Investment	4
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

5 TRL /9

3 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

QUANTUM SENSORS

QUANTUM SENSORS, which are in the Prototype Stage and very early Productisation Stage, is the field of research concerned with developing sensors millions of times more sensitive than today's most sensitive sensors that harness the weird properties of Quantum Mechanics, and that can even monitor changes at the nanoscale. Recent breakthroughs include creating the world's first Quantum Compass, that is so sensitive to the variations in the Earth's magnetic field that it's capable of replacing today's GPS platforms, and the first quantum sensors capable of detecting the minutest changes in living cells that allow us to diagnose and monitor disease at the cellular, not just the system, level.

DEFINITION

Quantum Sensors exploit quantum correlations, such as quantum entanglement, to achieve a sensitivity or resolution that cannot be achieved using traditional sensor systems.

EXAMPLE USE CASES

Today we are using the first Quantum Sensor prototypes to create more precise quantum clocks, and quantum compasses capable of replacing today's GPS networks, and ultra-sensitive subterranean sensors that can detect even the deepest groundwater and mineral deposits, and underground anomalies. In the future the primary applications of the technology will be almost limitless, and include everything from civil engineering and defence applications, through to environmental monitoring and more sophisticated and sensitive sensors for wearable technologies.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a low base, primarily led by organisations in the Defence sector, with support from government funding and university grants. In time we will see the sensitivity of the devices increase, and our ability to produce them efficiently and reliably at scale increase.

While Quantum Sensors are in the Prototype Stage and very early Productisation Stage, over the long term they will be enhanced by advances in Quantum Dots, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

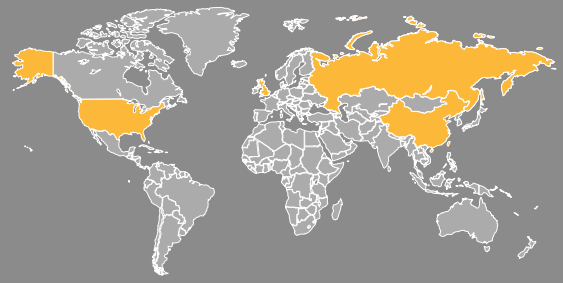
STARBURST APPEARANCES: '18, '19, '20, '21, '22, '23, '24

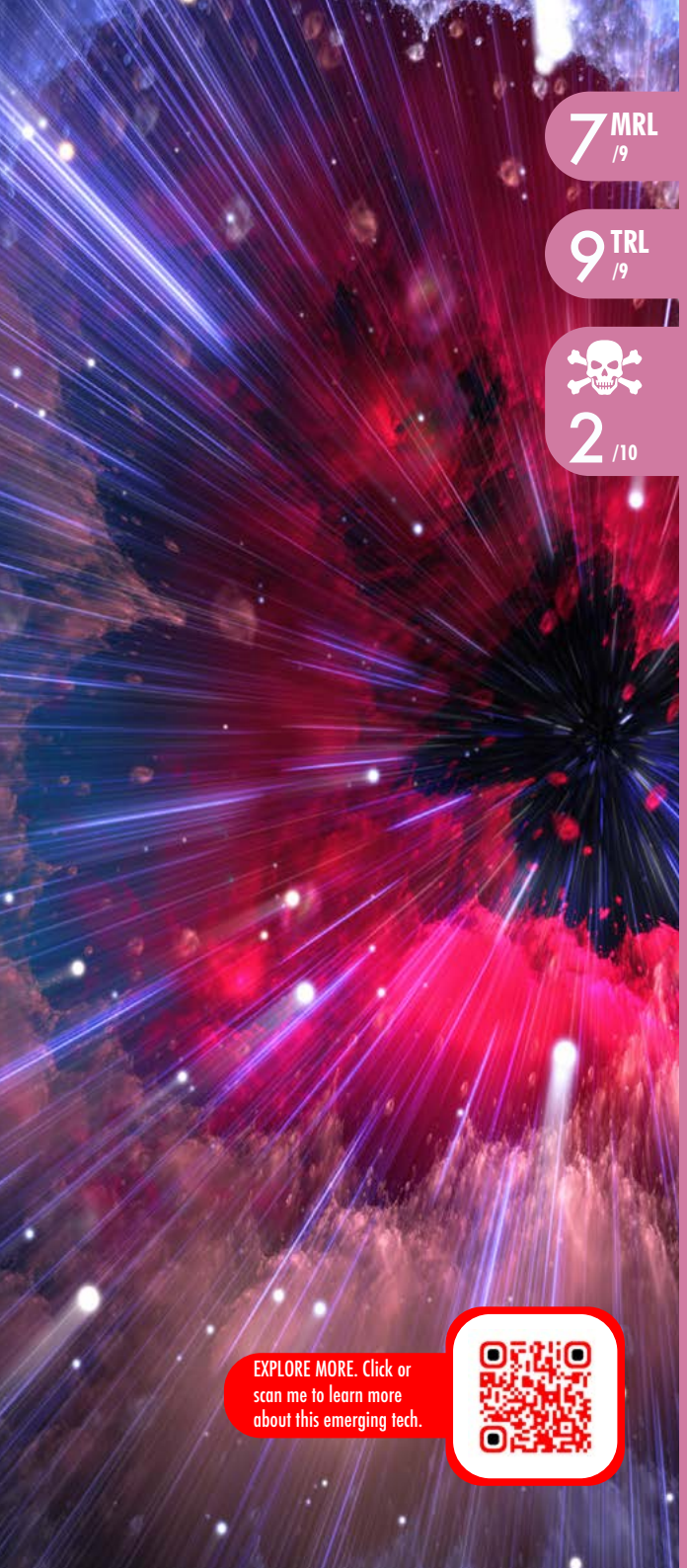
IMPACT

STATUS

Accessibility	2
Affordability	2
Competition	2
Demonstration	7
Desirability	8
Investment	4
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





RYDBERG SENSORS

RYDBERG SENSORS, which are in the Prototype Stage, is the field of research concerned with developing new highly sensitive sensors that can detect the faintest changes in microwave, millimeter-wave, radio frequency (RF), and terahertz electric fields at the quantum level using small vapor-cell sensing elements. Recent breakthroughs include the development of the use of intersecting laser beams which have given researchers the ability to create Rydberg based optical lattices that can be used to simulate and examine the properties of the systems they mimic - especially properties such as high-temperature superconductivity and magnetism that are frequently too complex to simulate even on modern computer systems. Other developments include the development of new atomic or quantum communication systems, and incredibly sensitive new radio receivers.

DEFINITION

Rydberg Sensors are small, highly sensitive, tunable sensors capable of detecting and measuring oscillating electric fields.

EXAMPLE USE CASES

While there are many use cases one of the most interesting is the ability to use their sensing abilities to create new atom based audio and video communications systems, such as "Atomic TV," which can be used in remote locations or emergency situations, as well as "Quantum Gaming" applications. Others include their use in the development of distortion free "Quantum Radios," as well as using them to detect all manner of electromagnetic emissions and frequencies at far greater ranges than traditional receivers.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in the field accelerate, predominantly led by the defence sector and government and military grants. As we continue to see a huge amount of investment flow into quantum technologies of all kinds it's inevitable that interest in this field will grow since it is complimentary to many of the technologies being developed - whether it's quantum communications, computing, materials, or sensors.

While Rydberg Sensors are in the Prototype Stage over the longer term they could be enhanced by advances in AI, Atomic Manufacturing, lasers, Quantum Computing, Quantum Materials, Quantum Sensors, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

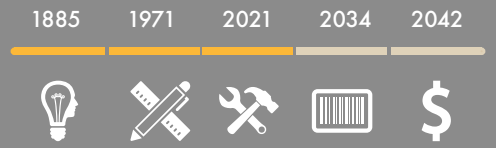
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23

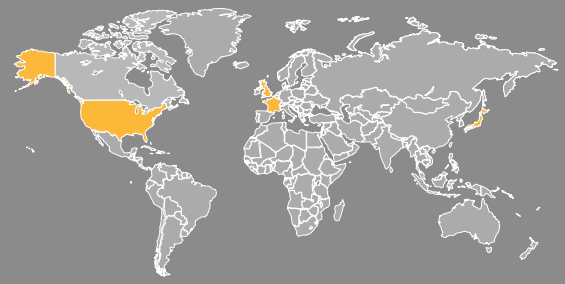
IMPACT

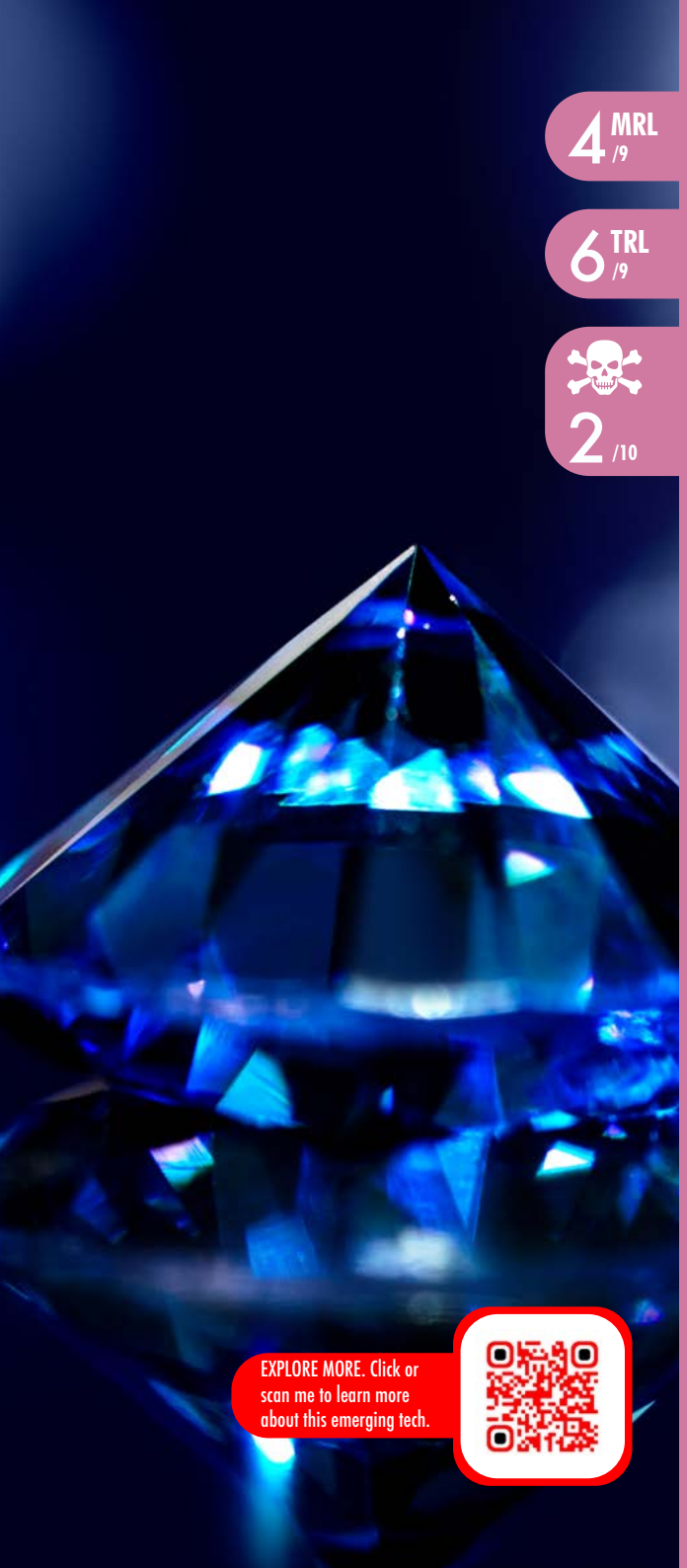
STATUS



Accessibility	4
Affordability	4
Competition	4
Demonstration	6
Desirability	8
Investment	3
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS





4 MRL /9

6 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SAPPHIRE SENSORS

SAPPHIRE SENSORS, which are in the Prototype Stage, is the field of research concerned with developing new kinds of optical sensors that can monitor and withstand ultra extreme environments and temperatures. Recently there have been a few breakthroughs in the field including the development of single thread optical Sapphire Sensors that are capable of withstanding temperatures in excess of 2,000C and extremely high levels of radiation which means that for the first time we have a way of monitoring all manner of new metrics in ultra extreme environments in real time.

DEFINITION

Sapphire Sensors are single mode optical fibre sensors that can withstand extremely high temperatures.

EXAMPLE USE CASES

While Sapphire Sensors are still relatively nascent their primary use cases will be in situations and environments where organisations need to monitor the behaviours of assets in ultra extreme environments, such as jet engines, nuclear power plants, as well as on the skins of supersonic and hypersonic aircraft and space vehicles.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this technology accelerate, albeit from a very low base, predominantly led by the aerospace and manufacturing sectors with government grants. While Sapphire sensors are still tricky to manufacture that problem is being solved. Meanwhile they've shown great potential and could play a vital role in helping monitor, optimise, and improve the performance of assets in currently hard or impossible to monitor environments. As a result, while they will likely remain niche but will likely be highly valued.

While Sapphire Sensors are still in the Prototype Stage over the longer term they could be enhanced by advances in 3D and 4D Printing, AI, Materials, Nanomanufacturing, Sensors, and other technologies, however over the long term it's unclear what they could be superseded by.

MATTHEW'S RECOMMENDATION

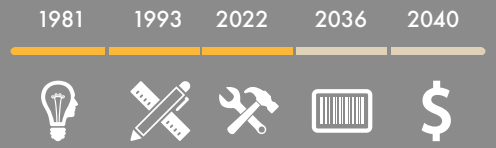
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23

IMPACT

STATUS



Accessibility	3
Affordability	5
Competition	6
Demonstration	6
Desirability	8
Investment	2
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

2 MRL /9

4 TRL /9

7 /10

SMART DUST

SMART DUST, which is in the Concept Stage and early Prototype Stage, is the field of research concerned with trying to create tiny intelligent systems packed with sensors that can act either as individual units or as swarms to monitor events, and where necessary, perform actions and make interventions. At the moment researchers predominantly focus on one of two areas, such as the development of Micro Electro-Mechanical Systems (MEMS) and Micromotes, packed with compute, intelligence and sensors, that are thousands of times smaller than a grain of rice, or Swarm Robot platforms that enable robots with different capabilities and properties to autonomously combine together to evaluate events, and, where necessary, perform follow up tasks, and over time these two research strands will continue to merge.

DEFINITION

Smart Dust is a collection of Micro Electro-Mechanical Systems packed with computing power and sensors that can act individually or as a swarm to monitor events and perform actions.

EXAMPLE USE CASES

Today we are using Smart Dust, albeit in the form of small robots and Micromotes, to prove the theory that MEMS embedded with compute and intelligence can monitor events, from the conditions within the human brain to the health of crops, either as individual units or as larger poly-morphic swarms that can combine together and adapt their shape to aggregate and improve their monitoring capabilities, and accomplish new tasks. Other primary use cases include using them to analyse the structural integrity of buildings, improve inventory control, monitor human health and wellness, and track shipments, as well as any other use case where wireless monitoring, and intervention, would be useful.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade research in the field will accelerate, and interest and investment will continue to grow, with funding primarily coming in the form of university grants.

While Smart Dust is in the Concept Stage and early Prototype Stage, over the long term it will be increasingly miniaturised and enhanced by advances in Artificial Intelligence, Biological Computing, Biological Electronics, Re-Configurable Electronics, Self-Healing Electronics, DNA Robots, Molecular Robots, Nano-Machines, Soft Robots, Swarm Artificial Intelligence, and Swarm Robotics, but not replaced.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

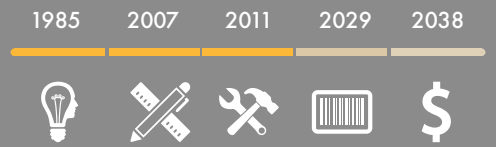
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	4
Affordability	5
Competition	5
Demonstration	8
Desirability	6
Investment	2
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

4 MRL /9

6 TRL /9

5 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SPRAY ON SENSORS

SPRAY ON SENSORS, which are in the Prototype Stage, is the field of research concerned with developing sensors or more importantly systems of sensors - as well as other device and material types - that you can spray onto surfaces to make those surfaces smart and give them all kinds of extra functionality and utility that would be almost impossible to do using any other method. While this technology has been in development for some time recent breakthroughs include the ability to take almost any mixture of sensors and spray them onto any kind of surface, with the upside being that those surfaces themselves have new utility, can be analysed and or monitored by those sensors systems, or those sensors become part of larger sensing networks that provide insights into all kinds of things, from a city's air quality through to anything else that the sensors can sense.

