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ABOUT THE AUTHOR



Matthew Griffin, an award winning futurist and author of Codex of the Future is described as “The Adviser behind the Advisers” and a “Young Kurzweil.” Matthew is the founder and CEO of the World Futures Forum and the 311 Institute, a global Futures and Deep Futures consultancy working between the dates of 2020 to 2070.

Regularly featured in the global media, including AP, BBC, CNBC, Discovery, RT, and Viacom, Matthew’s ability to identify, track, and explain the impacts of hundreds of revolutionary emerging technologies on global culture, industry, and society, is unparalleled.

Recognised for the past six years as one of the world’s foremost futurists, innovation and strategy experts Matthew is an international speaker who helps governments, investors, multi-nationals and regulators around the world envision, build and lead an inclusive, sustainable future.

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Recognised in 2013, 2015 and 2016 as one of Europe's foremost futurists, innovation and strategy experts Matthew is an award winning author, entrepreneur and international speaker who is regularly featured on the BBC, Discovery, Kurzweil, Newsweek, TechCrunch and VentureBeat.

Working hand in hand with accelerators, investors, governments, multi-nationals and regulators around the world Matthew shines a light on the future and helps them transform their industries, organisations, products and services by demonstrating how the combination of democratised, and increasingly powerful emerging technologies, are helping fuel cultural, industrial and societal change that is transforming old industries and creating new ones.

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PREFACE

“Matthew was a fantastic speaker at the ABI’s recent Biennial Conference on how insurance and long term savings markets were changing because of the digital revolution. He was clear, passionate and very successful in condensing a significant amount of knowledge and experience into an accessible series of contributions. His ratings from delegates was outstanding.”

Huw Evans
Director General, Association of British Insurers

THE INSURANCE industry, it can be argued, is unique because, unlike other industries its services help support and protect every conceivable activity and every industry - both on and off world.

Consequently, when we discuss the future of insurance what we are also discussing, indirectly, is the future of global culture, industry and society, and their downstream impacts on insurers and the insurance marketplace.

The tight knit relationships between insurers and the sectors they support means that shock waves that take place elsewhere in the global system inevitably ripple back here, to the spiritual heart of the financial services industry. And as every industry, without exception, continues to experience the increased pace of technology fuelled change and disruption inevitably in time every insurer will have to re-balance their organisation and operations and come to terms with its impact.

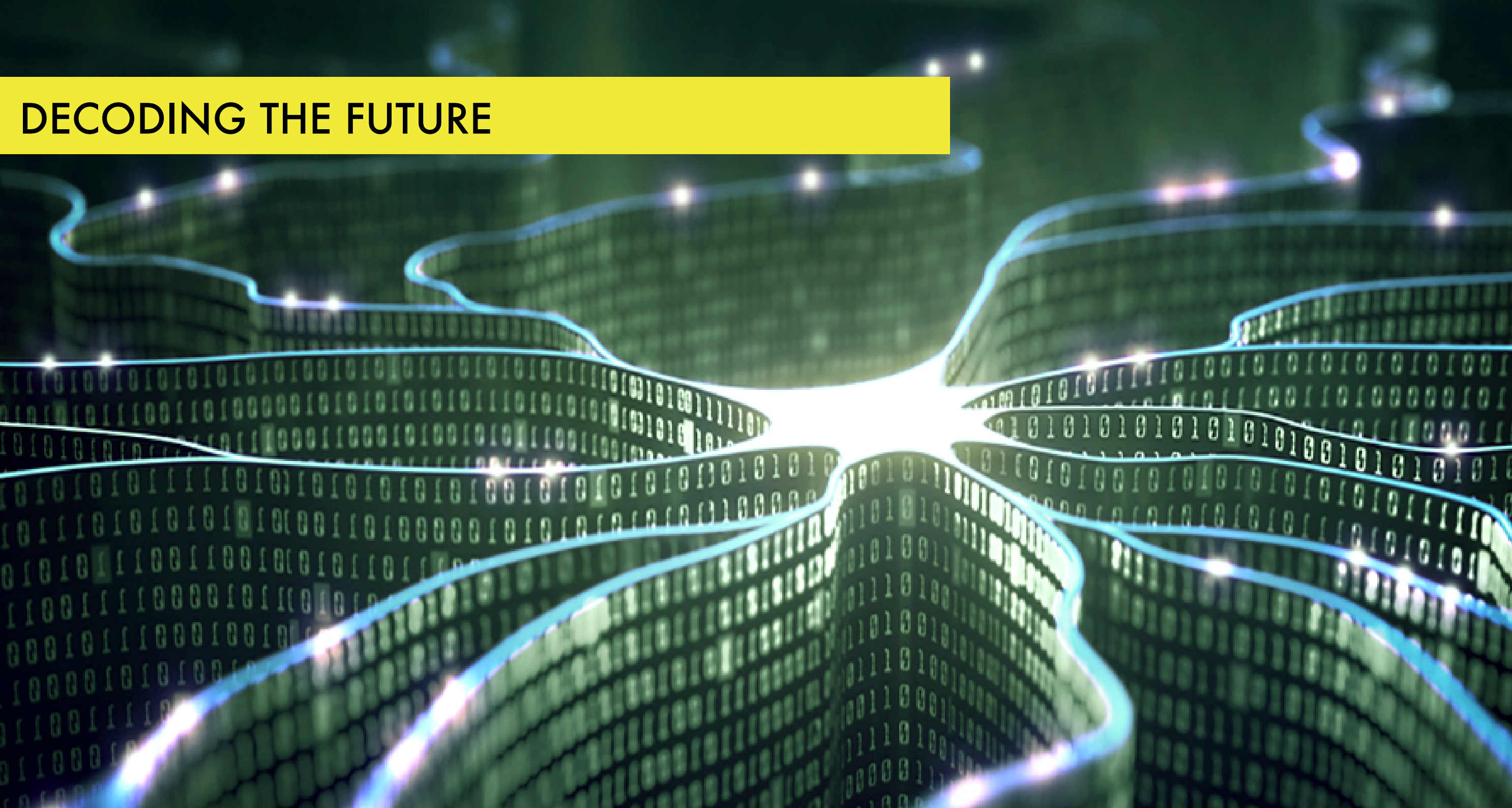
As we approach the next decade shock waves, and therefore heightened risks, are all around us so it is easy to argue that there has never been a greater time to be an insurer.

In this, my inaugural “Future of Insurance

&Beyond” report I’m going to provide you with net new perspectives that will help you identify new market opportunities, help you improve your competitive differentiation and help you create and capture new value.

However, what I can share here is only a small percentage of the whole picture, so to find out more about the strategic choices open to your company, talk to me.

Or Google it. Google’s also good.



DECODING THE FUTURE

WITH ACCESS to the right breadth and depth of insights, or dots, as I call them, putting the big picture together and predicting what the future will look like, and when it's going to arrive, isn't as hard as many people think. After all, as they say, the future is often hidden in plain sight, and sometimes it's just a simple matter of expanding your horizons and knowing where to look, and that's where I, as you'll see from this report, come in.

In order to predict the future as accurately as is practically possible, such as predicting when and where the first flying taxi service will take to the skies - the answer by the way is in Dubai this summer - I do my best to work with what I call full network insights. That is to say I work with the inventors, academia, accelerators, investors, governments, multi-nationals and regulators who are responsible for discovering, combining, building, testing, adopting, deploying, scaling and regulating new technologies, products and services.

It's this rich tapestry of contacts, across geographies and industries, combined with a deep understanding of over a hundred and eighty emerging technologies and their impact on culture, industry and society that allows me to piece together the jigsaw that is the

future with a high degree of accuracy.

While technology is, needless to say, one of the more important pieces of the jigsaw puzzle, to view it in isolation is a mistake, because if the new products and services it's used to create aren't culturally acceptable, or if they're pushed into the market in the wrong way at the wrong price or the wrong time, or if the regulators put their foot down and block them then they go nowhere. And then they never change the world, and never affect your business or its operations.

Some emerging technologies compliment each other, others don't. Some have the power to change everything, others don't. But that's alright, not everything has to change the world. But when technologies finally make it out of the labs it's then down to you and I, and increasingly our creative, Artificial Intelligence (AI) comrades, to connect the right dots and combine them together to create tomorrows must have products and services.

However, with so many dots, literally millions, which can be combined in billions of different ways, trying to pick the winners, and see through the noise can be a challenge, and I find that one of the fastest ways around this problem is to divide everything into one of two types of

Notes:

trends - Hard and Fuzzy.

Hard Trends are just that, trends that we know will happen but assessing when they'll first appear, and maybe more crucially, when their tipping points will take place, requires us to identify and assess a variety of factors that include, but are not limited to, accessibility, affordability, cultural and generational bias, investment patterns, technology maturities, and the regulatory, macro-economic and socio-political environment.

Assess all of these factors successfully and building your organisations new products, services, strategy and vision becomes a much simpler task. After all, if you could accurately forecast the future, including where, when and how it will land, why wouldn't that be an asset to your organisation?

Autonomous vehicles, for example, from cars, drones and semi-trucks to aircraft, cargo ships and passenger drones are a prime example of a hard trend - an ascending trend that began gaining traction, investment and regulatory interest in earnest in 2010, just seven years ago. We know for a fact that these new platforms will become the de-facto transportation standard of the future, and consequently we can model their implications, on culture, industry and

society, with a high degree of accuracy.

For those of you who think I've gone for the easy option here I'll flip some more hard trends into your hat - the ascendancy of fully autonomous organisations, extreme life extension services and space internet platforms, and many more. But we'll come to those later.

Fuzzy trends in the meantime are trends that might happen - a future maybe. These trends can include, among other things, the likelihood of new regulations, or the uncertain, or unequal, impact that AI will have on society and the jobs market - and therefore on earnings, asset ownership and, ultimately, insurance.

It's an irrefutable fact that technology is accelerating the world's pace of change but sometimes for all the forecasting we do there will be sceptics who choose inaction over action, and sit on the fence.

While there will always be margins of error, and room for debate, there are far too many corporate and government examples of where stubborn inaction has been damaging, or fatal. After all, no one sets out to be the next Blackberry, Blockbuster, Kodak or Nokia, but now that the pace of change is accelerating organisations will find that increasingly

Notes:

biding their time is a luxury many can ill afford.

Whichever side of the fence you sit on though, what we should all be able to agree on is that change is inevitable, and that the organisations that are the most adaptable are often the companies that are the most prosperous.

Preparing your organisation for the future doesn't need to be as complicated as many people make out though and there are often simple steps you can take to prepare yourself for the time when tomorrow comes. Because it always comes - the evidence of that is all around you.

New, ascending cultural shifts, customer buying behaviours, emerging markets and technology paradigms will all help to re-shape the insurance sector over the coming years and the insurers who can anticipate and adapt to the changes will be, arguably, masters of their own future, and fast followers will need to be agile and aware enough to recognise the leaders and adopt similar strategies.

The long term survivors will be the insurers who can capture the most value and who are adaptable and politically strong enough never settle for the status quo, or sit on the fence.



GRIFFIN EMERGING TECHNOLOGY RADAR

EVERY CULTURE, every industry, and every corner of society is being re-shaped and transformed by the relentless pace of change made possible by giant advances in technology, and in many cases these new emerging technologies are circling above us, like the stars in the night sky, just waiting to be brought to ground where their impact will be total, and irreversible.

Today, all of the changes we are seeing are being fuelled by the ascent of a staggering 170 emerging technologies, any one of which has the capacity to change the future, across 11 categories, but when they're combined, to create tomorrow's next generation products and services many of them will have the capability to upend culture, industry and society and shake them to the core.

Today, the majority of organisations forecast and innovate along industry lines, and as a result it is often easy to miss the signs of disruption emanating from other industries which in many cases, as the borders between industries break down, are now just a virtual hop and a skip away.

The Griffin Emerging Technology Radar, found on the next page, is my response, and my effort to shine a light on the variety, volume and voracity of change

we are all about to experience.

Remember - today is the slowest rate of change we will ever experience, and it will only accelerate from here.