DEFINITION

Spray on Sensors represent a collection of sensors, or sensing systems, that can be sprayed onto a surface to give it sensing capabilities or intelligence.

EXAMPLE USE CASES

One of the biggest primary uses of this technology is to use it to make dumb legacy infrastructure smart, which then means it can become part of the Internet of Things (IOT) and have great utility in Smart City applications. However, when you realise that in time you could also spray a mix of sensors onto a surface within a photovoltaic substrate things get even more interesting, because by combining different materials and sensors in this way you could spray the equivalent of a solar panel onto a building, which could then be used to generate electricity that can be wirelessly transmitted to other devices around it - while also providing other IOT functionality.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Spray on Sensors increase, led primarily by university grants. The ability to give any object intelligence and new utility just by spraying "Smart paint" onto it could transform almost all aspects of our world, especially Smart Cities, so while this technology seems niche it's yet another that could change the world in all sorts of ways.

While Spray on Sensors is still in the Prototype Stage it could be enhanced by advances in Artificial Intelligence, Materials, Polymers, Nano-Sensors and Sensors, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

IMPACT

STATUS

Accessibility	4
Affordability	5
Competition	2
Demonstration	8
Desirability	9
Investment	3
Regulation	1
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

2 MRL /9

4 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

TERAHERTZ IMAGING

TERAHERTZ IMAGING, which is in the early Prototype Stage is the field of research concerned with developing new imaging sensors and systems that harness and use terahertz radiation. Recently there have been a number of breakthroughs in the field including the development of the highest resolution terahertz cameras yet in the megapixel range as well as cameras that can see and image the internal workings of complex organic and non-organic 3D structures.

DEFINITION

Terahertz Imaging is the visualisation of internal structures using Terahertz radiation.

EXAMPLE USE CASES

Terahertz Imaging has many interesting use cases including in real time industrial imaging and liquid imaging, as well as playing a role in non-destructive testing and the ability to non-invasively scan the interior of complex and dense objects, the outputs of which can then be used for analysis or to re-create detailed 3D models of those objects for 3D Printing purposes. Meanwhile other applications include the ability to similarly analyse and image the human body in new ways and create the equivalent of live real time videos of is inner workings down to the cellular level.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the defense and healthare sector, with support from government funding and university grants. In time we will see Terahertz Imaging become much more commonplace within certain sectors, at first in the enterprise sector and then eventually in the consumer sector where it's highly likely that it will be combined with other imaging technologies such as Hyperspectral Imaging and others.

While Terahertz Imaging is in the early Prototype Stage, over the long term it will be enhanced by advances in Artificial Intelligence and Materials, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

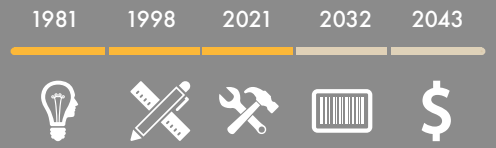
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and re-visit it every few years until progress in this space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: NIL

IMPACT

STATUS



Accessibility	3
Affordability	3
Competition	2
Demonstration	7
Desirability	8
Investment	4
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

USER INTERFACES

ALL THESE powerful emerging technologies asides though you're right - it's all about you. The user. And from your perspective at least you likely don't care too much about all the fancy technologies and tools organisations have had to use to design, manufacture and distribute your new products - you just care about the user experience, and this is where what's coming could literally blow your mind especially as we dive into the wormholes that are Neural Interfaces and Telepathy.

In this section you will find details of the emerging technologies that made it into this years Griffin Emerging Technology Starburst along with details of other impactful emerging technologies:

1. 11K Displays
2. 16K Displays
3. 8k Displays
4. Affective Computing
5. AI Symbiosis
6. Augmented Reality
7. Avatars
8. Behavioural Computing
9. Bots
10. Digital Humans
11. Electrogenetic Interfaces
12. Flexible Displays
13. Generative User Interfaces
14. Gesture Control
15. Haptics
16. Hive Minds
17. Holodecks
18. Holograms
19. Holoportation
20. Hypersurfaces
21. Memory Downloading
22. Memory Transfer
23. Memory Uploading
24. Mixed Reality
25. Neural Interfaces
26. Personalised Sound
27. Screenless Display Systems
28. Spray On User Interfaces
29. Telepathy
30. Universal Translators
31. Virtual Beings
32. Virtual Reality
33. Volumetric Displays

In addition to these emerging technologies there are many others that have yet to get an entry in this codex. These include, but are not limited to:

34. 360 Degree Video
35. 3D Voice
36. Acoustic Augmented Reality
37. Acoustic Holograms
38. Brain to Brain Interfaces
39. Brain to Machine Interfaces
40. Co-Presence
41. Conversational Interfaces
42. Digital Twins
43. Electronic Paper
44. Emotion Tracking
45. Eye Tracking
46. Far Field Microphones
47. Holographic Displays
48. Light Field Systems
49. Micro LED Displays
50. Naked Eye 3D
51. Natural Language Systems
52. Parallax Barrier Displays
53. Personal Digital Assistants
54. Pico Projectors
55. Sound On Display
56. Spatial Computing
57. Spatial Intelligence
58. Speech Recognition
59. Telepresence
60. Touch
61. Tractor Beams
62. Virtual Locations
63. Volumetric Video

8K DISPLAYS

8K DISPLAYS, which are in the Productisation Stage, is the field of research concerned with developing ultra High Definition displays that are orders of magnitude better than traditional 4K Displays. Recent breakthroughs in the field include refining the manufacturing processes needed to make these displays to such a point that they are now commercially viable products.

DEFINITION

8k Displays are screens around 8,000 pixels in width.

EXAMPLE USE CASES

Today we are using 8k Displays in everything from computer monitors to home TV's. In the future the primary applications of the technology will include entertainment and gaming, as well as in situations where ultra high resolution displays are valuable, such as in fine micro-surgery, and beyond.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Consumer Electronics sector. In time we will see the technology's manufacturing costs continue to decrease, and quality increase, to the point where manufacturers will be able to manufacture larger and larger displays that, in time, will help ensure the technology becomes the world's display standard.

While 8k Displays are in the Productisation Stage, over the long term they will be enhanced by advances in Semiconductors, and in time they will be replaced by 11k Displays.

MATTHEW'S RECOMMENDATION

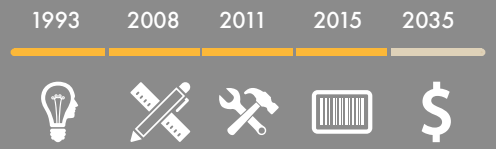
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '19

IMPACT

STATUS



Accessibility	8
Affordability	7
Competition	6
Demonstration	9
Desirability	8
Investment	8
Regulation	5
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

11K DISPLAYS

11K DISPLAYS, which are in the early Prototype Stage, is the field of research concerned with creating Full Ultra High Definition (FUHD) displays whose resolutions are so high they have a natural 3D effect. Recent breakthroughs in the field include the development of the first 11k display prototypes, but as is common when it comes to developing new displays it will likely be a while before we see them in the stores.

DEFINITION

11K Displays are Ultra High Definition screens around 11,000 pixels in width, with resolutions so high they offer a natural 3D image effect.

EXAMPLE USE CASES

The first prototype 11k Displays are being used to test and refine the technology. In the future the primary use of the technology will include entertainment and gaming, and situations where ultra high resolution display systems and natural 3D effects are valuable, such as in fine micro-surgery, and beyond.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a low base, primarily led by organisations in the Consumer Electronics sector. In time we will see the technology mature, and as organisations refine the manufacturing process we will see costs fall and quality increase to the point where the technology becomes commercialised.

While 11k Displays are in the early Prototype Stage, over the long term they will be enhanced by advances in Nanomanufacturing, Quantum Dots, and Semiconductors, but in time they will be replaced by Neural Interfaces, and Screenless Displays.

MATTHEW'S RECOMMENDATION

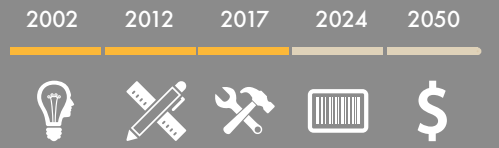
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '18, '19, '20

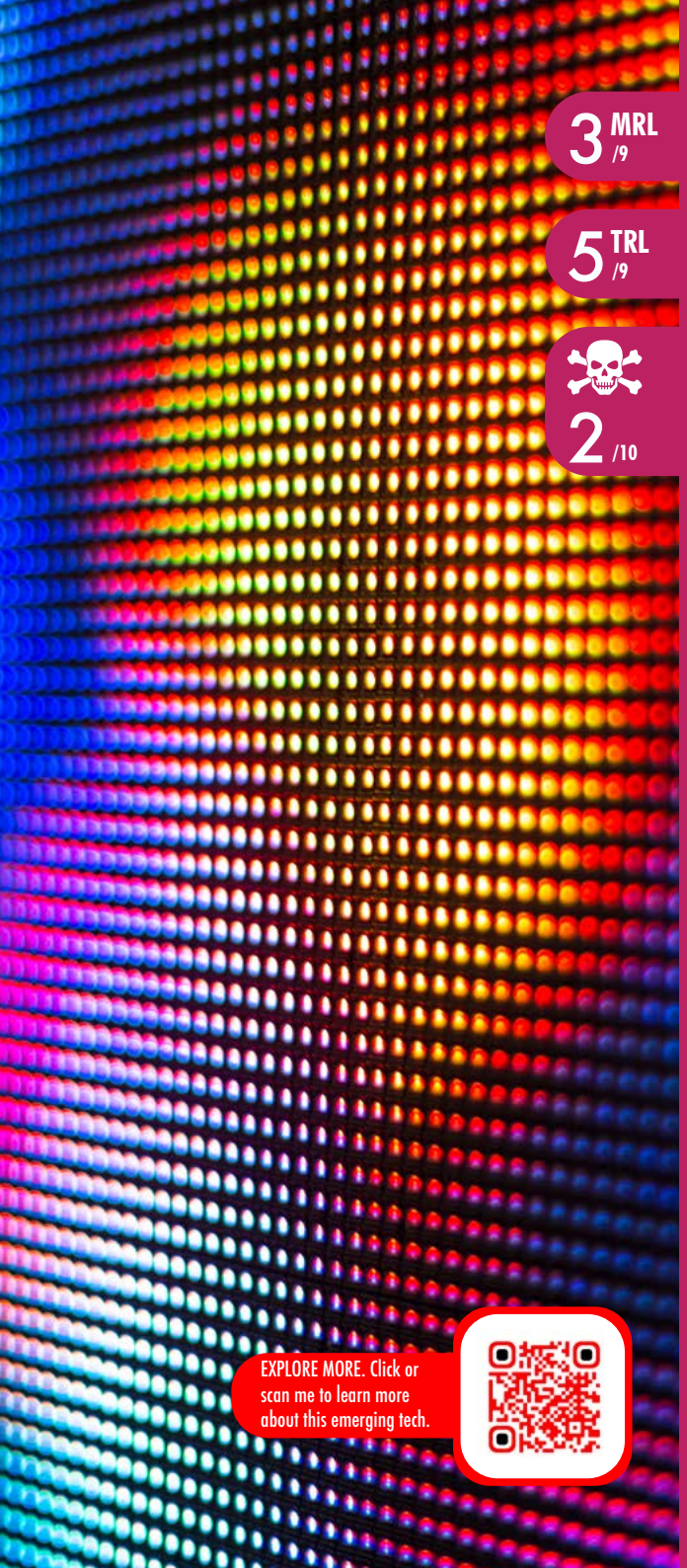
IMPACT

STATUS



Accessibility	3
Affordability	4
Competition	6
Demonstration	4
Desirability	8
Investment	5
Regulation	4
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



16K DISPLAYS

16K DISPLAYS, which are in the Productisation Stage, is the field of research concerned with developing displays with ever higher resolutions than the ones we have today. Recently there have been a number of developments in the field including manufacturing and process improvements that now make it possible to manufacture 16K Displays reliably at scale.

DEFINITION

16K Displays are displays with a resolution with approximately 16,000 horizontal pixels.

EXAMPLE USE CASES

Today 16K Displays are being sold commercially and are being used for entertainment purposes. In the future though the technology will likely merge with other display technologies, such as Flexible and Transparent Displays which will increase its utility and appeal - especially where incredibly high definition and large format displays are valued.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Consumer Electronics sector. In time we will see the technology mature and its costs come down as it commercialises.

While 16K Displays are in the Productionised Stage, over the long term they will be enhanced by advances in Quantum Dots, and Semiconductors, as well as Advanced Manufacturing, and in time while it is natural to assume the technology will be replaced by 32K Displays the human eye cannot perceive the difference which likely means that other display formats, such as high resolution Flexible, Holographic, and Transparent Displays, as well as Retinal Display Systems and Telepathic Displays will start coming to the fore.

MATTHEW'S RECOMMENDATION

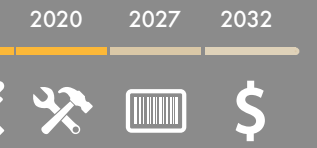
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '21, '22

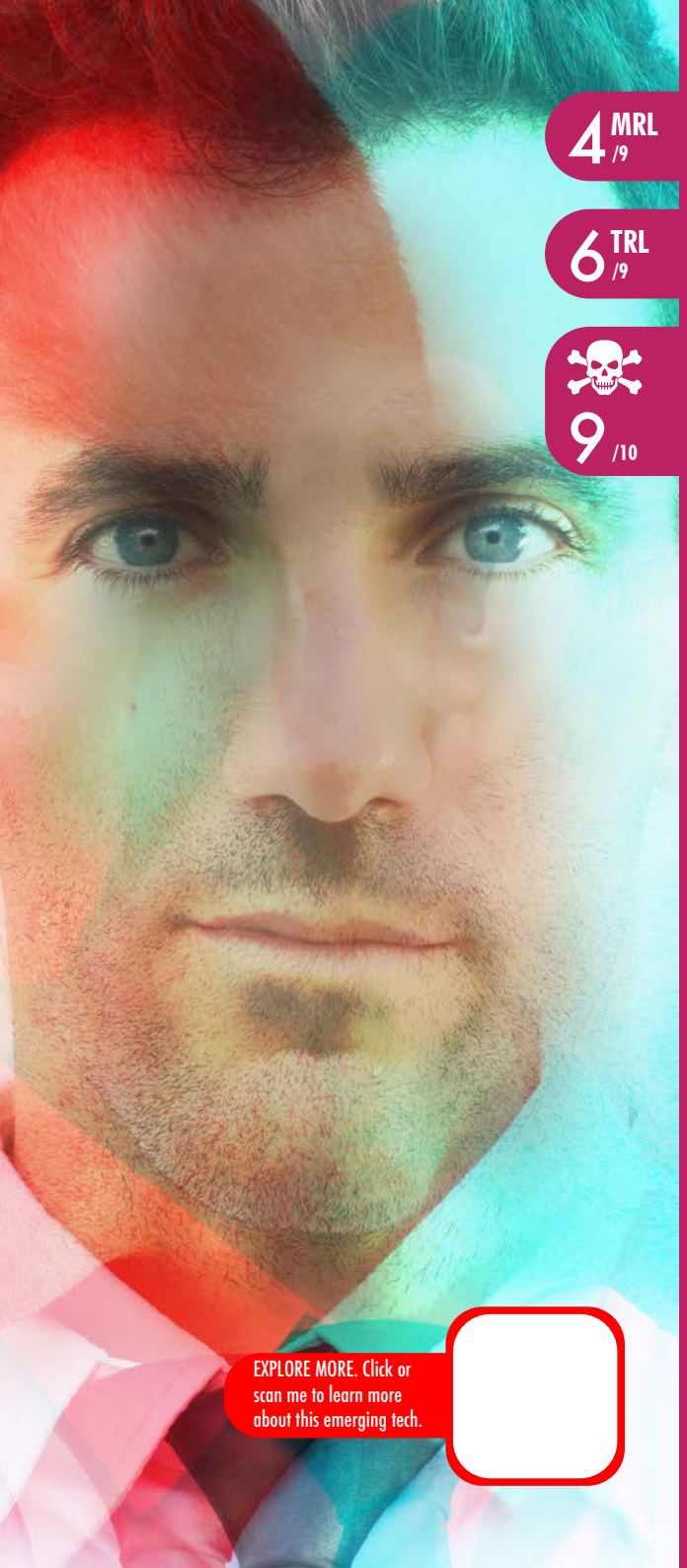
IMPACT

STATUS



Accessibility	7
Affordability	3
Competition	4
Demonstration	8
Desirability	8
Investment	7
Regulation	5
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



AFFECTIVE COMPUTING

AFFECTIVE COMPUTING, which is in the Productisation Stage, is the field of research concerned with developing computing platforms that are able to accurately and intelligently read and predict people's emotional and physical states in real time using an incredibly diverse range of data inputs. Recently there have been many breakthroughs including the use of users direct and indirect biochemical, biomarker, biomechanical, and biometric data which are all now helping machines read, analyse, and respond to human behaviours and states more accurately which, depending on how that data is used can be either a good thing or a bad thing.

DEFINITION

Affective Computing is the study and development of systems and devices that can recognise, interpret, process, and simulate human affects.

EXAMPLE USE CASES

There are many examples where this technology comes in useful, such as in healthcare settings where different computing and robot based systems can detect when patients are getting upset or stressed and then make the necessary interventions. In security settings these same technologies are able to read people's intent and purposes, and in some cases predict their future actions which include everything from shoplifting to the performance of terrorist activities. Elsewhere, these systems can tell when customers are getting angry either in person or on customer service calls so that AI agents, bots, and Digital Humans, can change their speed and tone, as well as their language, accordingly. Then, in more extreme settings, these same systems have also been used to predict the risk of depression and suicide, and many other examples.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, from a high base, primarily led by organisations in the defense, and technology sectors. In time we will see Affective Computing become ubiquitous across every sector and almost every online and offline service.

While Affective Computing is in the Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Behavioural Computing, Biometrics, Machine Vision, and many other fields, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

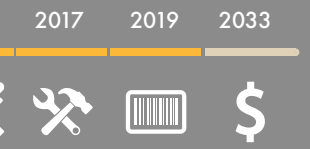
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

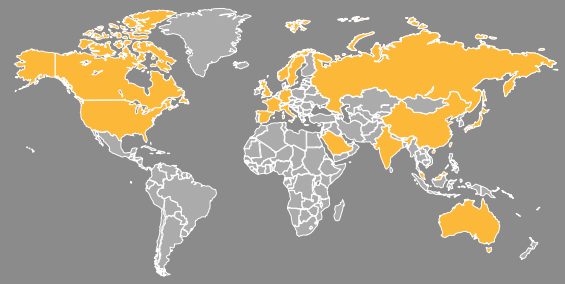
IMPACT

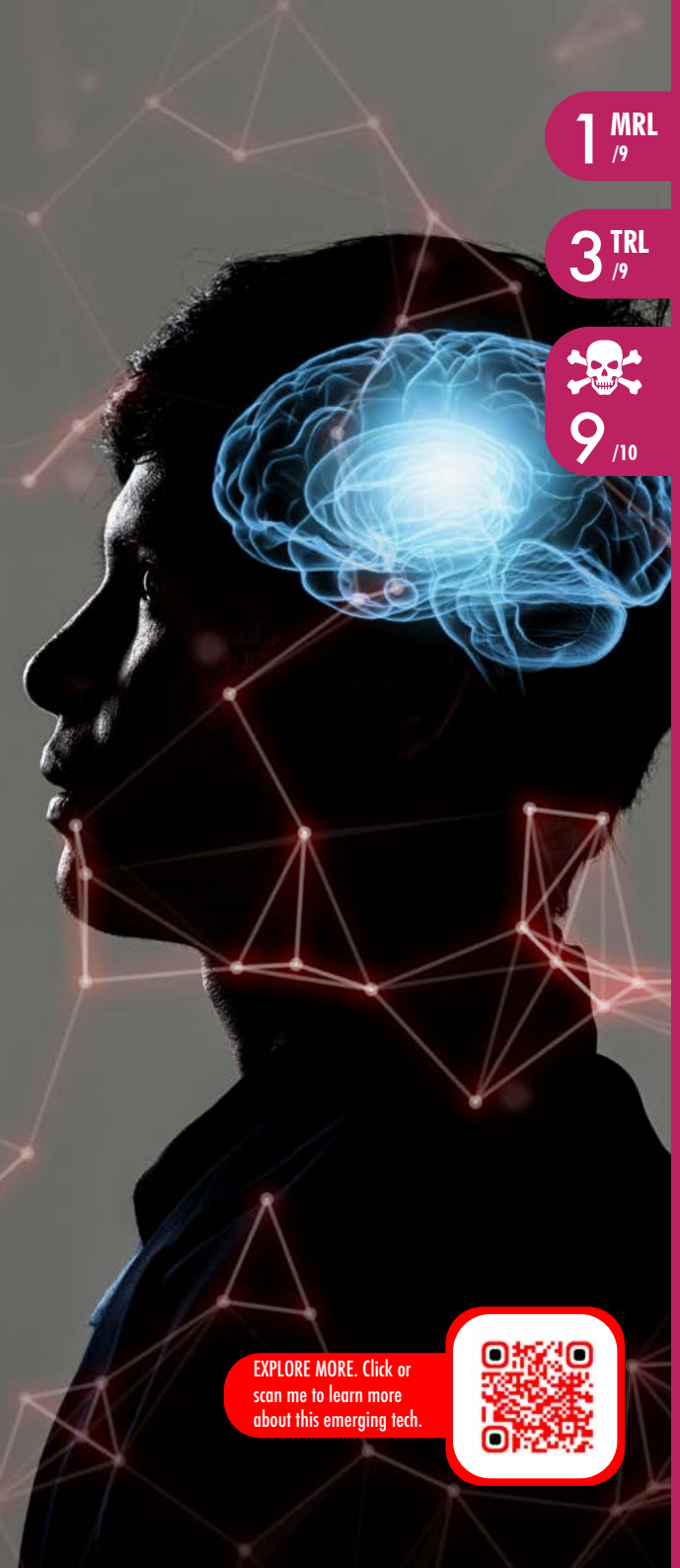
STATUS



Accessibility	7
Affordability	7
Competition	3
Demonstration	9
Desirability	9
Investment	5
Regulation	4
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





1 MRL /9

3 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

AI SYMBIOSIS

ARTIFICIAL INTELLIGENCE SYMBIOSIS, which is in the Prototype Stage, is the field of research concerned with developing new ways to merge humans, and other organisms, with Artificial Intelligence so that, ideally, both can benefit from the union. Recently there have been a number of breakthroughs in the field, especially when it comes to the development of Bio-Compatible computer interfaces, electronics, materials, and transistors, as well as Invasive and Non-Invasive Brain Machine Interfaces. There have also been advances in Neuro-Prosthetics which for the first time have allowed researchers to read biological signals and memories directly from the human brain, digitise and store them - in short the first product that allows researchers to download and store human memories in digital form.

DEFINITION

AI Symbiosis is the fusion of biological organisms with Artificial Intelligence so that both can benefit from one anothers capabilities.

EXAMPLE USE CASES

Today the only working products are basic and they don't enable AI Symbiosis, they only enable ALS patients to converse with their loved ones via AI. In the future however humanity's ability to interface and communicate directly with powerful AI's will not only change the human condition, but will also change the course of human education, evolution, and knowledge.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Healthcare sector, with support from government funding and univesity grants. In time we will see the technology mature to the point where it is able to connect a human brain directly with an AI and enable two way communication. While this is a way off this technology obviously has the potential to transform human culture, society, and the human condition itself - as well as give regulators more nightmares.

While AI Symbiosis is in the Prototype Stage, over the long term it will be enhanced by advances in Artificial Intelligence, Bio-Compatible electronics and materials, Brain Machine Interfaces, Hive Minds, Memory Downloading, Editing, and Manipulation, Neuro-Prosthetics, and Telepathy, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

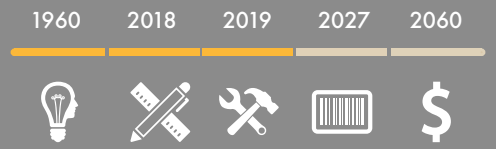
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, and re-visit it every few years until progress in this space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '21, '22, '23, '24

IMPACT

STATUS



Accessibility	1
Affordability	2
Competition	1
Demonstration	4
Desirability	8
Investment	6
Regulation	3
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

AUGMENTED REALITY

AUGMENTED REALITY, which is in the Mass Adoption Stage, is the field of research concerned with developing the hardware, software, platforms and tools necessary to support Augmented Reality (AR) creations and environments. Recent breakthroughs in the field include the rapid development of a burgeoning global developer ecosystem, and the general availability of devices and hardware capable of running AR environments.

DEFINITION

Augmented Reality systems and devices superimpose computer generated elements and objects on a users view of the real world.

EXAMPLE USE CASES

Today we are using Augmented Reality in a myriad of ways that include helping commercial airline and industrial engineers repair and service aircraft and industrial systems faster, within the entertainment and retail sectors, as well as in the classrooms where it is being used to help teach children in new ways. In the future the primary use cases of the technology will be almost unlimited.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Communications, Consumer Electronics, Defence, Education, Healthcare, Manufacturing, Retail, Services, and Technology sectors. In time we will see the technology mature as the stack of technologies that support it continue to improve, however its adoption will still be impacted by cultural biases and affected by the usability of the platforms.

While Augmented Reality is in the Mass Adoption Stage, over the long term it will be enhanced by advances in 5G, 6G, Artificial Intelligence, Behavioural Computing, Creative Machines, Gesture Control, GPU's, High Definition Rendering, Low Earth Orbit platforms, Machine Vision, Mixed Reality, Sensor Technology, and Simulation Engines, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

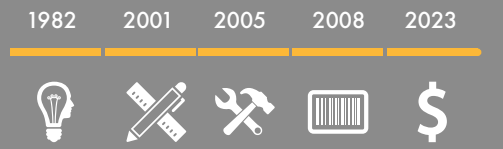
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

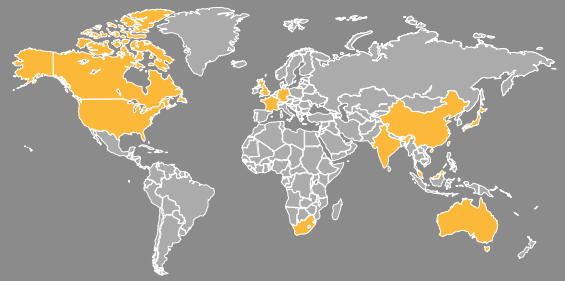
IMPACT

STATUS



Accessibility	9
Affordability	8
Competition	4
Demonstration	9
Desirability	7
Investment	8
Regulation	5
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



9 MRL /9

9 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

AVATARS

AVATARS, which are in the early Productisation Stage, is the field of research concerned with developing increasingly interactive and realistic digital representations of entities, including the creation of so called Virtual Humans, that are capable of understanding and responding to user behaviours and stimuli. Recent breakthroughs in the field include the development of high definition humans avatars whose behaviours and interactions are driven by advanced Neural Networks that are capable of understanding and responding to increasingly complex social interactions and situations.

DEFINITION

Avatars are digital or physical entities that represent a particular character, identity, or individual.

EXAMPLE USE CASES

Today we are using Avatars in a wide range of ways that include using them to teach children about the energy industry, and responding to consumer enquiries and issues, including healthcare enquiries, as well as selling mortgages, and much more. In the future the primary use cases of the technology will be almost unlimited with Avatars playing more of a central role within both the physical and virtual worlds, and in Human to Machine, and Machine to Machine, engagements and transactions.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Consumer Electronics, Defence, Education, Healthcare, Retail, and Technology sectors. In time we will see the technology mature to a point where consumers will not know whether they are talking to a real human, or entity, or a virtual one. As such, and especially when it pertains to regulated industries where Avatars are dispensing advice, both regulators and the insurance sector will need to establish an entirely new set of rules.

While Avatars are in the early Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Behavioural Computing, Creative Machines, GPU's, High Definition Rendering, Machine Vision, Sensor Technology, and Simulation Engines, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

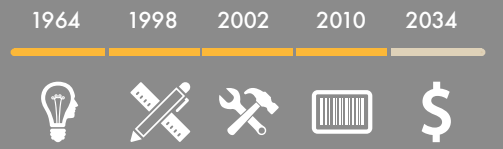
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19

IMPACT

STATUS



Accessibility	8
Affordability	6
Competition	4
Demonstration	9
Desirability	8
Investment	7
Regulation	4
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

8 MRL /9

9 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

BEHAVIOURAL COMPUTING

BEHAVIOURAL COMPUTING, a GENERAL PURPOSE TECHNOLOGY, which is in the Productisation Stage and early Mass Adoption Stage, is the field of research concerned with developing computing platforms and systems that humans can communicate and interact with in natural ways that include body language, gestures, speech, and thought. Recent breakthroughs in the field include the development of near perfect Natural Language systems, for an increasingly wide range of dialects, and the use of surveillance like technologies that are more commonly found in CCTV and other similar systems, that help the technology analyse and interpret human behaviours at the granular and micro level, from the faintest skin flushes to the smallest retinal changes that, when combined, give these systems deeper insights into human behaviour, character, and personality, than even humans can glean.

DEFINITION

Behavioural Computing is a way of interacting with technology and devices in a way that is natural to humans.

EXAMPLE USE CASES

Today we are using Behavioural Computing to change the way we interact with the devices and technology around us, from being able to converse with our smartphone assistants, and searching the internet with just our voices, to diagnosing problems with complex industrial machines, and much more. In the future the primary use case of the technology will be almost limitless, and change our relationship with technology, that will be increasingly proximal to, on us, or in us, forever.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Manufacturing and Technology sector. In time we will see the technology become culturally accepted as the primary way we communicate and interface with technology, and because of the connections with, and similarities to, the surveillance industry, regulators need to review it and draft new regulations to safeguard consumers.

While Behavioural Computing is in the Productisation Stage and early Mass Adoption Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Machine Vision, and Sensor Technology, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

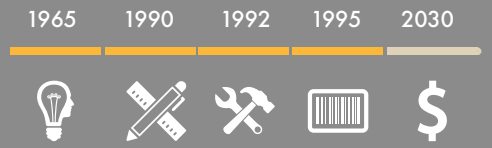
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23, '24

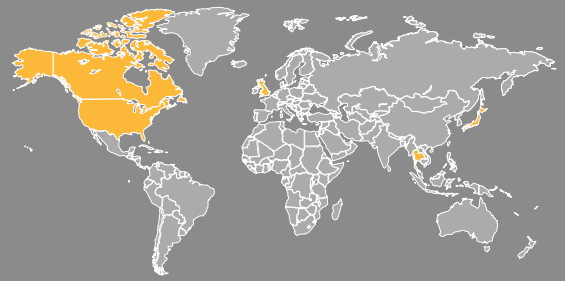
IMPACT

STATUS



Accessibility	8
Affordability	7
Competition	4
Demonstration	9
Desirability	9
Investment	8
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



9 MRL /9

9 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

BOTS

BOTS, which are in the early Mass Adoption Stage, is the field of research concerned with developing autonomous computer agents and programs that can autonomously and intelligently interact with humans and other machines as required. Recent breakthroughs in the field include the development of new training systems that let us train bots faster than ever before, and new models, including Conversational Commerce models, that overall are helping them to become more capable, engaging, and useful than their predecessors.