2 Estimated Maturation Date

ADVANCED MANUFACTURING

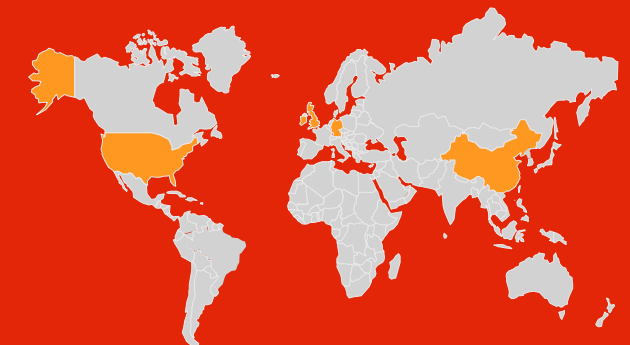
EVERYTHING IN the universe, in one way or another, is manufactured. Atoms born from ancient stars combine into molecules and compounds which are in turn combined to create organic and non-organic artefacts which are then similarly combined themselves to create today's, and tomorrow's life forms and products. As a consequence, once we are able to understand how something is made - something that we're getting much better at with every passing day - whether that's a Human cell or a next generation drug or compound the next challenge we have is to fabricate them, and to do that we need the right manufacturing tool, and fortunately for us our arsenal has never been fuller.

Today this 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 increase in the amount of research and investment in Molecular Assemblers and Printed Electronics, both of which will have a significant impact on the marketplace in time.

In this category there are eight significant emerging technologies:

1. 3D Printing
2. 4D Printing
3. Bio-Manufacturing
4. Bio-Printing
5. Bio-Reactors
6. Molecular Assemblers
7. Nanomanufacturing
8. Rapid Liquid Printing

Primary global development areas:



BIOTECH

ONE OF the most active fields by far it is fair to say that the number of significant emerging technologies that are being developed and, in some cases commercialised and deployed, in the biotech sector is truly staggering - and it's all good news for those of you who want to live longer, healthier lives.

The nature of the category, however, means that many of these new advancements are subject to intense regulatory scrutiny, and as a result many of them, even though they are already demonstrating significant results, such as the ability to reverse blindness, paralysis and even eradicate HIV, means it will take them years, and in some cases decades, to reach the market. That said though it can now easily be argued, and demonstrated, that humanity is entering a new era of medicine and biological regeneration where death is no longer an inevitable outcome.

Today this category is being driven, primarily, by advances in no less than seven significant and ascending technology fields, namely Artificial Body Parts, which are increasingly being bio-printed on demand, advances in Bioelectronic Medicine, new powerful Gene Editing tools such as CRISPR-Cas9 and it's less well known, but equally important -Cas3 cousin, new Labs on Chips products, Nano Medicine, Personalised Medicine, Regenerative Medicine, and advances in Stem Cell Therapies.

In this category there are twenty five significant emerging technologies:

- 1. Anti Ageing Drugs
- 2. Artificial Body Parts
- 3. Bioelectronic Medecine
- 4. Biomechanical Systems
- 5. Bionic Implants
- 6. Chimeras
- 7. Cryonics
- 8. Epigenetics
- 9. Gene Editing
- 10. Gene Therapy
- 11. Hi Resolution FMRI
- 12. Labs on Chips
- 13. Microbiome Medicine
- 14. Nano Medicine
- 15. Neurop prosthetics
- 16. Optogenetics
- 17. Personal Genetic Sequencing
- 18. Personalised Medicine
- 19. Regenerative Medicine
- 20. Smart Drugs
- 21. Smart Pills

- 22. Sonogenetics
- 23. Stem Cell Therapies
- 24. Synthetic Genes
- 25. Tissue Engineering

Primary global development areas:



CONNECTIVITY

IT IS no secret that we are headed towards a future where everything, whether we are talking about Cell to Cell (C2C), Human to Human (H2H), Human to Machine (H2M), and Machine to Machine (M2M) systems, will invariably be increasingly inter and hyper connected with each other. The significance, of these changes should not be underestimated, and their impact will be two fold.

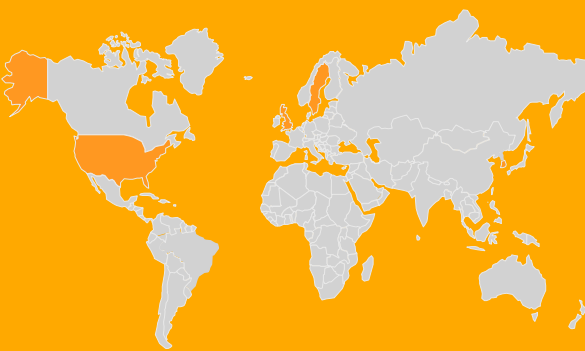
Firstly, we continue to see companies make great strides in helping to connect the last 3.5 Billion people on the planet using a combination of High Altitude Stratospheric Platforms (HASP), and low Earth orbit satellite systems, many of which will be in place and fully operational by 2025, and secondly, this increasing level of inter-connectedness, when combined with Artificial Intelligence (AI), and new cloud consumption models, will drive a revolution that sees humanity, and machines alike, become increasingly capable at tapping into an increasingly mature and accessible planet wide Hive Mind.

Today this category is being driven, primarily, by advances in five significant and ascending technology fields, namely 5G, which will fuel a new global digital services revolution, High Altitude Platforms, like those being deployed by Google, Facebook and SpaceX which will connect the last 3.5Billion people, Molecular Networks that are complementing new Biotech and Nano Medecine technologies, Nano Satellites, and Terabit networks, whose development in turn is being fueled by developments in new optical systems.

In this category there are fifteen significant emerging technologies:

- 1. 5G
- 2. Airbourne Networks
- 3. Cognitive Radio
- 4. High Altitude Platforms
- 5. Interplanetary Internet
- 6. LiFi
- 7. Mesh Networks
- 8. Molecular Networks
- 9. Multefire
- 10. Nano Satellites
- 11. No Power WiFi
- 12. Self Healing Networks
- 13. Small Cell Networks
- 14. Terabit Networks
- 15. WiGig
- 16. Wireless Personal Area Networks

Primary global development areas:



ENERGY

EVERYTHING NEEDS energy in order to fulfil its function - whether it's an aircraft carrier, a cell, an electric vehicle, a national energy grid or a rocket, but the amount of energy something needs, the form factor it can accommodate and the variability in power quality that those systems can stomach varies wildly.

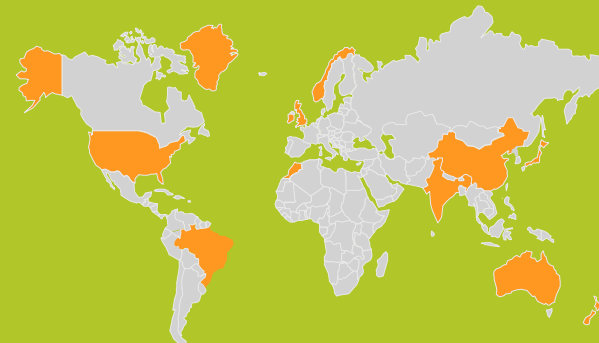
At one end of the spectrum we have nanobots traversing the human body that are being powered by molecule sized enzyme engines, while at the other end we have APJ and EMEA consortiums actively working together to develop new Grid Scale Storage technologies and Global Energy Super Grids that will let countries, irrespective of their place in the world, harness Geothermal energy from Iceland, Solar power from Africa, China and India, and Wind power from the UK and USA. And then, of course, in the past year we have made significant advances in harnessing Fusion energy.

Today this category is being driven, primarily, by advances in six significant and ascending technology fields, namely Artificial Photosynthesis, Biofuels, Film Based Batteries, Fuel Cells, new Molecular Energy Systems and Photovoltaics.

In this category there are twenty three significant emerging technologies:

1. 5D Electronic Blood
2. Artificial Photosynthesis
3. Biofuels
4. Biomechanical Harvesting
5. Conductive Energy Systems
6. Electromagnetic Drives
7. Film Based Batteries
8. Fuel Cells
9. Fusion
10. Liquid Metals
11. Lithium Air Batteries
12. Microwave Engines
13. Molecular Energy Systems
14. Nanogenerators
15. Nanowire Batteries
16. Photovoltaics
17. Piezoelectric Power Generators
18. Plasma Engines
19. Quantum Wires
20. Thermoelectric Drives
21. Thorium Reactors
22. Travelling Wave Reactors
23. Wireless Energy

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 2021.

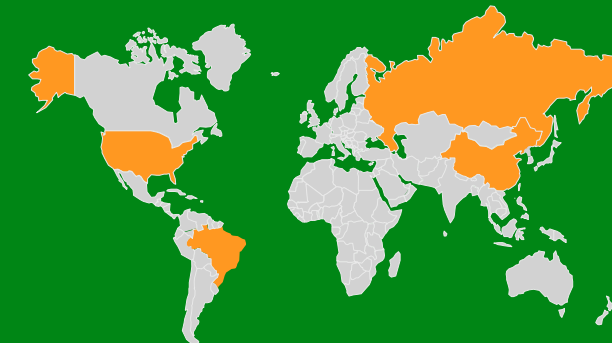
Once seen as a way to bring rain to drought stricken areas geoengineering is now being seen by many in the global scientific community as our "Plan B" if our "Plan A" to tackle climate change fails, and today countries around the world, such as China, are investing hundreds of millions of dollars to 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.

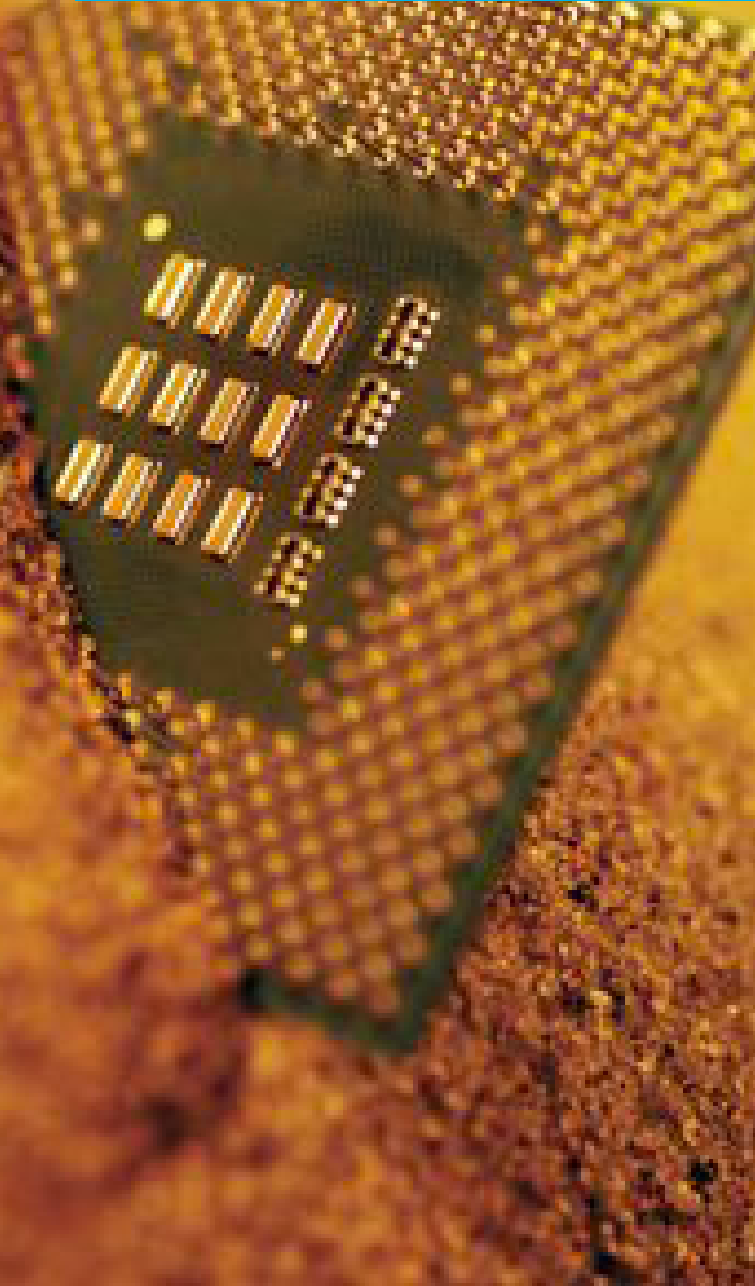
In this category there are four significant emerging technologies:

1. Archologies
2. Carbon Sequestration
3. Climate Engineering
4. Terraforming

Primary global development areas:



MACHINE SYSTEMS



MACHINE SYSTEMS is arguably today's most powerful technology category, and its power has been significantly multiplied by the emergence and adoption of new cloud computing services and the network effect. As new technologies, such as Artificial Intelligence (AI), Blockchain and Quantum Computers are amped up at the center of the cloud everyone with an internet connection and a modicum of skill has access to technologies that even a decade ago were beyond even the most optimistic individuals wildest dreams. And we are just at the beginning.

Indeed, not a day goes by now when there isn't news of a significant breakthrough or development, whether that's news of AI's building new AI's, AI's that can code and design their own programs, and create their own secret languages, or new advances that put human skills and capabilities in the shade, such as their ability to learn new skills without being specifically trained, as well as their ability to understand and translate natural language conversations into over a hundred alternative languages at better than human levels of accuracy, and outperform the world's best doctors and investors, create, operate and scale fully autonomous multi-national organisations, and much more.

Suffice to say, the advances in this sector are too numerous for these scant pages, and by the time I'd written a book covering them it'd be out of date.

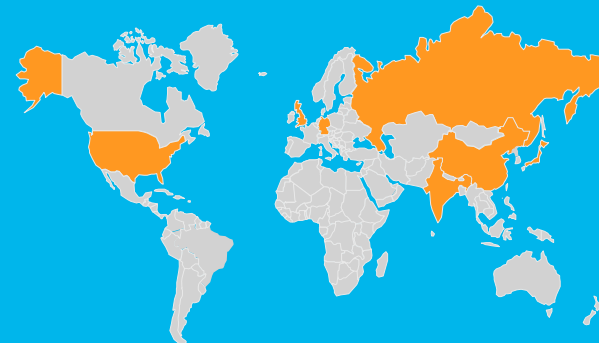
Today this category is being driven, primarily, by advances in ten significant and ascending technology fields, namely Artificial Intelligence, specifically in the areas of Cognitive Computing, Deep Learning, Machine Learning and Machine Vision, Blockchain, which is starting to slowly find its way into production systems, Fog Computing, Micromotes, Quantum Computing and Swarm Intelligence.

In this category there are eighteen significant emerging technologies:

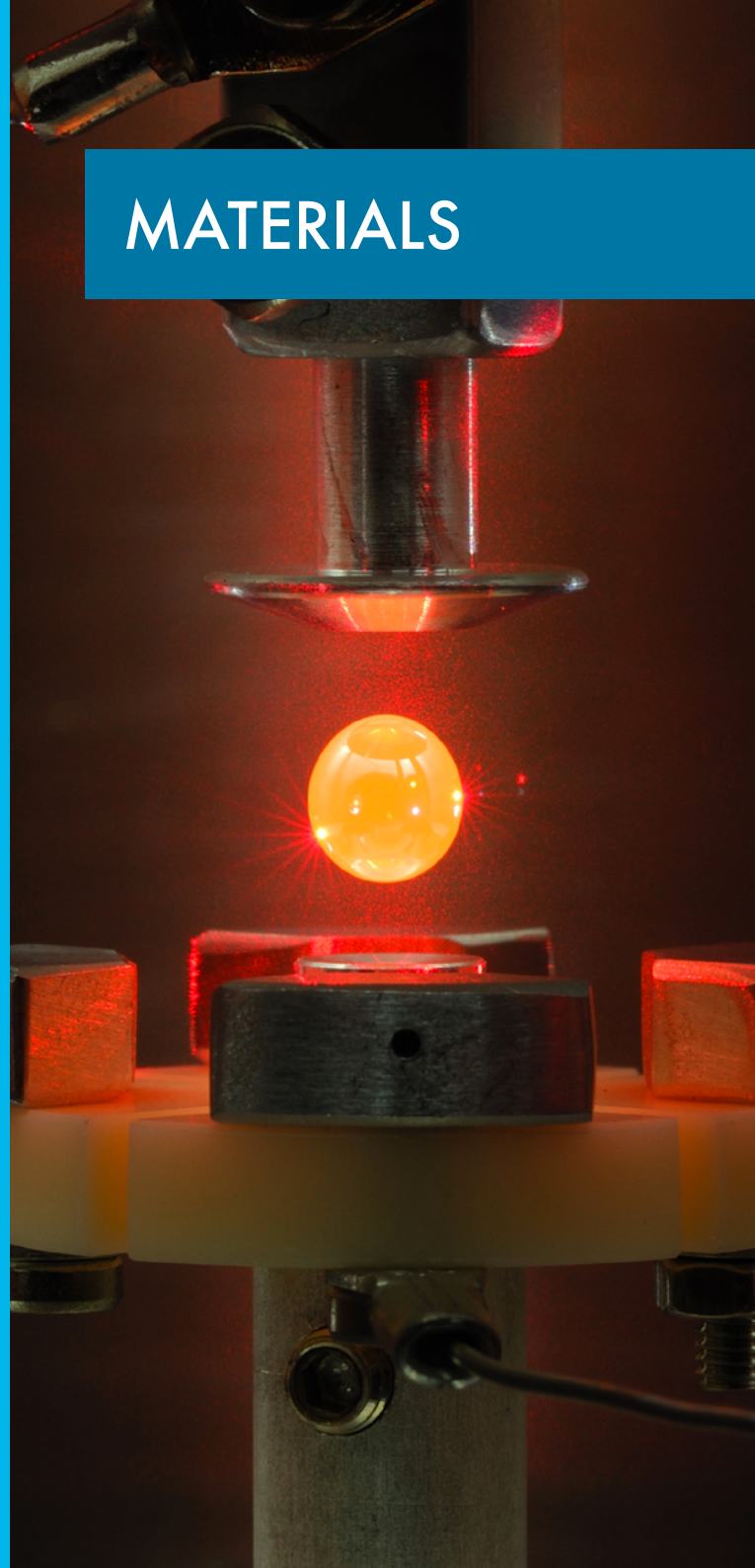
1. 3D Chips
2. Artificial Intelligence
3. Blockchain
4. Chemical Computing
5. Cognitive Computing
6. Deep Learning
7. DNA Computing Systems
8. Fog Computing
9. Machine Learning
10. Machine Vision
11. Memresistor
12. Micromotes
13. Neuromorphic Chips

14. Optical Computing
15. Quantum Computing
16. Reconfigurable Electronics
17. Sentient Software
18. Swarm Intelligence

Primary global development areas:



MATERIALS



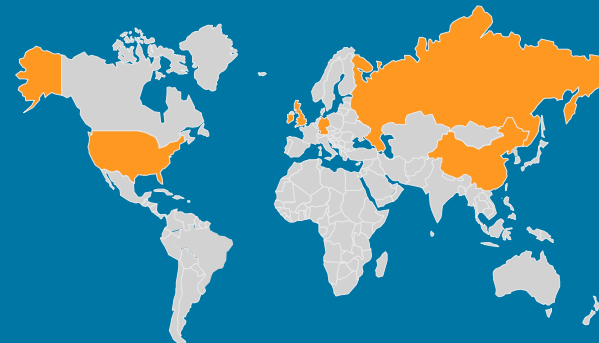
THE GLOBAL materials marketplace has undergone a renaissance in the past five years and as a result I'm seeing a significant increase in investment and activity in the category, spurred on by breakthroughs in new advanced manufacturing techniques such as 3D Printing, Biomanufacturing and Nanomanufacturing, and advances in the Biotech space that include, but are not limited to, Gene Editing and Synthetic Biology.

Today this category is being driven, primarily, by advances in twelve significant and ascending technology fields, namely Bio-Materials where new manufacturing and gene editing techniques are helping researchers turn mother nature into fabrication factories that produce new categories of compounds, drugs and materials, Graphene where new processes are increased the speed and lowering the cost of manufacture, Meta Materials, Nano Materials, Nano-Ceramics, Nanotubes, Programmable Matter, Self Healing Materials, Semiconductors, Super Alloys, Superconductors and Synthetic Materials that at one end of the scale could help solve world famine and at the other could create living buildings.

In this category there are twenty four significant emerging technologies:

1. Aerogels
2. Bio-Materials
3. Graphene
4. Liquid Armour
5. Liquid Metals
6. Living Metals
7. Mega Magnets
8. Meta Materials
9. Nano Materials
10. Nano-Ceramics
11. Nanotubes
12. Nanophotonic Materials
13. Programmable Matter
14. Reactive Materials
15. Self Healing Materials
16. Semiconductors
17. Smart Materials
18. Spray on Materials
19. Stretchable Electronics
20. Super Alloys
21. Superconductors
22. Synthetic Materials
23. Thermo Bimetals
24. Thermoelectric Materials

Primary global development areas:



ROBOTICS

WHEN WE discuss robotics people often have the misconception that we are simply discussing robots - the kind of automatons that first appeared over half a century ago, but today the category is much broader, and includes both hardware and software robo variants, of all shapes and sizes, as well as drones and soft bodies, bio-hybrid robo systems, and when these fields are all combined, and brought to the surface, it is easy to see that we are already living in the “Robo” age.

To the casual observer it might look as though there have been few advances in the category over the past decade, let alone the past year, and on the surface, especially when we look at hardware variants, it could be argued that they’re right. But despite the fact that many robots still have a clumsy, and somewhat twentieth century feel to them the biggest breakthroughs have happened beneath the surface where researchers have been busy creating and re-engineering robots sensing and control systems, infusing them with Artificial Intelligence (AI), educating them via Hive Minds, and powering them using the cloud.

The robotics space can be broadly cut into two marketplaces - the enterprise marketplace, where industrial grade hardware Drones and Robots rule, and the consumer marketplace where Bots, Drones and lower grade Robots are increasingly finding footholds.

In the past industrial robots were difficult to program, and then it was even more difficult and costly to re-program them to perform new tasks but today human operators can teach them new skills telepathically via Brain Machine Interface systems, and new Codeless Computing systems, combined with the benefits of a collective robot Hive Mind mean that we re-train and re-program hundreds of thousands of robots almost instantly. And the same rules can be applied to robots in the consumer space too.

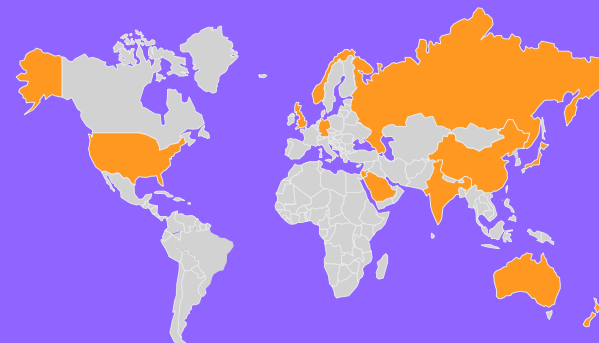
Today this category is being driven, primarily, by advances in six significant and ascending technology fields, namely Bio-Bots, Bots, Co-Bots, Drones, Hardware Robots and Swarm Robotics.

In this category there are ten significant emerging technologies:

1. Bio-Bots
2. Bots
3. Co-Bots
4. Drones
5. Exo-Systems
6. Hardware Robots

7. Nano-Bots
8. Soft Robots
9. Swarm Robotics
10. Utility Fog

Primary global development areas:



SECURITY

THE SECURITY technology marketplace is one of the fastest paced, this is being driven by the increasing digitisation of the world’s organisations and services, and the continued emergence of hyper-connected systems and devices.

While there have been significant advances in specific security technologies over the past few years the most significant impact on the sector is the emergence, and now the rise of Artificial Intelligent (AI) defensive and offensive cyber security systems, also known as “Robo-hackers,” which first debuted in earnest in 2016 at DARPA’s Capture the Flag Competition in Las Vegas, and as a consequence, ironically, it is this that, over the long term, that I expect to have the most significant impact on the sector.