DEFINITION

Bots are autonomous programs that can interact with systems or users in a variety of ways.

EXAMPLE USE CASES

Today we are using Bots in a wide variety of ways, including in consumer service, marketing, and trading applications, as well as in enterprise automation solutions, and, unfortunately, in the creation and dissemination of Fake News. In the future the primary use case of the technology will be almost unlimited, with Bots playing more of a central role within both the physical and virtual worlds, and in Human to Machine, and Machine to Machine, engagements and transactions.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Communications, Consumer Electronics, Entertainment, Finance, Retail, and Technology sector. In time we will see the technology mature and reach a point where it is no longer possible, without new tools, to distinguish Bot based interactions from regular human or machine ones, which, as a result will require greater oversight from regulators.

While Bots are in the early Mass Adoption Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Behavioural Computing, and Creative Machines, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

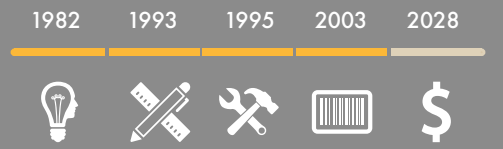
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19

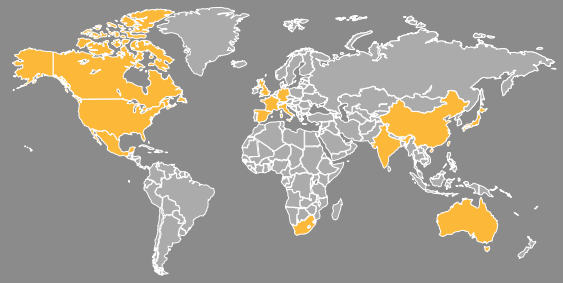
IMPACT

STATUS



Accessibility	9
Affordability	7
Competition	4
Demonstration	9
Desirability	9
Investment	7
Regulation	4
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



9 MRL /9

9 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

DIGITAL HUMANS

DIGITAL HUMANS, which are in the Productisation Stage, is the field of research concerned with developing new types of human-machine interfaces that are natural and easy for people to use. Recently there have been breakthroughs in developing life-like Digital Humans with neural network brains that can be pre-programmed to exhibit specific behaviours, emotions, and personalities, which in turn are able to understand the individual behaviours and emotions of the people who are conversing with them and using them in natural language.

DEFINITION

Digital Humans are digital Avatars with life-like qualities that can be tailored and programmed with digital personalities and specific traits.

EXAMPLE USE CASES

Today we are using Digital Humans to sell financial services products, and serve customers. In the future the primary use of this technology will be to act as a human-machine interfaces that allow people to interact in a more natural manner with machines, whether it is to access services, conduct transactions, or a myriad of other applications.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by organisations in the Consumer Electronics and Technology sectors. In time we will see the technology mature to the point where people can't tell the difference between Digital Humans and their behaviours, reactions and speech patterns, and real people, at which point their adoption will accelerate.

While Digital Humans are in the Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Avatars, Behavioural Computing, Hi Definition Rendering, Machine Vision, and Natural Language Processing but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

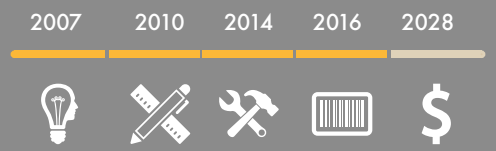
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22, '23, '24

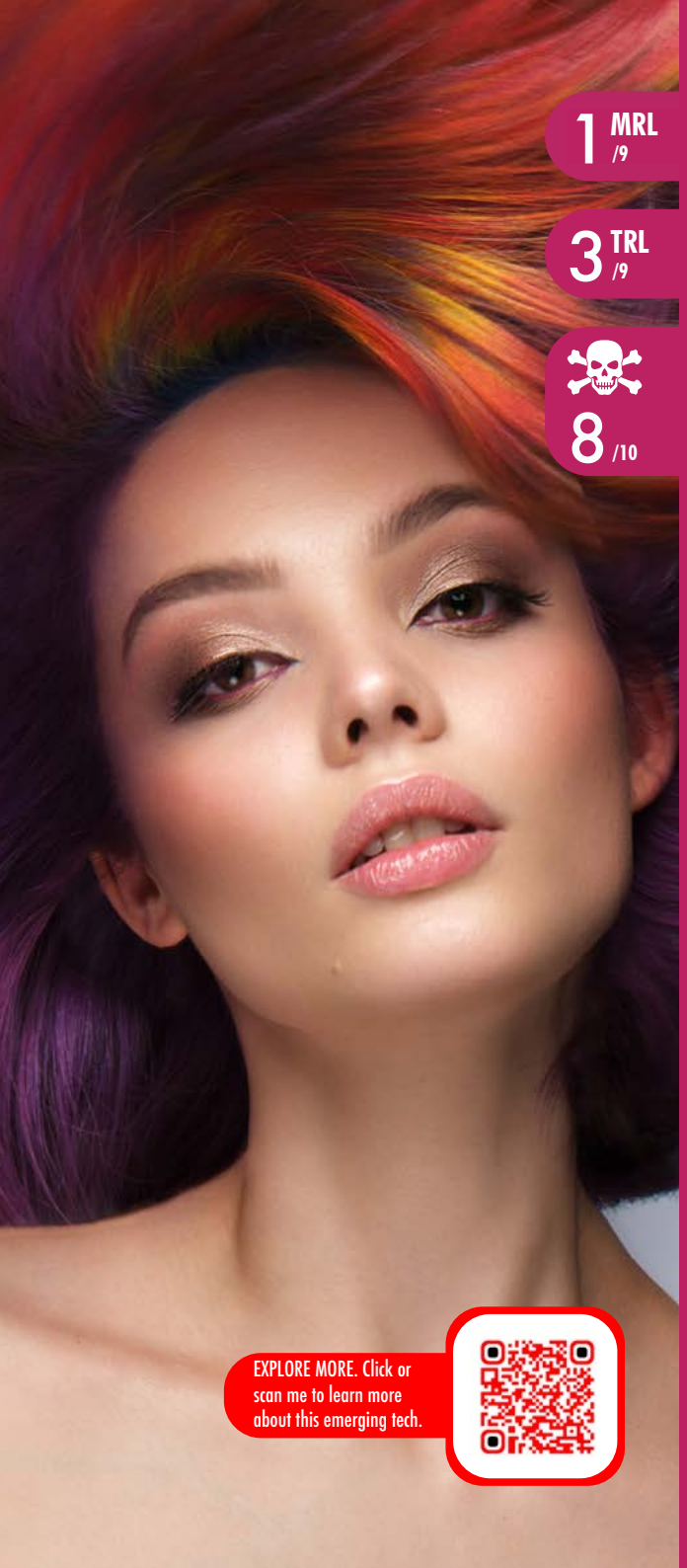
IMPACT

STATUS



Accessibility	4
Affordability	5
Competition	4
Demonstration	7
Desirability	9
Investment	5
Regulation	2
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



1 MRL /9

3 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

ELECTROGENETIC INTERFACES

ELECTROGENETIC INTERFACES, which are in the early Prototype Stage, is a sci-fi-like technology that would let a user genetically re-engineer themselves, possibly on demand and to as much a degree as the technology enables them to, using nothing more than a electronic smart device or app. Today we all have the ability to change the colour of a car, for example, using software apps on our smartphones but in this case imagine being able to alter your genes and their expressions as easily. By being able to activate, alter, and manipulate our genes from a wearable device like a smart watch you could feasibly change everything from your eye colour and hair colour, to how your immune system identifies and targets disease within your body. In essence, one day this technology could give us the ability to re-program our very own genetic makeup and identity.

DEFINITION

Electrogenetic Interfaces use device based electrical stimulii to activate, alter, and manipulate genes in vivo.

EXAMPLE USE CASES

Today use cases include the ability to use this technology to turn human gene expressions on and off - and there are an almost infinite number of outcomes. However, as for other practical use cases those remain hidden at this time.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Electrogenetic Interfaces increase, albeit from a very low base, primarily driven by university grants. While this technology has the potential to be world changing at the moment it is in the very early stages of research, and eventually there would be very serious ethical and regulatory hurdles to overcome, all of which mean that in time we might see this technology fade over time and either mount to nothing or morph into something new. Either way though given the nature of it this technology will likely take decades to be prototyped effectively and commercialise.

While Electrogenetic Interfaces are still in the early Prototype Stage they could be enhanced by advances in Artificial Intelligence, CRISPR, Inhalable RNA Therapies, and other technologies, however over the long term it could be replaced by CRISPR therapies.

MATTHEW'S RECOMMENDATION

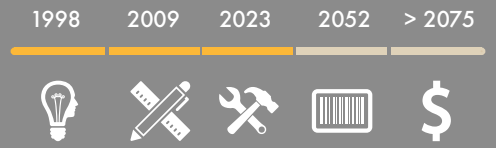
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

IMPACT

STATUS



Accessibility	2
Affordability	7
Competition	1
Demonstration	7
Desirability	8
Investment	1
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

6 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

FLEXIBLE DISPLAYS

FLEXIBLE DISPLAYS, which are in the Productisation Stage, is the field of research concerned with developing high definition displays that can fold and twist into any configuration to suit a variety of different display formats. Recently there have been a number of significant developments in the field which now mean that the technology is being openly manufactured and incorporated into mass consumer products that range from large format TV's to smartphones and smart devices.

DEFINITION

Flexible Displays are a form of electronic visual display that is flexible in nature.

EXAMPLE USE CASES

Today Flexible Displays are being used to develop laptops, smartphones, and TV's with large screens that can be folded or rolled into just a fraction of their footprint. In the future, as complimentary connectivity and wireless energy systems improve which hep male the technology truly stand alone, and as the technology gets cheaper to manufacture and more reliable it will be integrated into all manner of products, from packaging to vehicle interiors, and beyond.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Consumer Electronics sector. In time we will see the technology become ubiquitous and cheap enough to be incorporated into all manner of products.

While Flexible Displays are in the Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Display technologies, Nanomanufacturing, Semiconductors, Wireless Energy Systems, and Compute, Connectivity, Electronics, and Sensor technologies, and in the long term it will be complimented by Atomically Thin Displays, and Retinal Displays, and replaced by Atomically Thin Displays, Telepathic Displays, and Transparent Displays.

MATTHEW'S RECOMMENDATION

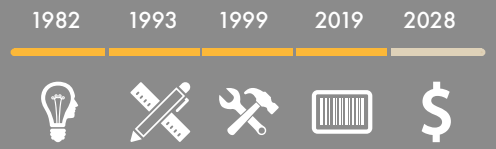
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: NONE

IMPACT

STATUS



Accessibility	5
Affordability	7
Competition	4
Demonstration	8
Desirability	9
Investment	6
Regulation	6
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

2 MRL /9

3 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

GENERATIVE USER INTERFACES

GENERATIVE USER INTERFACES, which is in the early Prototype Stage, is the ability to use Creative Machines, Generative Artificial Intelligence, and other so such technologies, to dynamically adapt and if necessary re-code and re-design user interfaces at the individual level in real time, meaning that every individual receives their own tailored UI which, in essence, helps organisations realise the ultimate dream of hyper personalisation at extreme scale. Recent breakthroughs in this field include efforts to create Generative Operating Systems (OS), as well as Large Action Model AI's, that adapt to the individual user - which would finally mean that users will be freed from the "One UI to serve them all" concept we've had since the dawn of computing.

DEFINITION

Generative User Interfaces use Generative Artificial Intelligence to dynamically alter and re-code an individual UI in real time in response to the individual users behaviours, information, and other stimuli.

EXAMPLE USE CASES

Today we are all used to having the same technology user interfaces as everyone else, give or take a few adjustments via the preferences settings, but this technology would mean that finally we can hyper personalise UI and UX at scale and give each individual user the best interface for them and the tasks they're doing at the time.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Generative User Interfaces increase, albeit from a low base, primarily led by organisations in the Technology Industry. While this is a revolutionary technological capability that could help us transform how humanity interacts with technology the fact remains that it is disruptive to many technology companies, especially those in the app store business and, unless they allow it, then its reach could be limited. However, that said consumer and enterprises alike would greatly benefit it, so it has longevity.

While Generative User Interfaces are still in the early Prototype Stage it could be enhanced by advances in Affective and Behavioural Computing, Artificial Intelligence, Creative Machines, Immersive AR/MR/VR, Natural Language Processing, and other technologies, however over the long term it could be replaced by other forms of Behavioural Computing, Neural Interfaces, and others.

MATTHEW'S RECOMMENDATION

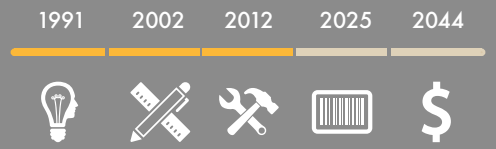
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '24

IMPACT

STATUS



Accessibility	6
Affordability	5
Competition	3
Demonstration	7
Desirability	9
Investment	5
Regulation	5
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

9 MRL /9

9 TRL /9

3 /10

GESTURE CONTROL

GESTURE CONTROL, which is in the early Productisation Stage, is the field of research concerned with developing systems that can sense, and react, to gestures that also include human body language. Recent breakthroughs in the field include the development of improved sensing systems, such as Machine Vision, as well as Radar and Sonar on Chip systems, that can detect movements at the micro and millimetre level from greater distances, and the computerised control systems that translate these into actions and outcomes.

DEFINITION

Gesture Control is the ability to recognise and interpret movements in order to interact with and control computer systems and devices without direct physical contact.

EXAMPLE USE CASES

Today we are using Gesture Control to develop interactive games, and more immersive virtual worlds, as well as to develop new computer interfaces that can be used to control and interact with a wide variety of products, including Augmented Reality and Digital Twins. In the future the primary applications for the technology will largely be the same as it is today, although there will be more devices and platforms, including wearables, that will support it.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow albeit from a low base, primarily led by organisations in the Consumer Electronics, Entertainment and Technology sector. In time we will see technology mature as the sensing systems needed to support it become embedded in more technology platforms, but in order for the technology to be more widely adopted we will also require a cultural shift, something that might be facilitated by the move to Behavioural Computing.

While Gesture Control is in the early Productisation Stage, over the long term it will be enhanced by advances in Artificial Intelligence, Augmented Reality, Behavioural Computing, Machine Vision, Optics, Sensor Technology, Simulation Engines, and Virtual Reality, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

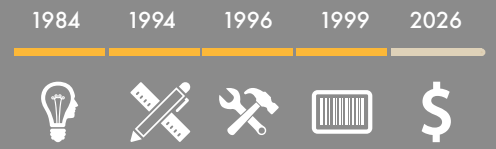
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19

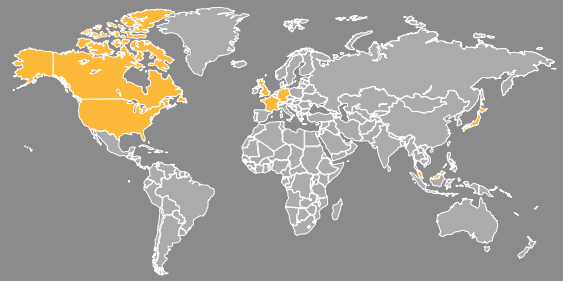
IMPACT

STATUS



Accessibility	8
Affordability	7
Competition	6
Demonstration	9
Desirability	8
Investment	6
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



7 MRL /9

9 TRL /9

7 /10

HAPTICS

HAPTICS, which is in the Prototype Stage and very early Productisation Stage, is the field of research concerned with developing technologies that allow humans to experience the sensation of touching an object when it is not physically present. Recent breakthroughs include the development of Acoustic Holograms, that let users interact with and touch objects made from "3D sound," and new display systems that use combinations of Electro and Mechanical sensations, including vibrations, to imitate the feel of a range of materials and objects, and augment the user experience.