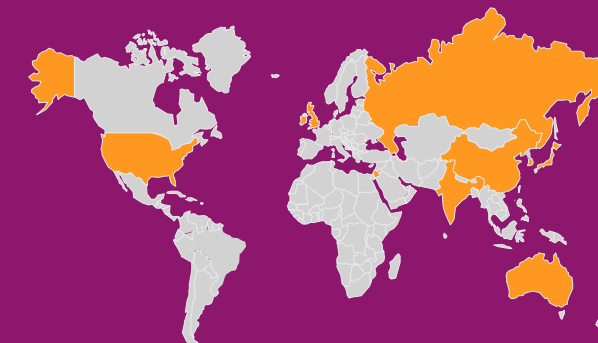
However, not to be left out in the cold the emergence of new ultra powerful Quantum Computing platforms, which in some cases have already shown themselves to be at least a hundred million times more powerful than equivalent logic based computing systems, will also have a dramatic effect on the sector with many experts predicting that at least seventy percent of all of today’s common encryption systems could be cracked - and not within decades, or years, but within minutes.

Today, outside of the above fields, this category is being driven, primarily, by advances in five significant and ascending technology fields, namely Artificial Immune Systems, Behaviour Based Security, Biometric Security, Hackproof Code, High Assurance Platforms, Quantum Cryptography and Post Quantum Cryptography, and Self Patching Network Defence Systems.

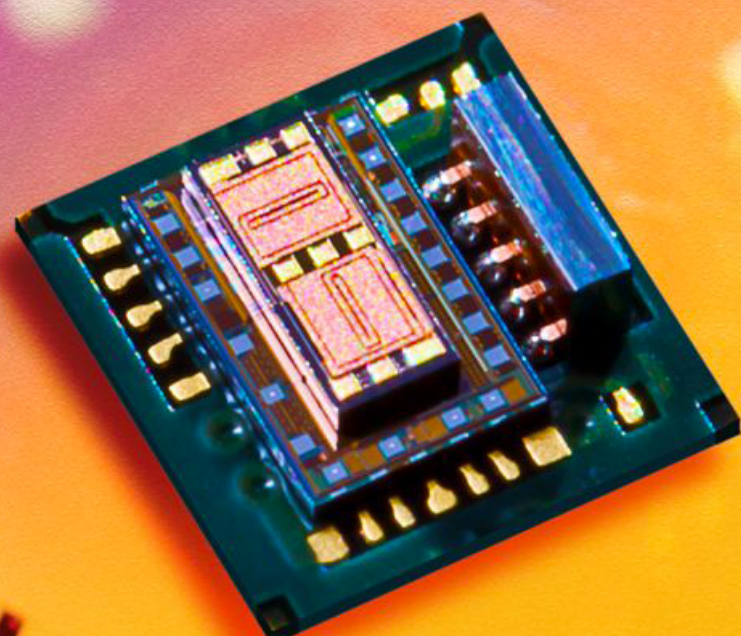
In this category there are eight significant emerging technologies:

1. Artificial Immune Systems
2. Behaviour Based Security
3. Biometric Security
4. Hackproof Code
5. High Assurance Platforms
6. Homorphic Encryption
7. Identity Based Security
8. Micro Movements
9. Post Quantum Cryptography
10. Quantum Cryptography
11. Self Patching Defence Systems
12. Visual Fingerprinting

Primary global development areas:



SENSORS



THE GLOBAL sensor technology marketplace is more dynamic now than at any point in its history, and this is driven by an increasingly insatiable global appetite for sensors, and sensing products and devices. While this increased demand has inevitably been good for companies in the sector the downside is that new innovations are commoditised incredibly quickly, often within months of general release, which in turn affects the amount of money that can be re-invested, and the category's rate of innovation.

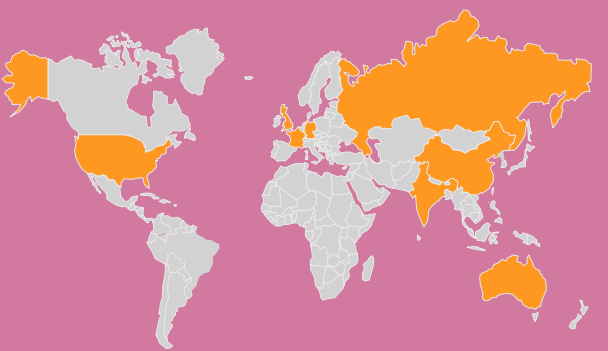
To some degree it goes without saying that demand for new sensors is being driven by the increased, and almost insatiable, demand for new, connected and smart consumer and enterprise products and devices, and the rise of biometric security systems. Meanwhile on the supply side new advanced manufacturing techniques, such as Nanomanufacturing and Screen Printing are helping manufacturers significantly ramp up production volumes, increase product complexity and reduce costs.

Today this category is being driven, primarily, by advances in eight significant and ascending technology fields, namely Bio Markers, which are being increasingly used in the healthcare industry to detect the early onset of disease, Electromyography Sensors, Hyperspectral Sensors, Micro Electro-Mechanical Sensors, Nano Sensors, Sensor Fusion, Smart Dust and Time of Flight Sensors.

In this category there are eleven significant emerging technologies:

- 1. Biomarkers
- 2. Biometric Sensors
- 3. Electromyography Sensors
- 4. Electrophoresis Sensors
- 5. Hyperspectral Sensors
- 6. Micro Electro-Mechanical Sensors
- 7. Molybdenite Sensors
- 8. Nano Sensors
- 9. Sensor Fusion
- 10. Smart Dust
- 11. Time of Flight Sensors

Primary global development areas:



USER EXPERIENCE



EVENTUALLY EVERY new product and service companies create ends up here, in the laps of its customers, and from a customers perspective it's fair to say that the majority of them don't care about the underlying technologies that companies use to help them deliver, or perform, that service. What they do care about though is the user experience, and today there are more engaging, immersive and sensory options open to them than ever before.

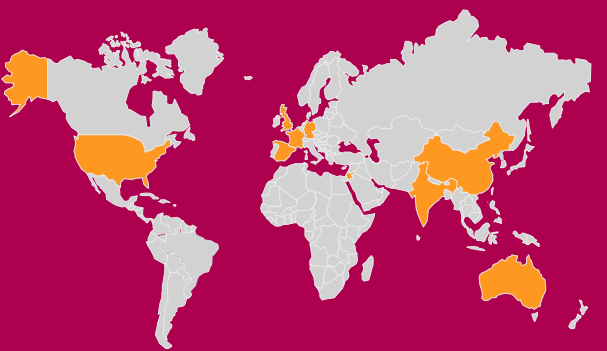
The road to deliver new experiences to our customers though hasn't been an easy one, for example high definition still isn't ubiquitous, and the less said about 3D TV's the better... Despite that though today consumers are, arguably, swamped with alternatives and one day we'll see content streamed directly into our brains, via Neural Interfaces, and we'll be free to "live" vicariously in the moment - whatever that moment is.

Today this category is being driven, primarily, by advances in twelve significant and ascending technology fields, namely 360 Degree Video, 8K Resolution, Augmented Reality (AR), Avatars, Emotion Tracking, Neural Interfaces, Personal Digital Assistants, Screenless Displays, Touch, Ultra High Def Rendering, Universal Natural Language and Virtual Reality (VR).

In this category there are eighteen significant emerging technologies:

- 1. 360 Degree Video
- 2. 3D Imaging
- 3. 8K Resolution
- 4. Augmented Reality
- 5. Avatars
- 6. Emotion Tracking
- 7. Flexible Electronics
- 8. Gesture Control
- 9. Haptics
- 10. Holograms
- 11. Neural Interfaces
- 12. Personal Digital Assistants
- 13. Screenless Displays
- 14. Telepresence
- 15. Touch
- 16. Ultra Hi Def Rendering
- 17. Universal Natural Language
- 18. Virtual Reality

Primary global development areas:

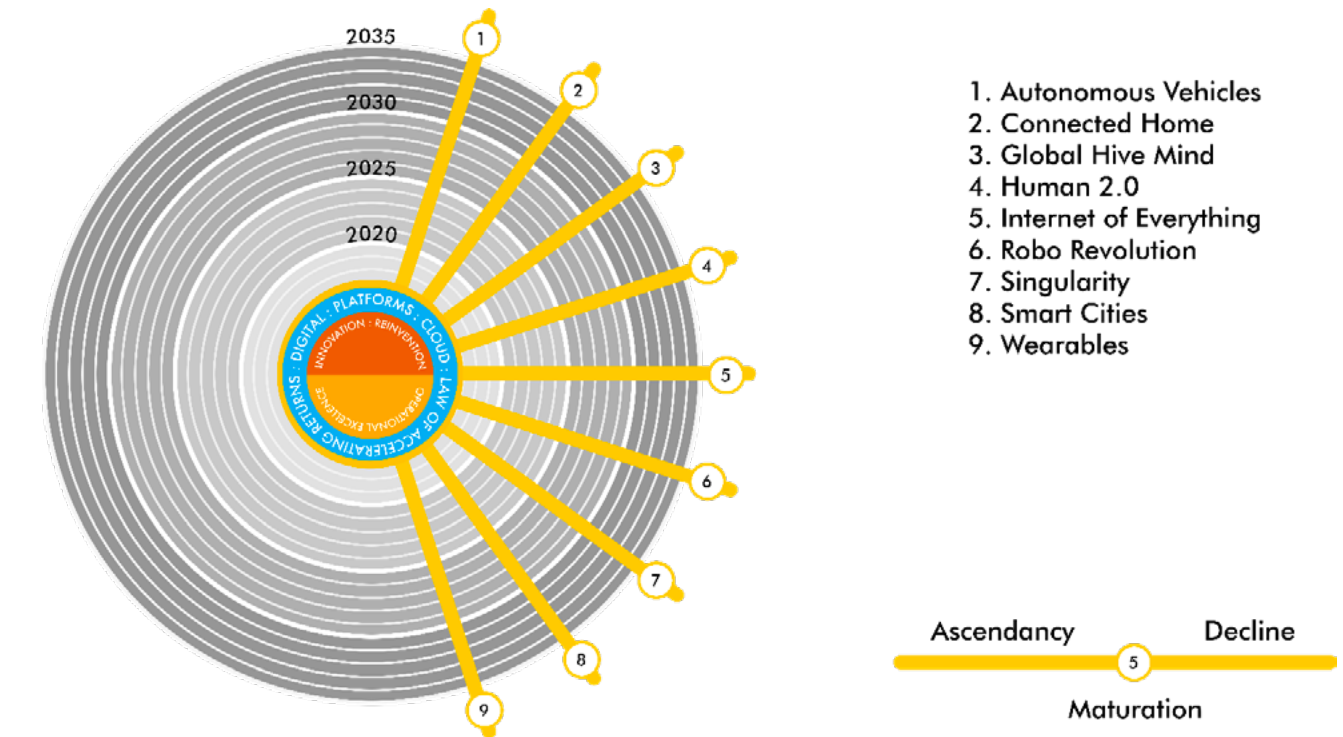




ASCENDING GLOBAL MEGA TRENDS

THERE COMES a point in everyone's life when, whether they know it or not, see it or not, they find themselves standing at the intersection between old, and new, trends. And today billions of us stand with one foot in the past, and one in the future as we start to bear witness to not one, but nine ascending mega trends whose impact on our culture, industries and society will be total, and irreversible.

While estimates about their total value varies wildly, from \$6 Trillion to \$26 Trillion, it's clear they present us all, individuals and organisations alike, with opportunities and threats, and which side of the fence you sit on depends on your ability to see them coming, and your ability to adapt. For example, on the one hand, as a result of robo-automation, we will likely see mass unemployment, the like of which we have never seen before,



but on the other we will have access to new and advanced technologies that help us live longer, and potentially more prosperous lives.

Most people are already aware of the majority of the major global trends that are either already ascending, or that are appearing on the horizon, but sometimes it's good to pause, take stock and reflect on the progress they've made over the past year, if for no other reason that it helps us focus our minds on what's coming and how it's going to threaten, or benefit, our businesses, investments and strategic thinking.

As devices, machines, objects and people increasingly become inter-connected, and as the boundaries between them all blur, it's fair to say that we're beginning to see the emergence of what we could call "Living Services" - services that are tailored, flexing to meet each individual's personal circumstances and preferences, that evolve, by learning intents and needs, and that are proximal, living in the devices that are in us, on us, or near us.

AUTONOMOUS VEHICLES



WHILE MANY insurers are focused on the emergence of autonomous cars the fact is that across the board organisations, both civilian and military, are now running almost full tilt to automate every mode of transport, as well as create new modes, such as sky taxis.

Every new development presents insurers with both threats - such as the end of personal car ownership which will impact general insurance lines, as well as new opportunities - such as the opportunity to insure and corner the future sky taxi market that is being shaped and developed by the likes of Airbus, EHang and Uber.

2016 was an inflection point for the autonomous vehicle industry and it was the first time we saw private organisations, governments and regulators come together in a meaningful way, for example, in Australia, China, Dubai, the UK and the US, to authorise widespread trials of the technology - in many cases without the need for human drivers to be present in the vehicles.

Meanwhile Michigan and Singapore took things one step further and, in the first moves of their kind anywhere in the world, passed new laws permitting the public to use fully autonomous cars on

their public roads. Obviously, I expect both trends to continue and accelerate in the coming years.

There were also advances on the technology front too in both AI and mapping systems. However, one development which could have easily gone under the radar was the miniaturisation of Velodyne's Lidar sensors, which thanks to a \$150 million investment from Ford and Baidu, now means that this critical sensor technology is now easier to install and integrate into autonomous vehicle platforms than ever before. But perhaps most importantly these sensors are now much cheaper to buy, dropping from \$30,000 per unit to just \$2,000 - a move that will make autonomous vehicles, particularly cars, much more affordable.

As mentioned I also saw significant advances in 3D mapping, AI and Machine Vision capabilities, as well as business model creation, from companies including Didi, Ford, Lyft, Tesla and Uber, all of which play their part in helping the technology and platforms mature and take shape.

Based on current information I expect to see companies starting to scale their autonomous car services and operations in earnest from 2020 onwards, starting

with a few hundred cars in each fleet and then quickly scaling from there.

Across the road in the field of autonomous semi-trucks again I saw an increase in the number of public trials, both of individual trucks, as well as platoons, but on a much more limited scale with the main test beds being in America, specifically Arizona, Michigan and Ohio, and Europe. In America Otto, Uber's autonomous trucking company, was the first company to complete a fully autonomous test run of their technology on public roads in Colorado, but as it later turned out they did so without regulatory approval. From a regulators perspective it is clear that the autonomous semi-truck space lags behind the autonomous car space by at least one or two years.

In developments elsewhere I saw an incremental, but still significant, rise in the number of autonomous agricultural and industrial vehicle, drone, sky taxi and ship trials by organisations including Airbus, CNH, EHang, Komatsu and Rolls Royce, and again I expect this trend to continue to accelerate, however, I also expect adoption of all of these new platforms to be staggered and spotty until at least 2020, after which it will accelerate, again, albeit in an uneven fashion.

CONNECTED HOME

THE CONNECTED home ecosystem is rapidly expanding beyond merely connected entertainment (TV, receiver, DVD recorder, media player, gaming consoles etc.) to include many other areas such as home and office equipment (printers, VoIP phones etc.), personal consumer electronics (wireless IP cameras, smart phones, tablets, portable media players, navigation devices etc.), energy management systems (temperature, lighting, heating and air conditioning), safety, and smart consumer appliances (dishwashers, refrigerators, washing machines etc.), and many more.

However, while the ecosystem has been expanding at a steady pace adoption has been lagging behind. However it is clear from spending in the sector that this incremental growth is helping to build an increasingly firm foundation for future growth. At the current rate of development I expect the major industry growth inhibitors, such as gateway interoperability, lack of true device Plug-and-Play, and concerns over privacy and security to be further eroded over the next few years, and I continue to see expanding business opportunities for cloud service providers and big data analytics within the Internet of Everything (IoE) and connected home ecosystem.



GLOBAL HIVE MIND

THE GLOBAL Hive Mind is a trend that has been on the ascent since the early 1980's ever since the emergence of the internet itself, but, arguably, it's a trend that is creeping up on humanity, slowly. And it could be one that suddenly catches the majority of the people unawares.

For the most part we're all familiar with the fact that today billions of people use the internet - something which itself is going away as it gets replaced by the Internet of Everything (IoE) - every day to search for, uncover and consume new information, and ergo remotely draw upon the experiences and expertise of other individuals at will. But fewer people are familiar with the fact that increasingly intelligent machines are now able to do all this too, and with much greater dexterity, skill and speed.

At the moment the greatest difference between the two camps, and one that's getting wider every day, is the fact that, unlike us, the machines, or, for want of a better term, nodes - whether we're talking about bots, devices, intelligent machines, platforms, robots, vehicles or a plethora of other connected artefacts and things - can already draw on, and tap into, this vast "brain," using native Machine to Machine (M2M) language, to acquire and transfer new experiences,

knowledge and skills to each other. And today they're already at the point where the new experiences and skills acquired by one node on the network can be seamlessly and instantly passed on to every other node on the network - the very definition of a Hive Mind.

Humans, on the other hand, are still at the beginning of our journey to realise the full potential of the Hive Mind. We're still relegated to accessing this brain using tools that were developed in the 1970's, namely keyboard, mice and monitors. Sure, the content has gotten richer over those decades, in a whole variety of ways, and it's proliferated, but the way in which we interact with it all isn't frictionless. Do you want to suddenly be able to acquire a new skill? Then get your tablet and Google it. This isn't the future...

However, thanks to breakthroughs across several major fields, namely AI, including Cognitive Computing, Deep learning, Machine Learning, Machine Vision, Natural Language Processing and Translation, Brain Machine Interfaces (BMI), fMRI, Nanotechnology and Neuroscience, which are all beginning to converge, we're slowly getting to the point where we can talk to, and even interrogate, the nodes around us using natural language and hold two way

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conversations. But it doesn't end there. We're slowly reaching the point where we can push the spoken word to the side and communicate with the nodes around us telepathically as our own brains are slowly connected directly into the global brain, the Global Hive Mind.

Today, we're using traditional BMI's such as the blue skull caps you see in the labs around the world, as well as sensors that are implanted directly into the human brain, to communicate with and teach robots using nothing more than, for want of a better word, telepathy, the sixth sense, stream movies, images and information directly from inside people's minds to others, and much more.

Tomorrow though those ungainly 1970's BMI tools and devices will be made obsolete by smaller, less intrusive ones, as well as new technologies, which have already been trialled, like the Neural Lace, a "nano injectable electronic" that once injected into the human body wraps itself around an individual's cerebral cortex to act as the interface between our own biological systems and the digital world around us.

It is only a matter of time, and technology, until we can realise the goal of finally being able to tap into the global hive mind natively, and without

limitation. But whether we can unplug ourselves once we're connected, well, that's another question.



HUMAN 2.0

FROM A research perspective it could be argued that the healthcare sector is by far the busiest of all the sectors I track - with not ten, not twenty but a staggering thirty two significant, disruptive technologies on the ascent.

In many cases the technologies that are being developed today are as beneficial, and in some cases potentially more dangerous than, AI. As a result many of them are already being subjected to increased ethical and regulatory scrutiny from a wide range of individuals and organisations, from Bill Gates, who talks about the dangers of bio-terrorism and new, destructive pandemics, to independent bodies, governments and the UN whose review summits are increasingly filled with a sense of urgency.

In 2016 the most hotly debated technologies included 3D Bioprinting, Gene Editing and Gene Drives, Nanotechnology, Neuroscience, Regenerative Medicine, Robotics, Stem Cell Technology and Synthetic Biology but they were definitely not the only ones causing regulators to sweat - with AI, cloud and Quantum Computing in healthcare also making appearance after appearance.

Last year we saw an enormous number of

breakthroughs across the board - many of which, such as 3D printed bones, brains, hearts, kidneys and skin, cancer vaccines, new forms of alien DNA with six, not four, nucleotide bases, and the birth of the world's first designer babies, even a few years ago would have been considered science fiction.

While the commercialisation of many of these technologies is still at least ten to twenty years away I have seen a significant - albeit still incremental - up tick in the number of organisations, such as GSK, the UK NHS and the Wellcome Trust, embracing and trialling them, and again, I expect that trend to continue and accelerate in the coming years.

When all of the advances in the healthcare field are combined it is increasingly clear that humans, particularly the members Generation Z, will see extreme life extension, and possibly immortality, become a reality in their lifetimes, and all of this will have a dramatic impact on the insurance marketplace.

Today we can already replace over 70% of the human body with artificial alternatives, and over time that will edge towards 100%. However, in the future these artificial alternatives will be replaced by natural ones that are

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personalised, to eliminate the chances of rejection - grown, printed and synthesised on demand using the patients own stem cells and genetic code - and even augmented, for example, with inbuilt nanotechnology and sensor technology, to harness the best of both worlds.

As I've mentioned 2016 was an amazing year, and if I was to visualise the near future for you then picture this - you've been involved in what, in the past would have been considered a life changing accident. During the crash you broke your neck and became paralysed, and there was significant damage to your internal organs, including your liver, lungs, spleen and stomach, both your legs were broken and you suffered extensive muscular damage and burns, meanwhile swelling in your head put pressure on your brain and optic nerves, putting you into a mild coma and rendering you partially sighted.

In 2016 this kind of accident happens, sadly, all too frequently and it is life changing, for the worse. However, fast forward to 2040 and the picture is a very different one. Now, rather than treating your injuries in a piece meal fashion, and waiting, where necessary for donor organs to become available, the doctors have a whole new tool bag of technologies to play with.

First the doctors use a touch screen table to retrieve a copy of your digital twin - an exact cell by cell replica of you, a 3D Avatar they created a few years ago when they combined the results of your different scans, such as fMRI, MRI, ultrasounds and X-Rays, together. Next, using this digital twin as a baseline they assess the damage, get a set of generic synthetic pluripotent stem cells from the freezer, insert them into a 3D Bioprinter then they send the printer a set of instructions and it prints out replacement bones, organs and tissue, personalised to your own DNA within a few minutes which are transplanted into your body.

A little while later they use a nanowire and stem cell scaffold to bridge and repair your damaged vertebrae, reversing your paralysis and then, a little later they assess the damage to your brain and optic nerves. After careful consideration they decide to use Rosa their neurosurgeon robot to remove part of your brain, and again they print off a replacement piece from your twin. Next they use a genetically modified serum to repair the damage to your optic nerve and finally they use a stem cell gun to help repair your burns - without leaving any scars.

The result of all of this of course, is that your recovery time is much faster, but

more importantly, in the future, you recover either full, or almost full function - something that would be unthinkable to many people today.

The twist in this particular tail though is that much of this technology is already here today, and it's already been demonstrated. The digital twin, for example, is being used by the US Army to create digital copies of its soldiers who then 3D bioprint replacement body parts in the field when their soldiers are injured. Stem cells have already been used to grow human stomachs in petri dishes, cure blindness, reverse burns, and we've already reversed paralysis and created working artificial wombs.

As I mentioned previously, sometimes the future is in plain sight - all you have to do is join the dots. And as for the ethical and regulatory debates that are raging around some of healthcare's latest developments?

Well, gene drives for example could help cure hereditary diseases but also help terrorists exterminate entire populations of people based on specific genetic traits, which is one of the reasons it's being dubbed the world's most powerful bioweapon. Meanwhile, gene editing technologies like CRISPR, which is dubbed the "Genesis engine"

because it's so powerful, holds the key to eliminating over 6,000 of today's most incurable diseases, from cancer, where it's been used to develop bacterial chainsaws that replace anti-biotics, the world's first cancer vaccine, and HIV, where it's been used to eliminate the disease, and even the HIV reservoirs, from the cells of living patients.

Going small we have nanotechnology, and enzyme propelled "Nano submarines" helping researchers deliver drugs to specific sites, detect disease before it grabs hold and repair, and operate on, organs in vitro. Synthetic biology is helping us create designer babies and new life forms - including ones that are resistant to all forms of known viruses. And that's all just the tip of the iceberg.

Consequently, if you're an insurer in this space, well, if you couldn't guess it already, then you're about to enter a whole new minefield full of threats and opportunities.