DEFINITION

Haptics stimulate the senses of touch and motion to reproduce the sensations that would be felt naturally if the user was interacting with real objects.

EXAMPLE USE CASES

Today we are using Hapatics in industrial control rooms and our smartphones to provide additional, tactile, system feedback, in wearables to help blind people better sense and navigate their environment, and as part of Virtual Reality equipment, such as gloves and suits, to create richer immersive experiences. In the future the primary applications of the technology will include any situation where having additional sensory, in this case tactical, feedback is valuable.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow albeit from a low base, primarily led by organisations in the Consumer Electronics, and Technology sectors, with support from university grants. In time we will see the tactical feedback the technology provides improve and become more realistic, and see it become easier to integrate into devices which will help spur its future adoption.

While Haptics is in the Prototype Stage and very early Productisation Stage, over the long term it will be enhanced by advances in Display Technology, Micro-Electromechanical Sensors, Semiconductors, and Virtual Reality, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

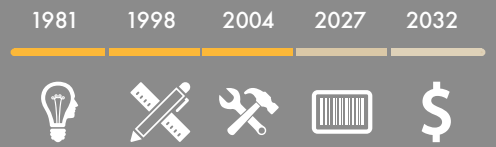
EXPLORE MORE. Click or scan me to learn more about this emerging tech.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

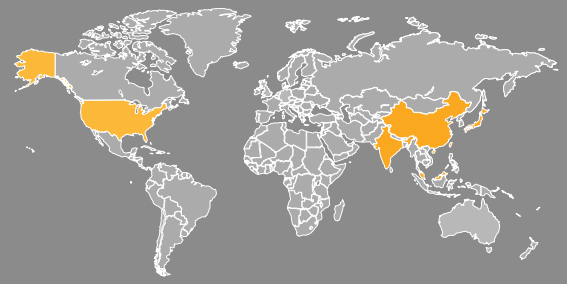
IMPACT

STATUS



Accessibility	6
Affordability	5
Competition	4
Demonstration	7
Desirability	8
Investment	5
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

6 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

HIVE MINDS

HIVE MINDS, which are in the Prototype Stage and early Productisation Stage, is the field of research concerned with developing a form of Collective Intelligence that can be accessed by humans, and or, machines to augment and enhance their own experiences and intelligence. Recent breakthroughs in the field include both the creation of a biological Hive Mind, that allowed rats on different continents to share and learn from mutual experiences in order to accomplish specific tasks, and the use of Artificial Intelligence and Cloud Computing to create equivalent machine based Hive Minds that allowed robots to share and learn from one anothers experiences, the impact of which allowed researchers to cut their collective training times down to near real time.

DEFINITION

Hive Minds are a form of collective conciousness and intelligence that allow large collections of entities, both digital and physical, to share experiences, knowledge and opinions with one another.

EXAMPLE USE CASES

Today we are using the prototype Hive Minds to create biological Hive Minds, that allow rats on different continents to share and learn from one another's experiences to accomplish specific tasks, and machine Hive Minds that use Artificial Intelligence and Cloud Computing to help researchers cut the time to train industrial robots down to near real time. In the future the primary applications of the technology will include any situation where self-learning, and access to collective experiences and intelligences, whether it is for biological, digital, or mechanical systems, is valuable.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow albeit from a low base, primarily led by organisations in the Technology sector, with support from university grants. In time we will see the technology become the defacto way to train machines, including autonomous vehicles and robots, but it is also inevitable that this will lead to regulatory and security issues that will need to be resolved.

While Hive Minds are in the Prototype Stage and early Productisation Stage, over the long term they will be enhanced by advances in 5G, 6G, Artificial Intelligence, Neural Interfaces, Robots, and Sensor Technology, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

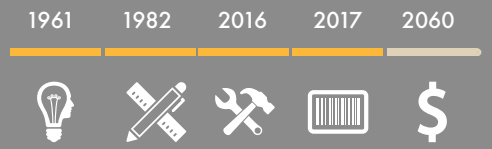
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23, '24

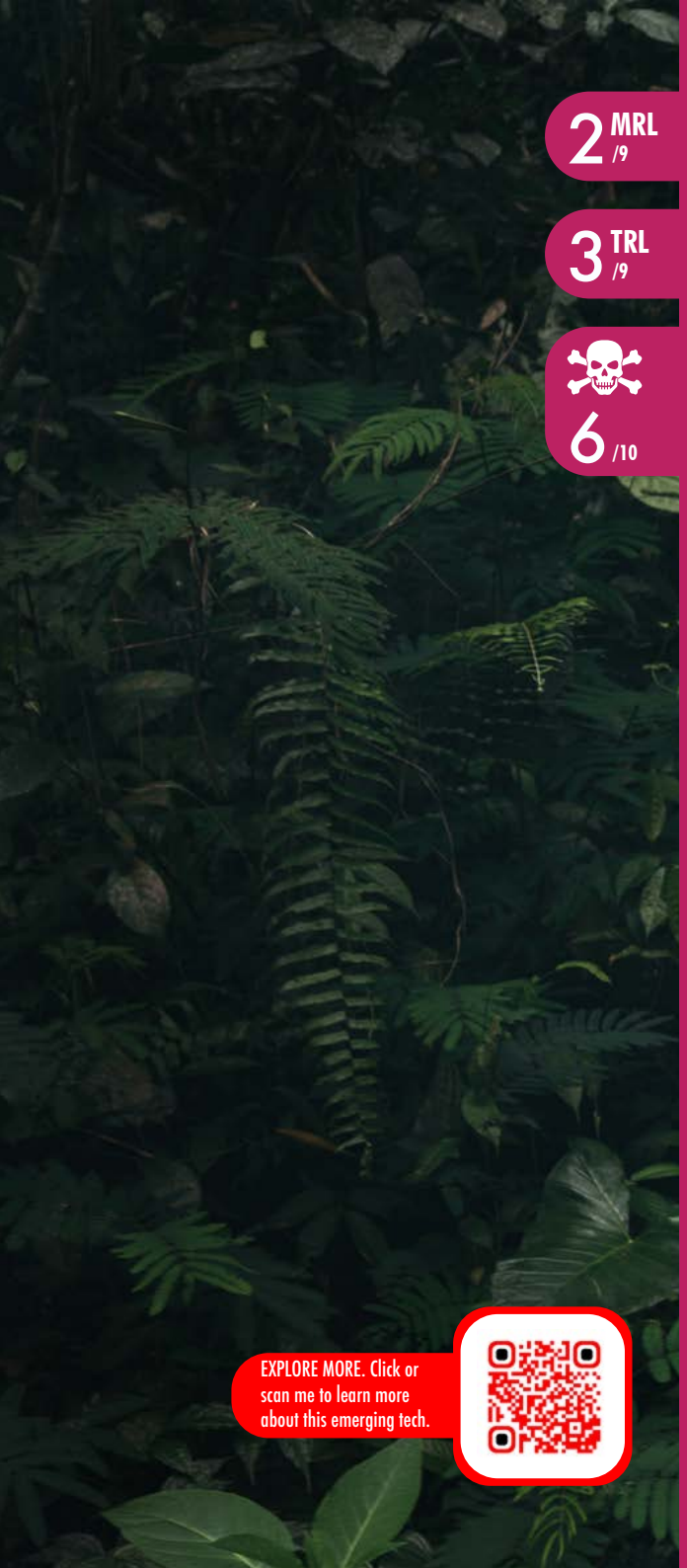
IMPACT

STATUS



Accessibility	4
Affordability	3
Competition	2
Demonstration	7
Desirability	8
Investment	4
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



2 MRL /9

3 TRL /9

6 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

HOLODECKS

HOLODECKS, which are in the Concept Stage and early Prototype Stage, is the field of research concerned with trying to re-create the famous Star Trek Enterprise Holodecks that provide users with a fully explorable and immersive simulated environment all within the confines of a defined space, without needing the user to carry or wear any specialist equipment. Recent breakthroughs in the field include the development of Parallax displays and sophisticated user analysis and tracking systems which, today, provide users with a very basic Holodeck experience.

DEFINITION

Holodecks are a chamber or facility in which a user can experience a holographic or computer simulated physical environments.

EXAMPLE USE CASES

Today we are using the first Holodeck prototypes to test the theories and methodologies, and refine them. In the future the primary applications of the technology will include education, entertainment and telepresence.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Entertainment sector, with support from private investors. In time we will see the technologies needed to create the first Holodecks emerge, but it will be a long while before we see the same kind of Holodecks shown on the TV shows.

While holodecks are in the Concept Stage and early Prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Augmented Reality, Creative Machines, Holograms, Machine Vision, Matter Holograms, Metalenses, Neural Interfaces, Programmable Matter, and Sensor Technology, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

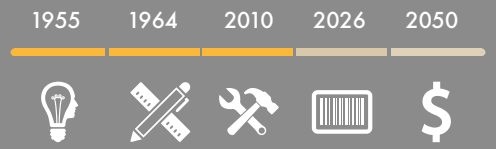
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22

IMPACT

STATUS



Accessibility	1
Affordability	1
Competition	2
Demonstration	2
Desirability	9
Investment	3
Regulation	1
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

5 TRL /9

4 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

HOLOGRAMS

HOLOGRAMS, which are in the Concept Stage and early Prototype Stage, is the field of research concerned with developing free form, 3D moving images using laser light. Recent breakthroughs in the field include the development of the world's first true, free form multi-coloured interactive Holograms that were created using a combination of laser suspended Nanocellulose particles, illuminated with laser light, and elsewhere the creation of the same but using a differet approach that relied on Femtolasers that turned small pockets of air into coloured plasma which were then manipulated to create true 3D holographic objects.

DEFINITION

Holograms are a 3D image formed by the interference of light beams from a laser or other coherent light source.

EXAMPLE USE CASES

Today we are using the first Hologram prototypes to test theories and methodologies, and refine the technology. In the future the primary applications of the technology will include any situation where free form 3D displays are valuable, from entertainment and healthcare, to even, one day, Holodecks.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a low base, primarily led by organisations in the Consumer Electronics sector, with support from university grants. In time we will see the size and resolution of these Holograms increase, and the size and cost of the equipment used to make them decrease to the point where they become commercially viable to produce.

While Holograms are in the Concept Stage and early Prototype Stage, over the long term they will be enhanced by advances in Artificial intelligence, Laser Technology, Nano-Materials, and Sensor Technology, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

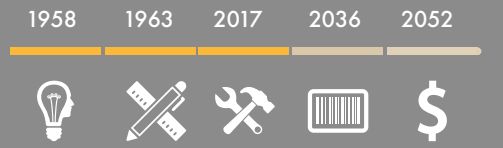
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	2
Affordability	2
Competition	2
Demonstration	5
Desirability	9
Investment	3
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

HOLOPORTATION

HOLOPORTATION, which is in the Productisation Stage, is the field of research concerned with trying to bring to life authentic and realistic holographic representations of people which can be used to improve inter-personal communication and collaboration across large distances. Recently there have been a number of breakthroughs in the field including the development of realistic Augmented reality-like holographic avatars which enable people to communicate and interact with one another, via headsets and haptic devices, as though they were in the same room. However, given network latencies and the difficulty of enabling fine co-ordinated movements between people the technology still has some way to go before it's truly like being in the same room as the person you're interacting with.

DEFINITION

Holoportation is the use of real time holograms to enable interpersonal communication and collaboration across distances.

EXAMPLE USE CASES

While Holoportation is effectively the digitisation of human presence across distances it's primary use case is its ability to make it look as though colleagues and team members who are physically remote seem as though they are in the same room as you. Additionally, the use Universal Translators that let people converse with one another in their own local dialects will enhance the effectiveness of the experience even more.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see the interest in this field accelerate, predominantly led by the Technology sector. The digitisation of human presence is a game changer, and in time with the development of new smart gadgets, higher resolution display systems, and other technologies it will be increasingly difficult for you to believe that you aren't in the same room as the people you're talking to, therefore the technology will have staying power.

While Holoportation is still in the Productisation Stage it could be enhanced by advances in 5G, 6G, AI, Augmented Reality, Behavioural Computing, Displays, Haptics, Holograms, Laser technology, Meta-Optics, Mixed Reality, Sensors, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

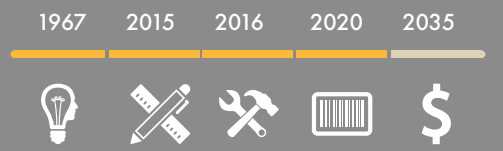
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23, '24

IMPACT

STATUS



Accessibility	5
Affordability	5
Competition	4
Demonstration	9
Desirability	8
Investment	5
Regulation	4
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

5 MRL /9

8 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

HYPERSURFACES

HYPERSURFACES, which are in the Prototype Stage, is the field of research concerened with turning every surface into an interactive user interface that can be used to control the different types of technology that's all around us. Recent breakthroughs in the field include using Artificial Intelligence and sensors to create systems that can track user behaviours, from knocks and the steps they take, to the patterns they trace across surfaces, to create gesture vocabularies that can be used to control and interact with almost any type of device or technology, from sound and lighting systems to tablets.

DEFINITION

Hypersurfaces employ a range of different technologies that turn any surface into a tactile user computer interface.

EXAMPLE USE CASES

Today we are using the prototypes to prove the theories and refine the technology. In the future the primary applications of the technology could be almost limitless, allowing users to turn anything and everything into a user interface that can be used to control and interact with the technology around them.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Technology sector. In time we will see the technology become refined and miniaturised.

While Hypersurfaces are in the Prototype Stage, over the long term they will be enhanced by advances in Artificial Intelligence, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

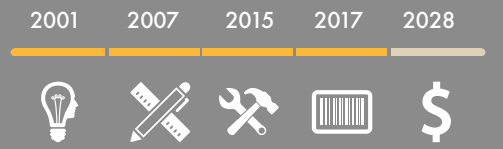
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20

IMPACT

STATUS



Accessibility	4
Affordability	6
Competition	5
Demonstration	8
Desirability	8
Investment	3
Regulation	2
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

MEMORY DOWNLOADING

MEMORY DOWNLOADING, which is in the Concept Stage and Prototype Stage, is the field of research concerned with developing the technologies and tools needed to accurately and safely download information and memories, from the human brain, into other entities or machines. While the field is highly complex the areas of research vary between researchers who are trying to stream information and memories from the brain, much in the same way we stream digital content today from the internet, and those who are trying to download "Whole Brain" information and experiences into, for example, Avatars or Robots. Recent breakthroughs in the field include the ability to stream static images and movie-like content from the brain in real time, using Artificial Intelligence and Neural Interfaces, to TV screens, but whole brain downloads are still far away.

DEFINITION

Memory Downloading is the process of downloading information from the human brain to any other system or device.

EXAMPLE USE CASES

Today we are using Memory Downloading in a variety of ways, including in the police force to help create better photo fits of suspects, and in hospitals to help ALS patients communicate with loved ones, and at a more basic level we are also using the technology to stream movie-like content to television screens. In the future the primary applications of the technology will be almost limitless, and it will revolutionise humanity.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Defence, Consumer Electronics, Healthcare, and Technology sectors, with support from government funding and university grants. In time we will the technology mature, at which point there will be serious ethical and regulatory hurdles to overcome.

While Memory Downloading is in the Concept Stage and Prototype Stage, over the long term it will be enhanced by advances in Artificial Intelligence, Bio-Compatible Transistors, Creative Machines, fMRI, Memory Editing, Memory Uploading, Memory Transfer, Neural Interfaces, and Sensor Technology, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

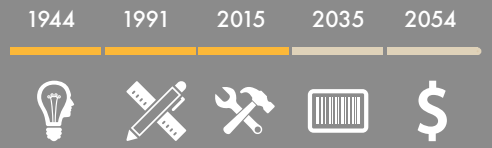
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	1
Affordability	1
Competition	4
Demonstration	7
Desirability	9
Investment	3
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

2 MRL /9

4 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

MEMORY TRANSFER

MEMORY TRANSFER, which is in the Concept Stage and early Prototype Stage, is the field of research concerned with developing the technologies and tools needed to transfer real memories between two independent living organisms, and eventually, machines. Recent breakthroughs in the field include the world's first memory transfer between two living animals, in this case snails, where scientists extracted RNA from trained snails and injected it into un-trained ones, the result of which was the un-trained snails were then able to complete the same tasks as the trained ones with the same accuracy and speed, conclusively proving that the theory of memory transfer is real, and giving us a potential pathway to one day transfer memories between humans.