INTERNET OF EVERYTHING

THE INTERNET of Everything (IoE) is an umbrella term that encapsulates everything in our world that is connected, but unlike the Internet of Things (IoT) it is not just limited to "things" - in a world where nanotechnology is becoming increasingly ubiquitous, and where scientists have laid the foundations to create human computers and virus sized computing systems, this means literally everything - from the cells in our bodies to chairs, cars, cities and, in the case of Mars, planets.

In 2016 I saw, as expected, an increasing number of companies bring out new IoE platforms, products and services. But 2016 also highlighted just how nascent the space still is with regards to standards and regulations, when hundreds of thousands of IoE devices were hijacked to take part in the Mirai DDoS cyber attack that took down huge chunks of the US east coast and European internet last October. And then again security popped its head over the parapet when a US hedge fund published research into St. Jude's connected implanted medical devices - such as pacemakers and insulin pumps - that suggested they were vulnerable to cyber attack, sending the company's shares into free fall.

Both of these events could have had

dramatic, even fatal, consequences but they proved to be pivotal in helping focus governments and regulators attention on the issue of IoE security, so much so that just a few months after they took place, in the first step of its kind, the US government and the FDA issued new cyber security guidelines for connected devices, which now, hopefully will lead to the introduction of industry best practises and standards.

However, while security will continue to be a hot topic in the years to come, as we reflect back on 2016, we can split the IoE marketplace into two categories - consumer and enterprise.

In the enterprise sector it can be argued that it's the industrial IoE, and Industry 4.0 specifically, that's seeing the fastest adoption rates, with companies including BMW, Bosch, Foxconn, GE, Rolls Royce, Siemens, Tesla, Whirlpool among many others in the sector making significant investments in smart factories and accelerating the pace of automation, which itself has been a beneficiary of a new category of self-learning robotics systems that can now use a hive mind - a combination of AI and the cloud - to learn new skills without the need for human intervention or coding.

In the consumer space it's fair to say

that there's the usual scramble for market dominance and relevance, and that nowadays you'd be hard pressed to find a product that wasn't, or couldn't in some way be connected to something or other. That said though, again, a lack of standards, combined with an increasing number of often contradictory communications protocols and regulations in the space, which is something that the EU are hoping to address with their incoming General Data Protection Regulation (GDPR), has inevitably led to thousands of manufacturers releasing products that struggle to interoperate or integrate with each other - inevitably slowing adoption and helping to fuel confusion in the marketplace.

ROBO REVOLUTION



TODAY THERE are few topics that are as captivating, or contentious, as the discussion about the impact - for better and worse - that increasingly capable and advanced AI, bot, drone and robot "robo" technologies will have on our society.

While these discussions have been swirling around since the 1940's, today there is a new sense of urgency, driven by the inescapable evidence that these technologies are increasingly encroaching on what society has traditionally considered uniquely human traits, namely creativity, dexterity, intelligence, and even empathy.

As the European Parliament put it recently, the Robo Revolution, as I call it, will leave "no stratum of society untouched," a sentiment that was echoed by the White House whose recent report similarly concluded that "the effects of [AI] automation will be felt across the whole economy," and that it will "undoubtedly ravage blue and white collar jobs."

With report after report emphasising that between 35 percent and 45 percent of all of today's jobs will vanish as a consequence of automation over the next ten to twenty years it would appear that society, and individuals, have plenty to

reflect upon.

Similarly, and remarkably, there is wholesale consensus among global leaders and world experts that the forthcoming revolution will shake the foundations of society to its very core, and with experts and popular opinion often flickering between two poles - that, on the one hand, these new technologies will hasten the emergence of a new age of opportunity and enlightenment, or, on the other, lead to humanity's destruction, it is clear that there is plenty to debate - and debate quickly, if for no other reason that the genie's already out of the bottle.

In 2016 I saw a rapid acceleration in the breadth and capabilities of these technologies with new records being set on an almost daily basis - so much so that towards the end of the year the rate of progress was becoming almost comical.

I also saw a dramatic rise, albeit from a low base, in the rate of adoption, deployment and propagation of these new automation technologies across every sector. With the rates being orders of magnitude greater than simply "incremental" it gives us a strong indication that over the coming years the pace of automation will accelerate significantly.

While there were many highlights from last year some of the major milestones included the announcements that AI's had finally become self-evolving, self-learning, self-programming and self-replicating; that AI generated algorithms were leaving those made by some of the world's best data scientists for dust; that AI natural language processing, speech and translation capabilities were superior to their human equivalents; and that robots were using a hive mind - a combination of AI and cloud - to propagate knowledge and learn new skills, self-evolve, self-learn and even self-manufacture using 3D printers. And as for the emergence of fabled Artificial General Intelligence (AGI), well, a new AGI "Universal Neural Net" architecture, published by DeepMind, might have just pulled that forwards from 2040 to 2030 or earlier.

It's therefore clear from the evidence, even just these few highlights, that the iterative pace of progress that many people, and organisations, have become accustomed to over the years, is accelerating, and that we are moving past the knee of the exponential curve. As a consequence it should be expected, from here on in, that the pace of progress in this space will begin to turn exponential over the next few years.

SINGULARITY

THE SINGULARITY represents the moment when an intelligent machine becomes quantifiably smarter, however that will be measured, than every human on Earth, and it's the point after which humanity and society undergo unfathomable, and irreversible change.

Many people expect the singularity to follow shortly after humanity manages to create the first officially recognised Artificial Super Intelligence (ASI) and while the Singularity itself is still a distance away in 2016 we saw experts bring forward their projections for the emergence of an ASI from 2071 to 2045.

While 2045 is still regarded by many executives as beyond the scope of even Horizon Planning it should not be forgotten that as the pace of AI development and deployment increases it's impact on culture, industry and society could be rapid and profound. As a consequence I encourage executives to remain vigilant and alert, and plan for the unexpected.



SMART CITIES

TRANSFORMING, AND in some cases re-inventing, the fabric and behaviour of the world's urban environments is no simple matter, and it's clear that it will take decades, and possibly even a century or more, to achieve.

Given the current rate of investment and progress I expect it to be at least two decades before we see the appearance of the world's first fully integrated smart city where every aspect of the living city - from it's climate and services, to its infrastructure and inhabitants - are digitally, and seamlessly, woven together.

In the meantime, however, while progress externally at least appears to be slow there has been a sharp rise in both the number of connected city initiatives being tabled by governments and authorities, as well as a huge surge in the amount of investment being put forward by countries including China, India, Singapore, Spain and South Korea to build a new generation of smart cities.



WEARABLES

IT WOULD be fair to say that wearable technology simply hasn't lived up to the hype that surrounded it all those years ago. While shipments of wearable devices has increased significantly over the years they haven't set the world on fire, and even Apple, that alleged king of all things new and shiny has struggled to move inventory.

One of the key reasons for the slack growth in the market has been the lack of a so called "Killer app." Sure tracking your steps and the distance that you've run is fine, but these types of devices and technologies have arguably been with us for decades and they only really appeal to a small subset of the overall market.

In 2016 we saw Fitbit lurch into trouble, Misfit, Pebble and Withings get acquired and new versions of the Samsung Gear and Apple Watch roll out. And the world yawned.

However, that said, it is beginning to look increasingly likely that wearables natural home is in the health space - specifically the wellness and quantified individual space. Ironically it's this space that had people the most excited when wearables first appeared all those years ago.

When wearables first appeared on the market the promise of being able

to track, monitor and analyse your activity, bio-chemical makeup, bio-mechanics, diet, heart rate and sleep patterns, to name just a few, helped draw early adopters into the stores. But over time those same early adopters found that their shiny new gadgets offered only basic functionality and had their limitations. Anticipation turned to disappointment, and the revolution stuttered.

In 2016 however we saw an up tick in the number of individuals buying wearables, in part because wearable devices are being integrated into other devices, such as smart watches and sports apparel, but as the technology and platforms mature, as the kinks get worked out, and as the technologies value to the consumer increases the initial reticence that developed in the early years is now slowly being eroded.

People, as well as companies, are also beginning to become more interested in tracking their health, and more specifically their wellness. And as the products mature, as the AI, sensors and sensor fusion technologies become more advanced, especially now with the emergence of new nano fabrication techniques that let us print transistors into clothing and objects en masse I'm slowly beginning to see the emergence

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of advanced wearable platforms that can predict disease, and notify doctors accordingly, and make much more valuable contributions to keeping people informed, healthy and engaged.

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15 TOP INSURANCE INDUSTRY PREDICTIONS

IT'S UNLIKELY that 2017 will be a breakout year for the insurance industry, nor will it be the year when the industry stares its Uber moment in the face, however, as we'll discuss later on in this chapter, we can already see that event materialising on the horizon - just not necessarily in the way that most people expect.

It is clear from the developments and progress made in 2016 that the industry's appetite, pace and propensity for change, albeit partially fuelled by an increasingly competitive and dynamic marketplace, is accelerating.

The journey to the future is made up of many steps, and these are my predictions for what lies ahead in 2017:

1. ARTIFICIAL INTELLIGENCE

AI, which is an umbrella term for at least four different classes of AI, namely Cognitive Computing, Data Science, Deep Learning and Machine Learning, which all have different traits and capabilities, will play an increasingly important role in helping insurers create, discover and unlock new value in their back and front office operations.

In 2017 data science and machine

learning will continue to be the two most dominant forms of implementation of AI because they are the best understood, the most widely distributed and the most predictable forms, then will come cognitive computing and deep learning respectively.

Most of this years new AI implementations will be discrete and focused on automating and improving operational efficiency and productivity as insurers, and regulators, try to bottom out the implications and risks associated with embedding what is quickly becoming to be regarded as "Black box" technology into the fabric of their organisations - even if organisations, like MIT, are trying to take the word "Black" out of the equation.

Over the longer term I can see insurers increasingly replacing their front end and back end staff with engineers at a ratio of approximately 4:1 as organisations slowly eke towards creating what will inevitably become fully autonomous organisations.

2. BLOCKCHAIN AND DLT

The insurance industry's interest in blockchain and other distributed ledger technologies will continue to increase

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and proliferate.

In 2017 there will undoubtedly be an up tick in the amount of insurance led blockchain patent activity, led by the US, and I expect insurers to predominantly limit their activities in this space to engaging with, and navigating, the burgeoning international blockchain ecosystem - especially in Asia, North America and the UK - as well as working with thought leaders in the space, to bottom out the technology's limits and potential use cases, and its disruptive power for business transformation and re-invention.

Meanwhile, taking a longer view, I expect the first production ready blockchain B2B and B2C applications to appear 2019 - two to three years behind a number of other industries, such as retail and utilities, who already have production applications running in the wild. I also expect these applications to be predominantly focused on improving back office efficiency, collapsing and simplifying processes and cost take out.

3. BROKERS UNDER ATTACK

Direct players will continue to gain share with the disintermediation of brokers within the general insurance space

unlikely to slow down, and as income from add ons continues to come under pressure insurers, particularly those without agile pricing models, will find it increasingly challenging to profit in the mass market.

4. CONNECTED INSURANCE

Many insurers are still busy architecting, building and re-wiring the digital fabric of their organisations. In today's world becoming a "Digital Insurer" simply gets you to the starting line - the point at which it becomes easier for your organisation to broker, integrate and manage new partnerships, ingest and analyse a greater variety and volume of data, and, ultimately, create new connected customer propositions and experiences.

As the depth and breadth of the global connected environment continues to evolve and grow at an accelerating pace, keeping up with it, let alone getting ahead of it will continue to be a challenge for insurers who, it is fair to say will likely remain around three to five years behind the main bough wave of change for the foreseeable future.

In 2017 we will continue to see insurers invest more time and resources in

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building and scaling new global platforms and ecosystems - both with peers in complimentary markets, as well as with established insurtech start up ecosystems in Asia, Europe and North America.

We will also see more connected propositions hitting the market - ones that not only address risk in a traditional way, but that also try to pro-actively identify and manage emerging risks before they turn into larger claims. While I expect the number of connected propositions to increase I also expect them to remain a relatively small percentage of the marketplace as insurers core systems and governance models continue, for now at least, to slow their roll out and widespread adoption.