DEFINITION

Memory Transfer is the process of transferring memories from one entity to another.

EXAMPLE USE CASES

Today we are using the first Memory Transfer prototypes to proe the theories and refine the technology. In the future the primary applications of the technology will be in the Healthcare sector in the treatment of Dementia patients, after which the number of applicable use cases, including entertainment, will grow before eventually it revolutionises humanity.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Defence sector, with support from government funding and university grants. In time we will see the technology mature to a point where both basic, and more advanced memory transfers can be performed, but as the technology inevitably improves the biggest hurdles for it to overcome will undoubtedly be ethical and regulatory.

While Memory Transfer is in the Concept Stage and early Prototype Stage, over the long term it will be enhanced by advances in Artificial Intelligence, Bio-Compatible Transistors, Hive Minds, Memory Downloading, Memory Editing, Memory Uploading, Neural Interfaces, Neurology, Neuro-Prosthetics, and Sensor Technology, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

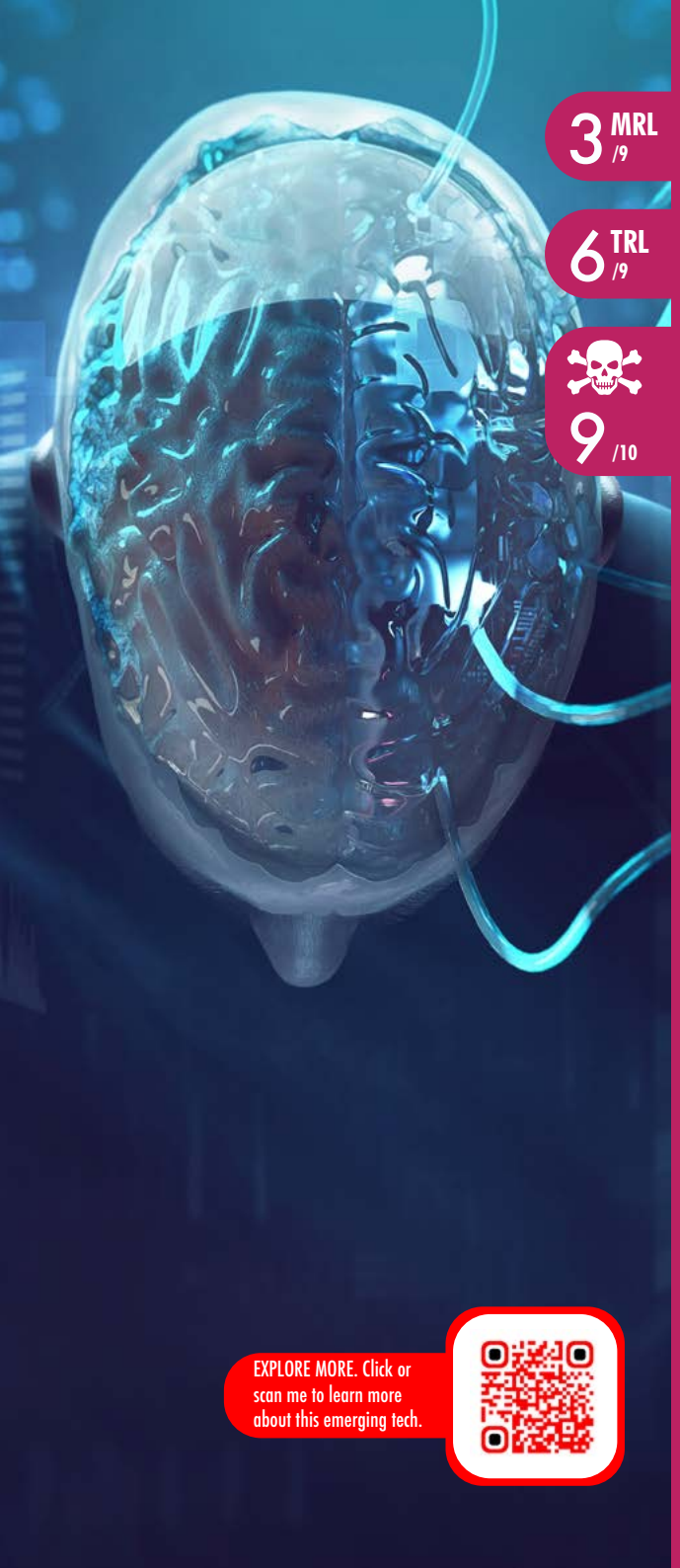
STARBURST APPEARANCES: '19, '20, '21, '22

IMPACT

STATUS

Accessibility	1
Affordability	1
Competition	1
Demonstration	2
Desirability	9
Investment	3
Regulation	1
Viability	6

PRIMARY GLOBAL DEVELOPMENT AREAS



3 MRL /9

6 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

MEMORY UPLOADING

MEMORY UPLOADING, which is in the early Prototype Stage, is the field of research concerned with developing new ways to upload information and knowledge, as well as the broader remit of uploading experiences and memories, to the human brain by harnessing the brain's natural synaptic plasticity. Recent breakthroughs in the field include uploading knowledge "Matrix style" to the human brain by isolating, re-playing, and then "transplanting" the brainwave patterns that correspond to certain skills, such as flying a fighter jet, from trained pilots whose brainwaves were recorded while they were in a simulator, into the brains of volunteers who, after the trials, were able to fly and land the jets successfully - albeit for a short period of time. Elsewhere other researchers have used Neuro-Electrical Stimulation to tap into this same natural plasticity to improve Olympians learning and subsequent Olympic performances by up to 80 percent.

DEFINITION

Memory Uploading is the process of uploading information from any system or device to the human brain.

EXAMPLE USE CASES

Today we are using the first Memory Uploading prototypes to test the theories and refine the technology. In the future the primary applications for the technology will be almost limitless, and it will revolutionise Humanity.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Defence sector, with support from government funding and university grants. In time we will see the technology mature as researchers find new ways to manipulate and tap into the brain's natural synaptic plasticity and unlock its secrets, but inevitably over time the technology will increasingly run into ethical and regulatory hurdles which will slow down its adoption.

While Memory Uploading is in the early Prototype Stage, over the long term it will be enhanced by advances in Artificial Intelligence, Creative Machines, fMRI, Hive Minds, Memory Downloading, Memory Editing, Memory Transfer, Neural Interfaces, and Neuro-Electrical Stimulation, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

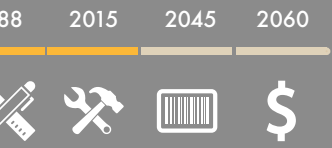
In the short to medium term I suggest companies put the technology on their radars, establish a point of view, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23

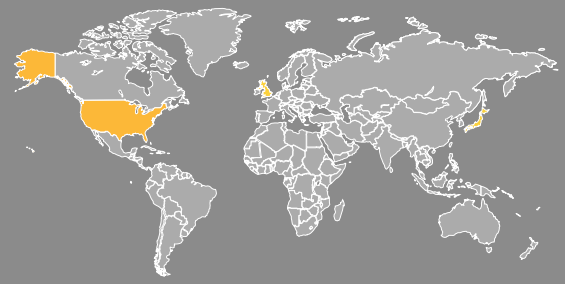
IMPACT

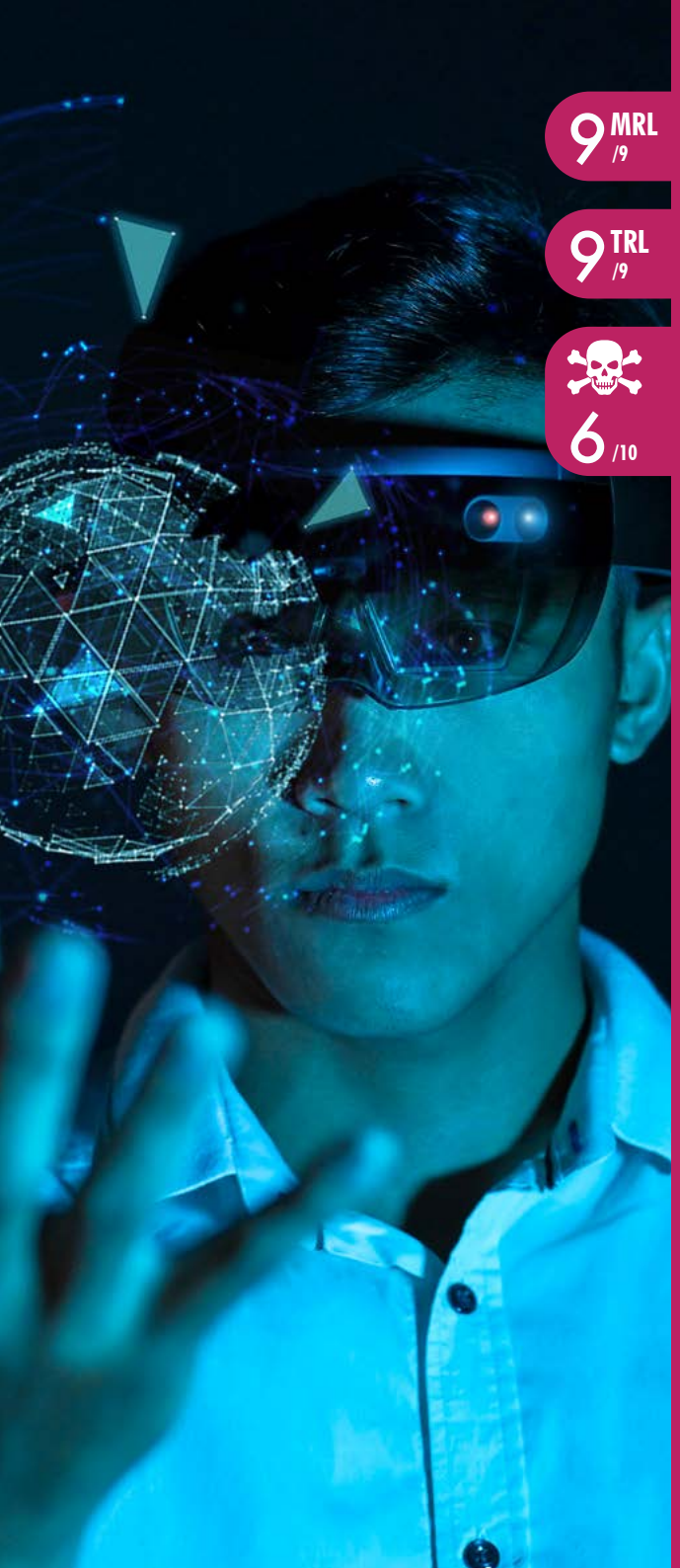
STATUS



Accessibility	1
Affordability	1
Competition	1
Demonstration	7
Desirability	9
Investment	3
Regulation	1
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





9 MRL /9

9 TRL /9

6 /10

MIXED REALITY

MIXED REALITY, which is in the Productisation Stage and early Mass Adoption Stage, is the field of research concerned with developing the hardware, software, platforms and tools necessary to support Mixed Reality (MR) experiences, creations and environments . Recent breakthroughs in the field include the rapid development of a burgeoning global developer ecosystem, and the general availability of devices and hardware capable of running AR environments.

DEFINITION

Mixed Reality allows physical and digital objects to co-exist and interact with one another in the same virtual space in real time while letting users manipulate both.

EXAMPLE USE CASES

Today we are using Mixed Reality in a myriad of ways that include being able to provide real-time holographic translation services, letting artists and architects manipulate real world and digital objects in order to create new environments and landscapes, and letting healthcare practitioners explore patients bodies and illnesses in more exquisite detail before performing surgery. In the future the primary use cases of the technology will be almost unlimited.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Communications, Consumer Electronics, Defence, Education, Healthcare, Manufacturing, Retail, Services, and Technology sectors. In time we will see the technology mature as the stack of technologies that support it continue to improve, however its adoption will still be impacted by cultural biases and affected by the usability of the platforms.

While Mixed Reality is in the Productisation Stage and early Mass Adoption Stage, over the long term it will be enhanced by advances in 5G, 6G, Artificial Intelligence, Behavioural Computing, Creative Machines, Gesture Control, GPU's, Haptics, High Definition Rendering, Low Earth Orbit platforms, Machine Vision, Sensor Technology, and Simulation Engines, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

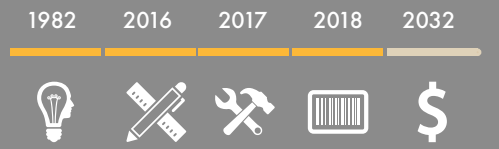
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21

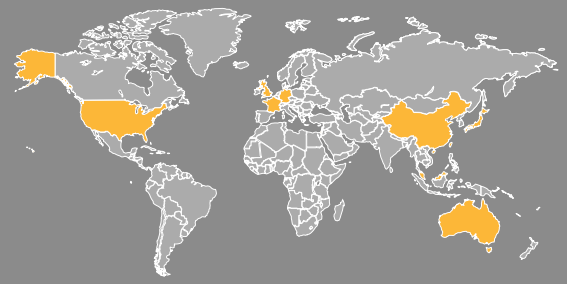
IMPACT

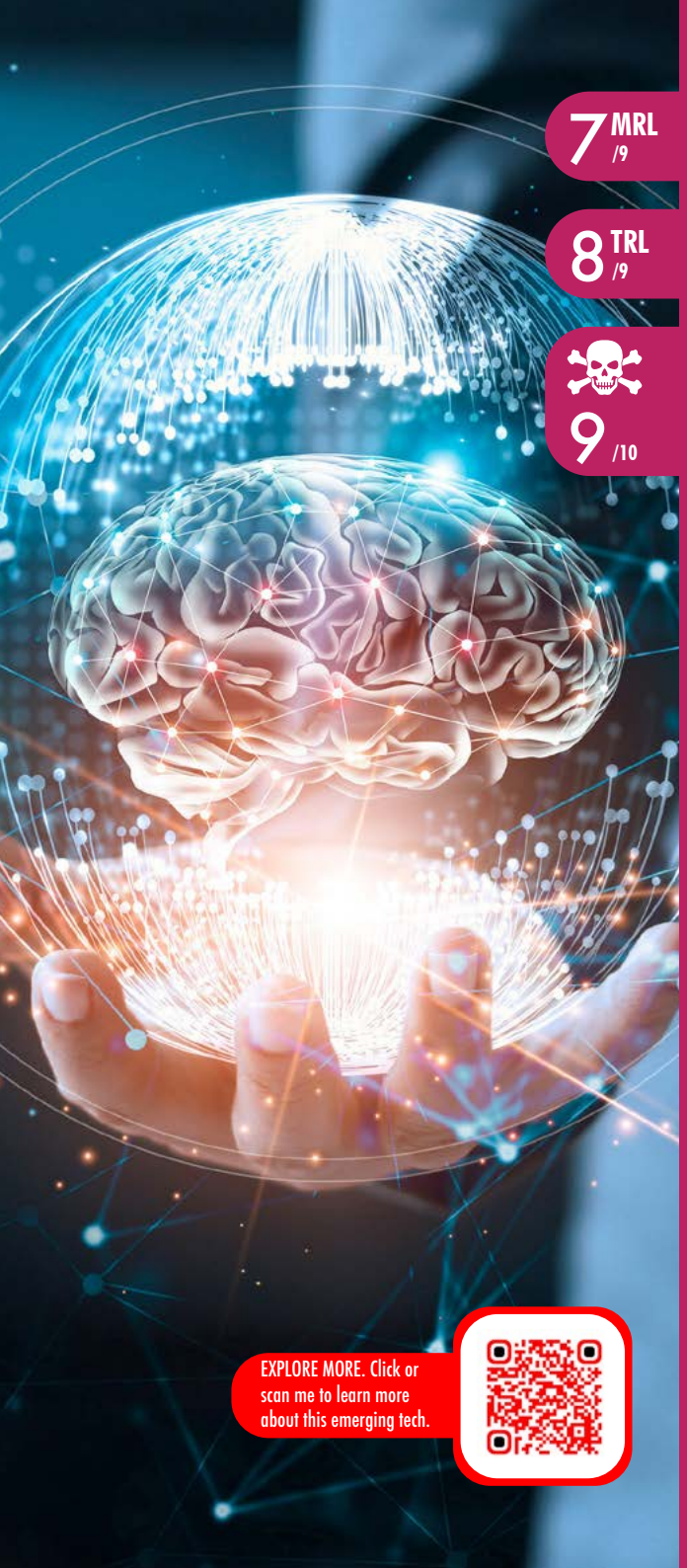
STATUS



Accessibility	5
Affordability	5
Competition	2
Demonstration	9
Desirability	8
Investment	4
Regulation	2
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





7 MRL /9

8 TRL /9

9 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

NEURAL INTERFACES

NEURAL INTERFACES, which are in the Productisation Stage, is the field of research concerned with developing the technologies and tools needed to unlock the power of the human brain, and allow the one way or two way telepathic communication of information between humans, and or, machines. Recent breakthroughs in the field include the development of invasive Bio-Compatible sensors that can be inserted directly into the brain, as well as ultra-sensitive non-invasive Acoustic and Near Infra Red sensing systems that, when coupled with trained Artificial Intelligence models, allow volunteers to telepathically stream thoughts and play telepathic games.