Meanwhile in commercial lines we will continue to see an increase in the number of corporations, led by the manufacturing sector, who use advanced analytics to analyse the data streaming from their own connected ecosystems of things and devices. Increasingly I expected that this data, for example, from infrastructure and vehicles to healthcare and security, will help customers better model and quantify areas of risk, giving them a several new bargaining chips at the insurance table.

5. CORE SYSTEMS REPLACEMENT

Many insurers remain in a period of intense core systems replacement which I expect to last at least until 2020. Agility and the ability to operate at "Digital speed," or as some put it the "Speed of business," will continue to be the primary drivers that influence architecture and procurement choices. These drivers will inevitably lead insurers to favour multi-cloud solutions that can be implemented more rapidly and which can help insurers adapt, respond to, and support new products, new business models, new distribution partners, and new customer demands faster and more efficiently than before.

6. CULTURAL SHIFT

Many, but not all, insurers have come to the realisation that in order to embrace and prosper from the opportunities that are emerging before their eyes it is not enough to simply maintain the corporate status quo and operate business as usual.

Insurers, like many other incumbents in their privileged position, are increasingly finding that procedural, structural and technological reforms by themselves are not enough to ensure success in the new marketplace, and that they must inspire

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a cultural revolution in both behaviour and thinking.

In 2017 we will continue to see insurers attempt to refashion and realign their corporate cultures and hiring practises with the new world realities, but these initiatives will likely remain restricted to specific areas of the business that are influenced by, or run by, forward thinking change agents who have the authority, resources, and vision to push the industry forward.

7. CUSTOMER CONTROL

Customers are increasingly informed and the number of options and channels they have open to them, whether that's a function of an insurers go to market or the type of proposition they're selling, is increasing.

In 2016 I saw more home insurance customers behaving like motor insurance customers and switching if they were unhappy with the service, or price, they were receiving.

Customers are increasingly getting used to the idea of having more control over their everyday lives and many customers still feel the relationship they have with their insurers is one sided. As customer

behaviours continue to morph in 2017 I expect we will see an above average, albeit still incremental, increase in the number of consumers who explore and embrace new models of insurance, as well as insurers who are increasingly invested in their communities, or causes.

8. CUSTOMER EXPERIENCE

The majority of insurers have been busy trying to re-invent their customer experience for the past couple of years, however, customer engagement and opinion in this area is still relatively poor.

In 2017 insurers will continue to bolster and invest in their efforts to improve customers end to end experiences - moving away from focusing on individual transactions to building frictionless, connected customer experiences - a key insurtech battleground.

Furthermore, as insurers continue to make progress against their other, inter-related connected and digital transformation goals I expect there to be an overall cumulative net benefit, however, I expect these benefits to emerge with more vehemence in 2020 and beyond.

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9. DATA DEMOCRACY

A buzz word since early 2010 most insurers are fed up with hearing about Big Data and it's purported benefits. However, the continued explosive growth in data volumes and data sources from today's and tomorrow's burgeoning ecosystems of connected devices, things and people, as well as the proliferation of new open data platforms, still present insurers with huge opportunities and tremendous scope for re-invention.

As new data sources, which include everything from nanoscale computer devices and machine vision systems to embedded electronics and genomic databases come online, and continue to mature and proliferate, they will offer insurers and insurtech companies the opportunity to scrape, acquire and analyse vast quantities of data that would have either been too expensive, or too difficult to acquire in the past.

In 2017 we will continue to see insurers invest large sums of money in big data initiatives. Furthermore, as insurers, corporations and consumers alike become increasingly adept at tapping into and interpreting these increasingly ubiquitous data streams we will see the establishment of a data democracy, more likely than not spearheaded

by blockchain and distributed ledger technologies, that can be leveraged to increase personalisation and transparency, and which will lead to improved risk management practises and fairer premiums.

10. DIGITAL TRANSFORMATION

Up to this point most insurers have taken an outside in approach to digital transformation, focusing on agents and customers.

In 2017 we will see an increase in the amount of resources that are focused on transforming insurers internal business operations that help to further automate, enhance and support these other external programs.

11. INSURTECH

It is clear that insurtech is here to stay and that is has already made it's presence felt. With the number of new insurtech start ups entering the market up 46% year on year it's certain that we'll see the net number of new entrants in 2017 increase to new record highs and that they will continue to find new ways to compete against and disintermediate the incumbents.

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That said though, in 2016 we saw, for the first time, incumbents Corporate Venture Capital (CVC) investments in insurtech out strip and out pace that of private venture capital firms. Therefore in 2017 I expect this trend not just to increase but accelerate, particularly in the area of digital distribution. It is also highly likely that we will see more joint propositions coming to market particularly in the B2C and mid market space and that European and North American insurtech companies will begin expanding East.

12. POLARISATION

Innovation, specifically primary, not iterative innovation, will be the key weapon that helps insurers ensure they remain relevant and at the forefront of the market. However, in 2017 it's likely that the gap between those insurers who are pushing innovation and re-invention hard, and whose executive teams "get it," and those who aren't and "don't" will continue to widen and accelerate as proactive innovators continue to assess and challenge the fitness of their organisations and product portfolios against the backdrop of a rapidly changing marketplace with an almost religious fervour.

13. QUANTUM COMPUTING

As the race to create the world's first commercial, re-programmable quantum computer continues to heat up, with IBM and others setting a date of 2020 for the first small scale "viable" service, insurers can, for the first time, see that the potential to perform calculations and complex operations hundreds of million times faster than today's systems are slowly coming within reach.

In time these new capabilities will give insurers the ability to hyper-personalise their products and services in real time. As a consequence in 2017 I expect to see a small number of insurers partner with some of the fields emerging quantum algorithm companies and begin experimenting with quantum algorithms.

14. REGULATORS STANCE

The scale, pace and voracity of global change is a significant challenge for regulators with many openly admitting that they're struggling to adapt and keep up. However, as rapid change, and all of the systemic risks that it brings, increasingly becomes the new norm, some regulators, particularly those in Asia, Europe and North America, are doing their best to embrace it.

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In 2017 we will see a rise in the number of regulators who are providing regulator sponsored and funded innovation hubs and sandboxes where insurers can test new ideas, products and services without the fear of penalised.

15. SPEED

One of the biggest criticisms that has been consistently levelled at the insurance industry over the past few years is its pace of change, but then again, the same can be said of many of your peers in alternative sectors.

In 2017, as the insurers continue to invest in transforming their core systems, and re-wiring their digital fabric I expect their pace of change within the industry to accelerate. That said though, macro-economic and socio-political factors, as well as a changing regulatory environment will continue to act as anchors.



SIGNS OF DISRUPTION

GIVEN ENOUGH time everything moves - even rocks. Many industry and government insiders and observers seem to agree with the sentiment that the insurance industry has changed little in a century, but they also now agree that, finally, it is under going a transformation that many feel is long overdue.

However, while the industry is now changing with more voracity and urgency than in the past, it can be argued that much of this change is in response to an increase in the size and number of new external threats, rather than proactive, self induced change.

The three most significant disruptive threats include:

- Changing customer behaviours; customers around the world have seen significant improvements in the way they engage organisations within a range of industries, in essence the “consumerisation” of design and service. As a consequence customers expectations have changed and this is leading to an increase in demand for new types of insurance products and services, new customer service expectations and a rejection of the status quo.

- Rate of innovation; so far the pace of innovation within the insurance market has been incremental, partly because of the tools and systems that were in place, and partly because of the relatively slow pace of change in the overall market. However, the advent of new PaaS and devops platforms, combined with increasing levels of industry automation and digitisation, and the ceaseless ascendancy of several paradigm shifting multi-trillion dollar trends, as discussed previously, have all helped to lower the barriers to entry and accelerate, partly through necessity, the rate of innovation within the industry.

- Startups; over the past ten years the cost of building and scaling a digital business has fallen by over a thousand fold and this, arguably, is helping fuel a ten times increase in the number of new business registrations globally within the past five years alone. This, combined with record levels of VC investment, a rapidly changing marketplace, and an industry that is ripe for transformation and re-invention have all contributed to a rapid rise in the number of startups targeting the insurance sector, filling gaps the incumbents have not and exploiting new, untapped market opportunities.



TECHNOLOGY IS YOUR FRENEMY

THERE IS no doubt, and no debating the fact, that we are witnessing the beginning of a new global technology fuelled revolution - because the evidence, even for the most hardened cynic, is on display everywhere.

Today, while some organisations are transforming their operating models to embrace a new Industry 4.0 model, we are already starting to see the emergence of organisations, such as Aidyia, Bridgewater Associates, Foxconn and Goldman Sachs, who are building out industry 5.0 models, where we move from a Human-Machine hybrid operations model to a pure machine model - where creative and intelligent machines build, scale and operate multi-billion dollar organisations without the need for humans.

Meanwhile, as the pace of change accelerates, enabled by rapid advances in technology the pace of industry disruption is also accelerating. In the 1900's, for example, it took on average 90 years to disrupt an industry, today it's taking on average seven to ten years, and by 2035 we will be able to disrupt industries within a two to five year time frame.

For those of you who, naturally, ask how that's possible then might I remind

you that we are moving from an age with limited connectivity, shaped by human ingenuity and entrepreneurship into a hyper-connected age that will increasingly be shaped by intelligent thinking machines, that can innovate, operate and scale at spectacular speed...

While 2016 will go down in the history books as the year we saw the rise of Brexit and Trump, it was also the first time we saw AI's finally become self-evolving, self-learning, self-programming and self-replicating; AI generated algorithms that left those made by some of the world's best data scientists for dust; AI natural language processing, speech and translation capabilities become superior to their human equivalents; and robots using a hive mind to propagate knowledge and learn new skills, self-evolve, self-learn and even self-manufacture using 3D printers. It was also the year when a handful of industry giants announced that they were creating the world's first fully autonomous organisations - something which could threaten the very foundations, and the cost models, of today's insurance companies.

What a difference a year makes, and 2017 is off to an even faster, more exciting - or troublesome, depending on your viewpoint - start, with the UN voting

on whether or not to ban autonomous, killer robots and gene drives, and the EU voting on recognising robots as “Electronic persons,” and the need for companies to implement AI kill switches that can terminate rogue AI systems. All of which have ramifications for the insurance sector.

It is clear, from these advances, as well as innumerable others, that the next generation of companies - and competitors - will be envisioned, built, operated and scaled by increasingly creative, intelligent inter-connected machines. 2016 saw the first echoes of that near future and companies, particularly transaction heavy companies, like many of those in the insurance sector, underestimate these new systems ability to discover and deliver new value, evolve, operate and scale at speed at their peril.

Consequently, as the pace of change accelerates, as we move from one disruptive technology cycle and headlong into not one, or two, but three more - first came the internet, then cloud, now here comes AI, blockchain and bots, whose roles can encompass everything from conversational commerce to customer service - organisations are faced with the very real prospect that, unless they have the right attitude, determination and

vision they could be disintermediated much quicker than they anticipate.

In the right hands - your hands - technology can be your greatest ally, but in the wrong hands, whether those hands are the hands of your competition or criminal actors, it can also be your worst foe.

THE UBER MOMENT



AFTER WHAT can only be described as a staggering and rapid rise to prominence it's little surprise that people inside, and outside, the insurance industry ask when, and if, the industry will ever experience it's own Uber moment. However with autonomous organisations, which can automate, disrupt and lower the cost of operations, and conversational commerce, that can automate, disrupt and lower the cost of commercial transactions, appearing on the horizon it's also clear that Uber, perhaps sooner rather than later, will also face its own Uber moment.

With some insider experts going on record over the past year dismissing the idea that the insurance industry will ever face its own Uber moment, I disagree, and I've already started seeing the first tell tale signals appear.

The answer to this burning question though relies on one thing - understanding what people mean when they talk about an Uber moment - after all, Uber is the embodiment of many different things.

Uber is disruptive, pioneering, relentless, ruthless, visionary and well capitalised, however, the idea behind the multi-billion dollar company that now books over two billion rides a year was a simple one; it

was a snowy Paris evening in 2008 and the two co-founders, Travis Kalanick and Garrett Camp, had trouble hailing a cab, so they came up with the idea of tap a button, get a ride.