DEFINITION

Neural Interfaces are Brain-Machine interfaces that allow users to communicate, control, and interact with devices and machines using thought.

EXAMPLE USE CASES

Today we are using Neural Interfaces to control military fighter jets, play telepathic Tetris, and telepathically train robots, as well as using them to allow ALS patients to communicate with loved ones, and stream images and dynamic content from people's brains directly to the internet. In the future the primary applications of the technology will be in situations where being able to operate at the speed of thought, and or, communicate using just thought, is valuable, from Telepathic Human to Human, or Human to Machine communication, to Telepathic "Active" cyber warfare.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Defence, Healthcare, and Technology sector, with support from government funding and university grants. In time we will see the use of invasive neural implants fade out as non-invasive alternatives become the norm, and as the sensing sensitivity of these systems improve, and as the technology miniaturises, their adoption will increase.

While Neural Interfaces are in the Productisation Stage, over the long term they will be enhanced by advances in 6G, Artificial Intelligence, Bio-Compatible Transistors, Graphene, Hapatics, Memory Downloading, Memory Uploading, Memory Transfer, and Sensor Technology, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

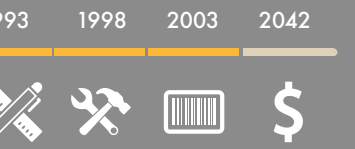
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23, '24

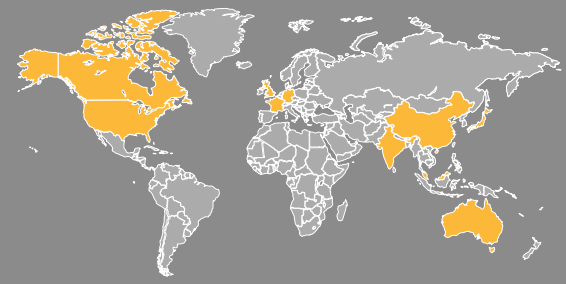
IMPACT

STATUS



Accessibility	8
Affordability	5
Competition	2
Demonstration	9
Desirability	9
Investment	5
Regulation	4
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS



7 MRL /9

9 TRL /9

6 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

PERSONALISED SOUND

PERSONALISED SOUND, which is in the early Productisation Stage, is the field of research concerned with splitting sound into individual channels so that only specific people can hear specific sounds or content, without others in the room hearing them, and all without the need for users to use any equipment, such as headphones or any other devices. Recent breakthroughs in the field include the development and release of the first commercial products, in the form of a small sound bar, that can be used in the car, home, or office.

DEFINITION

Personalised Sound Streaming is the ability to separate sound into individual channels that only individual users can hear, irrespective of their environment.

EXAMPLE USE CASES

Today we are using Personalised Sound to let consumers, in the car and at home, only listen to the content they're viewing without interupting the other people next to them. In the future the primary applications of the technology will include using it in areas where users either want to focus on their own content, and not someone else's, for example in autonomous vehicles, situations that require privacy, as well being a natural compliment to AI Procedural Story Telling that will allow users to listen to their own personalised AI generated content and storylines.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace and Consumer Electronics sector. In time we will see the technology continue to mature and become more widely adopted as the price point drops, and as manufacturers find new ways to integrate it with their own technology.

While Personalised Sound is in the early Productisation Stage, over the long term it will be enhanced by advances in Metamaterials, but at this point in time it is not clear what it will be replaced by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '19, '20, '21, '22, '23, '24

IMPACT

STATUS

Accessibility	7
Affordability	6
Competition	3
Demonstration	9
Desirability	8
Investment	4
Regulation	2
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

3 MRL /9

4 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SCREENLESS DISPLAY SYSTEMS

SCREENLESS DISPLAY SYSTEMS, which are in the Concept Stage and early Prototype Stage, is the field of research concerned with developing new ways to beam content and information directly into peoples eyes and retinas, which would allow them to view content without the need to use physical screens or traditional displays. Recent breakthroughs in the field include the development of new Holographic projection systems, and Semi-Conductor grids embedded into Smart Glasses that are capable of beaming photons into eyes to create very basic, grey-scale images, but we are still a long way off from realising some of the science fiction technologies that let companies beam adverts directly into users eyes.

DEFINITION

Screenless Displays are a range of virtual and retinal display systems that project images directly onto the retina.

EXAMPLE USE CASES

Today we are using the first Screenless Display System prototypes to test theories and refine the technology. In the future the primary applications of the technology will include entertainment, including Augmented Reality (AR) and Virtual Reality (VR), and any situation where not having to rely or use traditional screens adds value.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, albeit from a very low base, primarily led by organisations in the Consumer Electronics sector, with support from univesity grants. In time we will see the technology mature to the point where researchers are able to beam high quality content directly into users eyes, but there will likely be significant cultural and regulatory hurdles to be overcome before the technology can be adopted.

While Screenless Display Systems are in the Concept Stage and early Prototype Stage, over the long term they will be enhanced by advances in Holograms, and Semi-Conductors, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

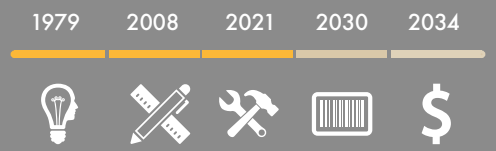
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	2
Affordability	3
Competition	2
Demonstration	4
Desirability	8
Investment	3
Regulation	2
Viability	7

PRIMARY GLOBAL DEVELOPMENT AREAS

4 MRL /9

7 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

SPRAY ON USER INTERFACES

SPRAY ON INTERFACES, which are in the Prototype Stage, is the field of research concerned with developing intelligent sensor laden functional inks and paints that you can spray onto any surface to create interactive user experiences and interfaces with. While this technology has been mooted in the movies for some time now recently there have been breakthroughs in the field that allow researchers to spray user interfaces onto any kind of surface which, through motion or touch, then allow users to control and interact with the different computing systems and technologies around them. And if you're wondering why this might be useful then check out the use cases below.

DEFINITION

Spray on User Interfaces are user interfaces that can be sprayed onto a surface.

EXAMPLE USE CASES

While there are many example use cases for this technology some of the primary ones could include being able to control different things in your home with them. For example, imagine spraying an interface onto your sofa that allows you to control your TV, or spray and interface onto your walls that let you control the lighting or temperature and you'll start getting the gist. Expanding this out though you could spray interfaces onto buildings which would let you control or play music or get information about the local area, and you could even spray an interface onto an industrial piece of equipment in a factory to get information about it or interact with it, and other interesting use cases.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Spray on User Interfaces increase, albeit from a very low base, primarily led by university grants. The ability to turn any object into a smart and interactive interface on demand has many benefits and ultimately many of the applications of this technology are only limited by our imagination - especially as we continue to see other complimentary technologies developing quickly alongside it.

While Spray on User Interfaces are still in the Prototype Stage it could be enhanced by advances in Artificial Intelligence, Compute, Display technology, Materials, Polymers, Quantum Dots, Sensors, Spray on Sensors, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

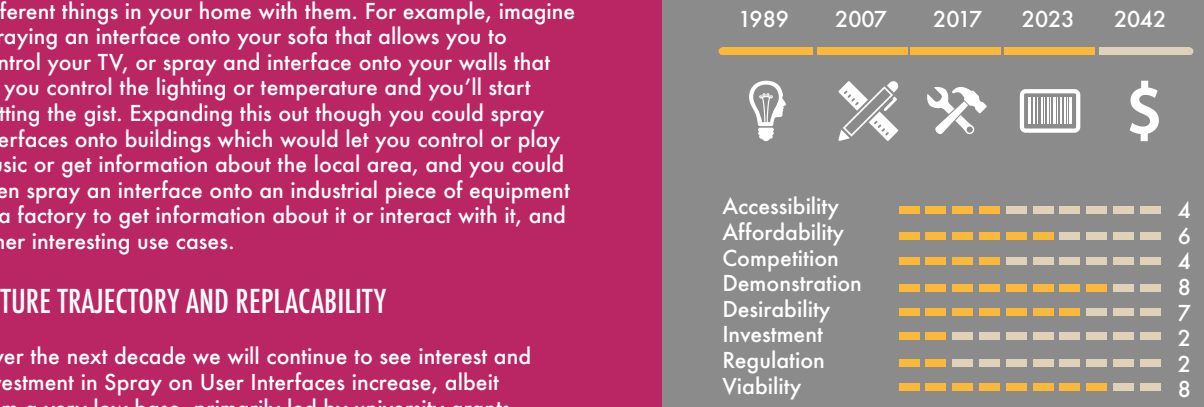
In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view.

15 SECOND SUMMARY

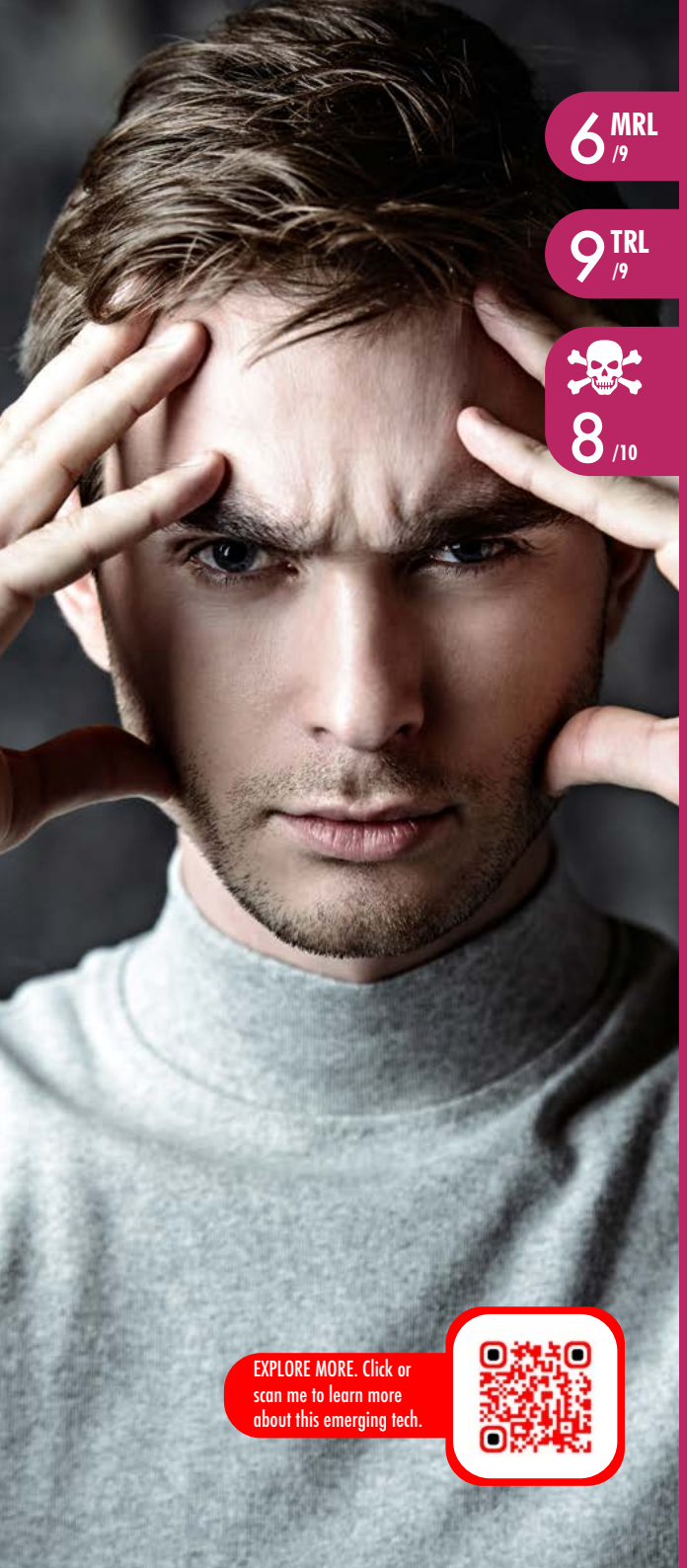
STARBURST APPEARANCES: '24

IMPACT

STATUS



PRIMARY GLOBAL DEVELOPMENT AREAS



TELEPATHY

TELEPATHY, a General Purpose Technology, which is in the early Productisation Stage, is the field of research concerned with trying to develop human Brain-to-Brain communication, as well as the ability to control and influence different things with just the power of your mind. Recently there have been a myriad of breakthroughs in the field including the development of fine grained Brain Machine Interfaces (BMI) and Neural Interfaces which have let people communicate their thoughts with others, control advanced fighter jets, navigate virtual worlds, play telepathic games, send texts, stream images of what they're thinking to TV, train robots and embue them with new skills, and even alter the shape of so called Telepathic Metamaterials. A busy space this is one to watch, but it will be a long time still before we all dump the decades old keyboard for a gadget with a BMI.

DEFINITION

Telepathy is the use of thoughts to communicate with other people and devices.

EXAMPLE USE CASES

Telepathy is a science fiction technology which is science fact. Described as one of the most efficient ways of communicating as with regular forms of communication its primary use case will be as a means to communicate with others around us, or at distance, as well as control and interact with different devices and systems for all manner of purposes. Today, however, it's primary use cases involve navigating virtual worlds, and letting ALS patients communicate with loved ones.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest in this field accelerate, predominantly led by the Defense, Healthcare, and Technology sectors. As our ability to use our minds to communicate, learn, and share information with others improves over time this technology will be as revolutionary as electricity or the wheel, and while it is accelerating fast there is still alot to be done before it is adopted en masse by people.

While Telepathy is still in the early Productisation Stage it could be enhanced by advances in AI Symbiosis, Neural Interfaces, and other technologies, however over the long term [it could be replaced by XYZ] [it's unclear what it could be superceded by].

MATTHEW'S RECOMMENDATION

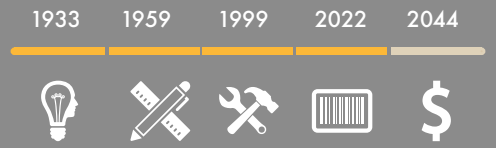
In the short to medium term I suggest companies put the technology on their radars, and re-visit it every few years until progress in the space accelerates.

15 SECOND SUMMARY

STARBURST APPEARANCES: '23, '24

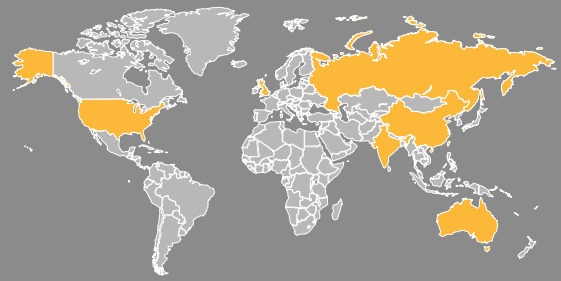
IMPACT

STATUS



Accessibility	5
Affordability	5
Competition	2
Demonstration	9
Desirability	9
Investment	4
Regulation	3
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS



9 MRL /9

9 TRL /9

7 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

UNIVERSAL TRANSLATORS

UNIVERSAL TRANSLATORS, which are in the Productisation Stage, is the field of research concerned with developing a single platform or system that can translate any language into any other language accurately and without any loss of context. Recent breakthroughs in the space include the ability to understand certain animal chatter as well as the ability to use Zero Day AI learning methodologies to translate conversatioins from one language to another without first having to go via an intermediary language, and given the current rate of development it will not be long before true universal translators emerge.

DEFINITION

Universal Translation is the automatic, real time computer based translation of one language into any other language.

EXAMPLE USE CASES

Today we are using standard language translation platforms to translate different languages but their accouracy varies and they often loose the context of the conversation or media they are translating. In the future the primary use case of the technology will be to allow anyone to communicate with anyone, or anything, in a fluid and frictionless manner.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by organisations in the Technology sector, with support from univesity grants. In time we will see emergence of true universal translators which offer consumers a fluid and frictionless translation experience, irrespective of whether they are talking an ancient or current human language, or even an animal language, and with little to no need for any form of regulatory scrutiny I expect the technology to be quickly adopted.

While Universal Translators are in the Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Digital Humans, Machine Vision, and Natural Language Processing, but at this point in time it is not clear what they will be replaced by.

MATTHEW'S RECOMMENDATION

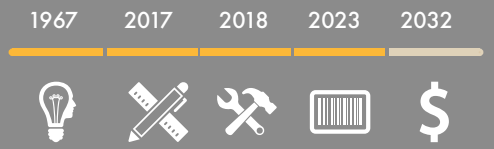
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20, '21, '22, '23, '24

IMPACT

STATUS



Accessibility	5
Affordability	7
Competition	5
Demonstration	8
Desirability	9
Investment	5
Regulation	2
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS

4 MRL /9

5 TRL /9

10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

VIRTUAL BEINGS

VIRTUAL BEINGS, which are in the early Commercialisation Stage, is the field of research concerned with trying to create artificially sentient virtual beings that to all intents and purposes are almost indistinguishable from real beings - or entities - in their actions, behaviours, mannerisms, and quirks, that have a wide range of utility. With recent breakthroughs including the development of authentic virtual beings that inhabit games and interact with players using natural behaviours and language, as well as the ever increasing number of virtual influencers, which have more in common with Avatars than this technology, there's no question that over the long term this technology will take off and become pervasive.

DEFINITION

Virtual Beings are computer generated sentient entities that can intelligently interact with Humans and other machine systems.

EXAMPLE USE CASES

Today we're seeing game developers, entertainment, and marketing companies especially trying to create authentic virtual beings that have their own "natural agency" which can autonomously interact with people, as we as other digital or virtual entities, to sell them products, entertain them, and act as in game companions. And this is just the beginning for this technology which in time will see us create living beings "at internet scale."

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade we will continue to see interest and investment in Virtual Beings increase, primarily led by organisations in the Consumer, Entertainment, Gaming, and Media sectors. With just one of the taglines for this technology being "Humans at internet scale" and with the cost and utility of Virtual Beings getting better all the time it's only a matter of time before they augment and replace many humans in online experiences, as well as in certain areas of the workforce, and dominate anything and everything with a screen.

While Virtual Beings is still in the early Commercialisation Stage it could be enhanced by advances in Affective Computing, Artificial Intelligence, Avatars, Communications, Machine Vision, UHD Rendering Engines, and other technologies, however over the long term it's unclear what it could be superseded by.

MATTHEW'S RECOMMENDATION

In the short to medium term I suggest companies put the technology on their radars, explore the field, and establish a point of view.

15 SECOND SUMMARY

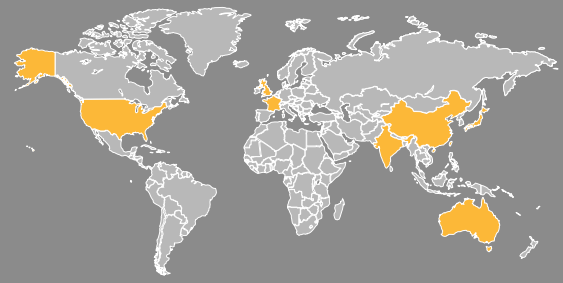
STARBURST APPEARANCES: '24

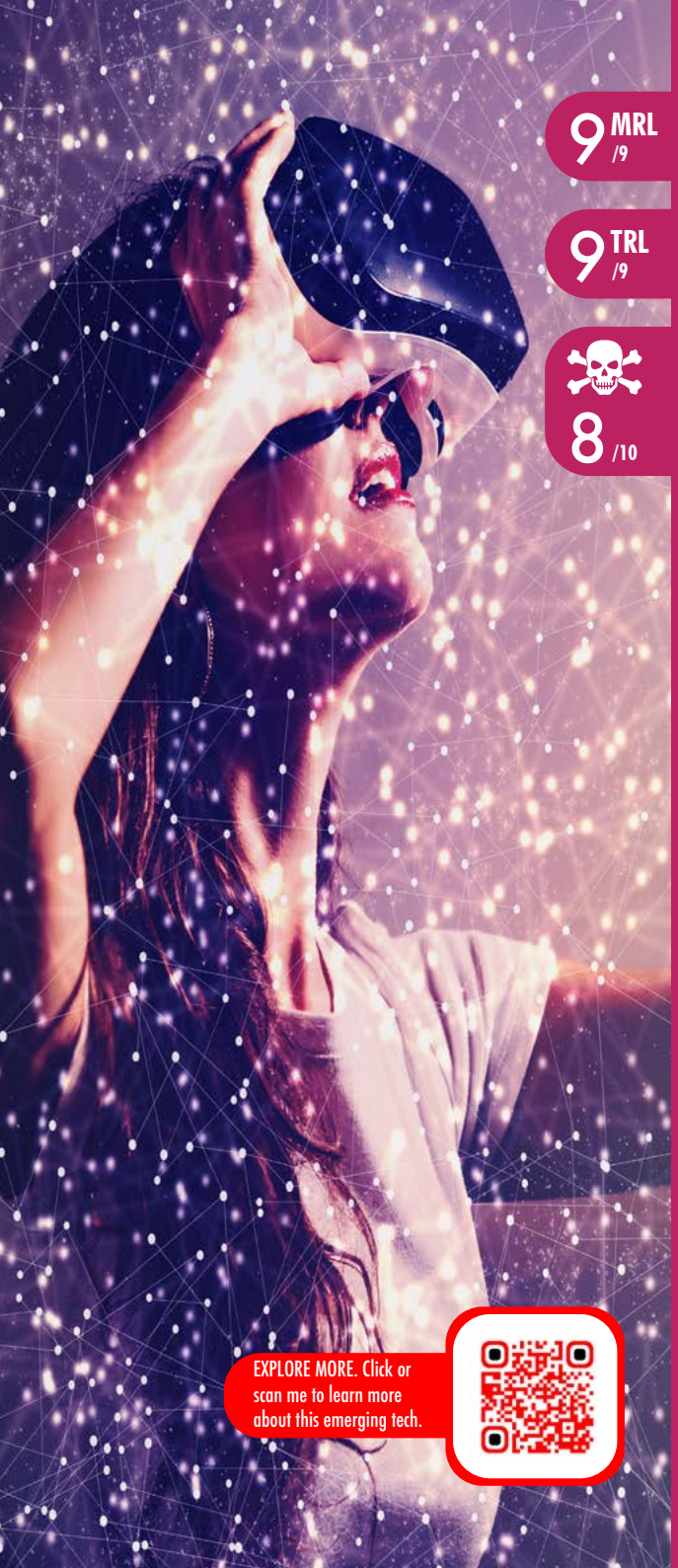
IMPACT

STATUS

Accessibility	4
Affordability	6
Competition	3
Demonstration	7
Desirability	8
Investment	5
Regulation	5
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS





9 MRL /9

9 TRL /9

8 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

VIRTUAL REALITY

VIRTUAL REALITY, which is in the Productisation Stage, is the field of research concerned with developing the hardware, software, platforms and tools necessary to support Virtual Reality (VR) creations and environments. Recent breakthroughs in the field include the development of wireless All in One (AiO) VR headsets that don't have to be tethered to computers, and the discovery of new ways to combat the feeling of sickness that many users experience, as well as the use of Artificial Intelligence and Simulation Engines to create and design new virtual environments and worlds, whether they're generated from real data or simulated data, in near real time.

DEFINITION

Virtual Reality is a computer generated simulation of a 3D image or environment that users and other digital entities can interact with.

EXAMPLE USE CASES

Today the technology is being used in a myriad of ways, including within education and training, in schools and corporate environments, in the maintenance of complex industrial assets, and in the entertainment and gaming sectors. In the future the primary applications of the technology will include any situation where being immersed in a virtual environment, or being virtually transported to a real place, whether it is for business, pleasure or training purposes, is valuable.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow at an accelerating rate, primarily led by organisations in the Aerospace, Defence, Consumer Electronics, Retail, and Technology sectors. In time we will see the technology mature, but even though content will be easier to create, the biggest issue, that of wearing bulky, unsociable headsets will still need to be overcome, but there are a number of complimentary technologies that will help us accomplish that.

While Virtual Reality is in the Productisation Stage, over the long term it will be enhanced by advances in 5G, 6G, Artificial Intelligence, Creative Machines, Display Technology, Hapatics, High Definition Rendering Engines, Metalenses, Nano-Materials, Sensor Technology, and Simulation Engines, but in time it will be replaced by Neural Interfaces.

MATTHEW'S RECOMMENDATION

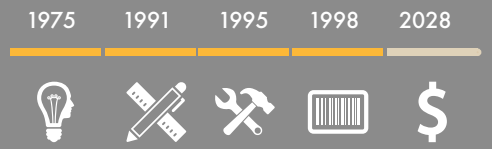
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '17, '18, '19, '20, '21, '22, '23, '24

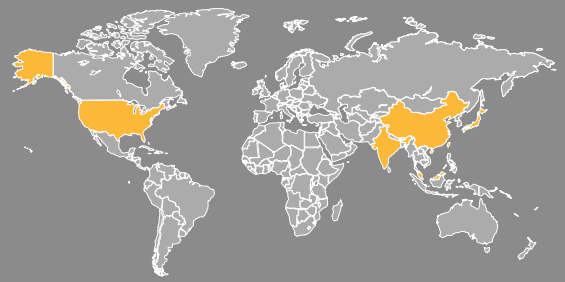
IMPACT

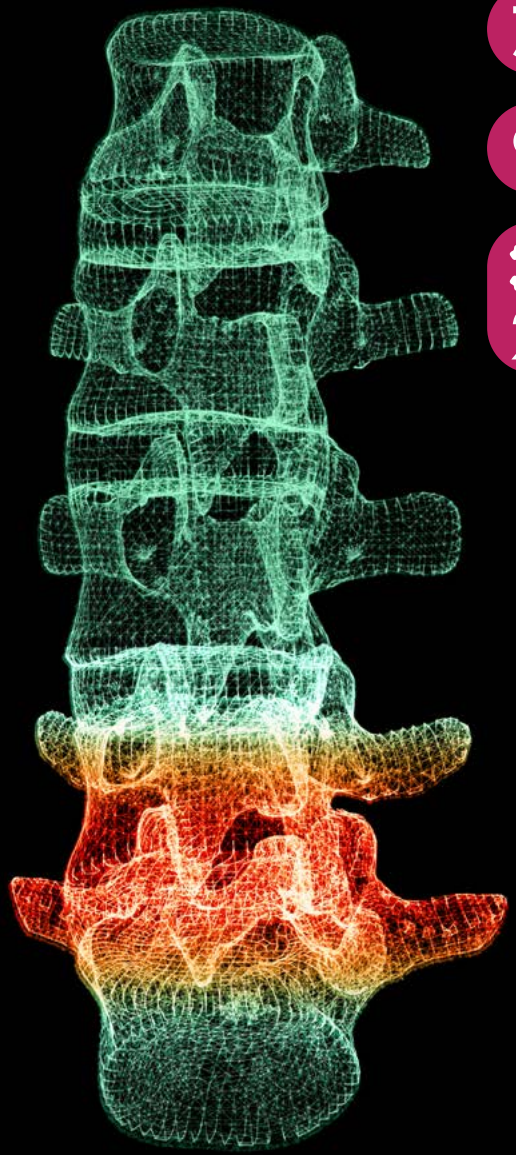
STATUS



Accessibility	9
Affordability	7
Competition	4
Demonstration	9
Desirability	8
Investment	7
Regulation	5
Viability	9

PRIMARY GLOBAL DEVELOPMENT AREAS





7 MRL /9

9 TRL /9

2 /10

EXPLORE MORE. Click or scan me to learn more about this emerging tech.

VOLUMETRIC DISPLAYS

VOLUMETRIC DISPLAYS, which are in the Productisation Stage, is the field of research concerned with developing displays that are capable of displaying and projecting genuine 3D images that users can interact with. Recent breakthroughs in the field include the development of technologies like the Looking Glass as well as increasingly detailed volumetric displays that are able to project genuine 3D images into a space using everything from bubbles to lasers.

DEFINITION

Volumetric Displays are graphic display devices that form a visual representation of an object in three physical dimensions.

EXAMPLE USE CASES

Today we are using Volumetric Displays as rudimentary teaching aids. In the future the primary use case of the technology will be as a form of education and entertainment and they will increasingly be used to augment more traditional display systems as well as more advanced display systems such as Holodecks and holographic systems.

FUTURE TRAJECTORY AND REPLACABILITY

Over the next decade interest in the field will continue to accelerate, and interest and investment will continue to grow, primarily led by organisations in the Consumer Electronics sector, with support from univesity grants. In time we will see the technology mature to the point where the resolution, responsivness, and size of these systems will be good enough for consumer consumption, however these systems may very well have an unexpectedly short shelf life as other technologies with better utility come through.

While Volumetric Displays are in the Productisation Stage, over the long term they will be enhanced by advances in Artificial Intelligence, Displays, Holodecks, Holograms, Laser Technology, and Sensors, and in time they will be replaced by Augmented Reality, Brain Machine Interfaces, Holodecks, Holograms and Virtual Reality.

MATTHEW'S RECOMMENDATION

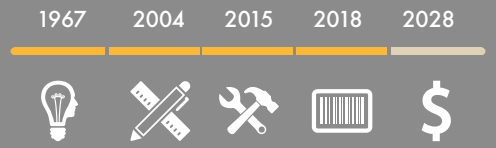
In the short to medium term I suggest companies put the technology on their radars, explore the field, establish a point of view, experiment with it, and forecast out the potential implications of the technology.

15 SECOND SUMMARY

STARBURST APPEARANCES: '20

IMPACT

STATUS



Accessibility	3
Affordability	4
Competition	7
Demonstration	7
Desirability	6
Investment	5
Regulation	2
Viability	8

PRIMARY GLOBAL DEVELOPMENT AREAS

CONCLUSION

PEOPLE SAY change is a constant, but in today's technology fuelled world this simple phrase is a deceiving, and often comforting, misnomer because change isn't constant, it's exponential, and the only boundaries to what we can achieve as individuals and as a global society are the ones that we invent for ourselves.

As researchers and scientists increasingly prove that nothing is impossible, that yesterdays science fiction is simply the future generations status quo, and as we all continue to bear witness to an increasingly rapid rate of change that's affecting and transforming every corner of global culture, industry, and society the future belongs to all of us equally, and we should never loose sight of that.

As you race into your own future I wish you well, and never forget you have all the friends and support you need around you as we all voyage through time and space together on this fragile living spacecraft we call Earth.

Explore More

MATTHEW GRIFFIN
Founder and Futurist in Chief

Notes:

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