Fundamentally, the company that turned an entire industry on its head, embodied the on demand economy and filled millions of column inches did what any good business does. It found an unmet need, designed a frictionless customer solution and executed, resourced and scaled its vision - to own the transportation layer - with deft determination, impunity and skill.

However, what isn't at first obvious though, unless that is you've been to the US west coast and worn out your shoe leather, is that Uber isn't a company, or an idea - it's a formula. One that's made up using thirty common business building blocks, and one that was created and perfected over the years by some of Silicon Valley's biggest venture capital companies, including Accel, Andreessen Horowitz, Kleiner Perkins Caufield & Byers, Lightspeed, Tiger Global and Sequoia.

Having perfected it over the years they've wasted no time replicating it time and time again with every new start up they've invested in, and now each and

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every one of them own majority shares in at least twenty of the world's largest multi-billion dollar start ups.

Did you, for example, think it was just chance, or coincidence, that one area of the US has managed to produce not one but over a hundred and eighty multi-billion dollar start ups, or unicorns ,as they're more commonly known? I'll freely admit that I did - until that is I walked the halls, met the executives, pressed the flesh and dug into their DNA.

AirBnB, AppDynamics, Box, Docker, Dropbox, Flipkart, GitHub, Palantir, Pinterest, Slack, Snapchat, SpaceX, Snapchat, Spotify, Stripe, Tableau, Uber, WeWork and Workday, when you look under the hood they're all related, and all built using the same formula. Only their products and services vary.

So as for the question - will the insurance industry face its own Uber moment? In my opinion the first tentative signs are already there. After all, an increasingly large percentage of the current crop of insurtech companies are disruptive, pioneering, relentless, ruthless, visionary and well capitalised, however, none of them have all of these attributes in a single package, and in many cases it shows, so for now at least, the insurance industry's Uber moment is still some

distance away.

However, if the murmurings coming from the masters of the universe are anything to go by then it won't be too long until we see a start up emerge built using the new formula. After all, to quote one of the masters of the universe: "There are 46 insurance companies in the Fortune 500, with an average age of around 95 years. We're talking pre-internet, and it shows."

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GATHERING STORM CLOUDS

COMPARED WITH other analogous financial services sectors it can easily be argued that the future insurance landscape is by far the most complex and dynamic. Just like these other sectors the insurance industry is influenced by new and emerging trends both inside and outside of its industry, however because of its direct, and often acute exposure to these trends, via its customers, many of those new trends present, at a minimum, transformative regional shifts and at worst titanic global shifts.

The cumulative effect of all of these shock waves is a rapidly evolving marketplace and increasingly complex business operating environment, and where there is change there is opportunity, as a consequence in 2016 we saw a noticeable rise in the number of new insurtech start ups, led by North America, the UK and China.

From next generation distribution intermediaries and peer to peer insurers to reinsurance platforms the majority of insurtech companies exploited weak points in the current incumbents business models, operations, portfolios and value chains, as well as addressing customer pain points and unmet customer needs.

However, while the number of new

insurtech start ups increased by 42% year on year to reach 177 new registrations, funding fell from \$2.6Bn to \$1.7Bn respectively. This was fuelled in part by what some investors are seeing as a lack of tangible returns, but it was also a direct result of more corporate and private investors investing smaller sums of money earlier on in companies, at the seed stage, rather than in later rounds which often command higher valuations.

In response to the volume and voracity of global change, as well as a surging insurtech market most global insurers and brokerages have either launched, or re-invigorated, their digital garage and innovation accelerator programs, and are now among insurtech's most active investors and participants.

However, in a world where industries are increasingly boundless and borderless this ostensibly siloed, own industry, approach to innovation and re-invention might not be enough to protect incumbents against some of the more aggressive incumbents sitting, watching, in adjacent industries, or some of the other disruption shocks, such as the emergence of fully autonomous competitors, that are appearing on the horizon - in many cases faster than people anticipate.

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When we look at what is happening outside of the industry it is clear that some of the hard trends I alluded to an earlier chapter, that include autonomous vehicles, industry 4.0, the robo- revolution, smart cities and smart infrastructure, and wearables as well as less obvious trends such as Human 2.0, have made spectacular progress over the last year, beating many of the analysts estimates and expectations. As these trends continue to grow and mature they will all, in one way or another, impact the way assets are managed, owned and used, and, therefore, assessed, protected and insured.

Additionally, when we look under the hood of these trends and analyse what I call the plumbing - the individual technologies that are either already, or will in the future, enable, enhance and underpin the them all - such as artificial intelligence, blockchain, cloud and edge computing, quantum computing and sensor fusion networks, to name but a few, not only do we see how the barriers to entry into the insurance market place are being lowered or eliminated, we can also see how would be disruptors are able to quickly transcend their own industry boundaries and adapt their operations to become threats - in some cases, almost over night.

When all of these trends and technologies are concatenated with broader global and regional cultural, economic, environmental and political trends the signs are clear. The way that insurance is structured, consumed, and provisioned in the future will not just be incrementally different, but significantly different.

The only questions that remain therefore are how different will the new landscape be, and how and when will those changes take place, but irrespective of the answers, opportunity for transformation and re-invention is rife, and we've only just begun.

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HARNESSING TECHNOLOGY FOR GOOD

ALMOST EVERY innovation and every patent produced today either incorporates technology, or relies on it in order to fulfil its role. But technology never works in isolation and the majority of today's products and services are built using different technology combinations that come together to create something new, interesting and game changing.

Unlike many other industries, such as Aerospace, Agriculture, Communications, Defence, Energy, Healthcare and Transportation that rely on tens, and sometimes even hundreds of different technologies the insurance industry is tied to a relatively small number of "Primary" digital technologies - such as Artificial Intelligence, Blockchain and Quantum Computing, and then more loosely to select "Secondary" technologies such as Augmented Reality, Machine Vision, Natural Language Processing, Sensor Fusion technologies, Universal Translation and Virtual Reality.

After all, it's unlikely that you'll find an insurance company that's either interested in, other than from a risk and client perspective of course, or investing in the likes of 3D printing, gene editing, nanotechnology, nuclear fusion, synthetic biology or many of the other technologies shown on the technology

radar on the previous page.

This narrow focus on, and comparative reliance on a small number of key technologies can be both a blessing and a curse.

On the one hand it means that insurers should be able to move more rapidly than their counterparts in other industries, but similarly, it also means that companies, whether those are incumbents or insurtech companies, who have deep domain expertise in one or more of these areas can quickly differentiate themselves in the market, out manoeuvre their rivals and attack different points of the industry value chain.

Below I'll take a closer look at some of the technologies that will help shape the insurance industry over the course of the next decade and highlight some of their primary near term, and long term use cases.

ARTIFICIAL INTELLIGENCE (AI) is now ubiquitous in many commercial products, from search engines to virtual assistants, and after spending decades lingering in the shadows it is now profiting from the exponential growth of cloud, computing power, distributed and parallel processing, global connectivity and open source.

AI's initial impact in the insurance industry primarily relates to improving efficiencies and automating existing customer facing, underwriting and claims processes. However, over time its impact will become more profound as it helps, and then begins to take the lead, in identifying, assessing and underwriting emerging risks, identifying new sources of revenue, and running fully autonomous next generation distributed organisations.

WHAT IS AI

The term AI is a catch all and includes a variety of technologies that each have distinct traits and capabilities.

These technologies include:

- Cognitive computing is a subset of AI that focuses on emulating human thought processes and it's unique in the respect

that it too is a collection of technologies, namely deep learning, machine learning and natural language processing, which are combined together to enable machines and people to interact in a more natural way, and extend and magnify human expertise and cognition.

- Data science refers to the interdisciplinary field that incorporates business analysis, computer science, mathematics and statistics to collect, organize and analyse large amounts of data in order to generate actionable insights.

- Deep learning is a form of machine learning that uses multi-layered neural networks to learn. There are other approaches to machine learning, including Bayesian learning, evolutionary learning, and symbolic learning.

- Machine learning is the science and engineering of making machines "learn." That said, intelligent machines need to do more than just learn – they need to plan, act, understand, and reason.

GOOD EXAMPLE USE CASES

- Augmented underwriting
- Automated underwriting
- Behavioural analysis

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- Claims management and automation
- Enhanced telematic services
- Fraud mitigation
- Information and event modelling
- Marketing automation
- P&L analysis
- Personalisation
- Preventative insurance
- Redefining distribution
- Risk modelling
- Rules based automation
- Service automation

BLOCKCHAIN

THE POTENTIAL for blockchain to deliver new and substantial value to the insurance industry is enormous.

Not only does blockchain offer the promise of cost reduction and efficiency, but it also heralds in the potential for insurers to create new top line growth by helping them build and deliver new products and services, and helping them to deliver game changing advances in customer service.

However, while blockchain has the potential to radically transform the global insurance industry, as well as all the other industries, insurers have only just started scratching the proverbial surface with many of them openly acknowledging that they believe that blockchain is disruptive, but similarly openly admitting that at the moment they're not sure how to best harness the technology for maximum impact. And that's fair enough - after all it's still a relatively new, revolutionary technology and it will take time for organisations to come to terms with it's benefits and limitations, pros and cons.

WHY BLOCKCHAIN

While there are many, certainly in the blockchain community itself, that will

say that blockchain should be used to transform every corner of insurance that's not necessarily the case - nor is it necessarily the best option.

As a result it is my suggestion that companies first ask themselves the following questions to determine whether or not blockchain could be a suitable fit for a particular process, product or service, and if the answer to at least four of these questions is yes then you should get a group together and thrash out some next steps:

- Are interactions are time sensitive?
- Are there intermediaries involved?
- Are others involved in the transaction?
- Do multiple parties share data?
- Do multiple parties update data?
- Do you need verification?

GOOD EXAMPLE USE CASES

With many insurers still trying to get their heads around where, and where not to use blockchain I've put together this brief list of use cases where it makes sense to use blockchain, rather than other technologies, to create a superior solution:

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- AML
- Archiving bindings
- Bail bond cancellation;
- Claims management
- Contract life cycle management
- Excess of loss reinsurance
- Global policy management
- Inter-company reconciliation
- KYC
- Managing multi-national policies
- Mobile phone insurance infrastructure
- National fraud register
- Policy management
- Proof of insurance
- Risk and portfolio management
- Treaty management

QUANTUM COMPUTING

In brief Quantum Computing is the use of Quantum Theory and Quantum Mechanics to create next generation computing platforms and systems that are hundreds of millions of times more powerful than today's most powerful logic based systems that are built using traditional silicon technologies., and the opportunities for insurers to save money, improve efficiencies and create new lines of revenues is immense.

What follows below is an excerpt of one of my interviews for Risk Management Solutions "Exposure" magazine.

What is the potential that quantum processing offers?

Quantum computers excel as solving what we call "Optimisation" problems, and the two biggest benefits will be the staggering increases in processing speed, which in turn will let insurance companies process hundreds of multiples more information in just a fraction of the time that they do today, and the emergence of new, ultra secure quantum cryptography standards.

What are the key challenges in creating a quantum processor for commercial use?

There are multiple challenges at the moment. Like any computing platform quantum computing platforms are made up of a variety of different components, very few of which are off the shelf and very few of which are anywhere near maturity. From compute to memory to networking and data storage companies are having to engineer a completely new technology stack.

For example, using these new platforms companies will be able to process huge volumes of information at near instantaneous speeds, but even today's best and fastest networking and storage technologies will struggle to keep up with the loads workloads – this is one of the reasons why companies are now also looking into building out DNA and atomic scale storage platforms that can scale to any size almost instantaneously, the first of which could be available courtesy of Microsoft in 2020.

Other challenges include the operating temperature of the platforms which today have to be kept as close to Absolute Zero as possible in order to maintain a high degree of processing accuracy, but one day it's hoped that these platforms will be able to operate at, or near, room temperature, and then there's the "fitness" of the software stack – after all, very few, if any, software stacks today

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can handle anything like the demands that quantum computing will put onto them.

How far are we along the evolutionary path to such a capability?

There are, ostensibly, two types of quantum computing platforms being developed at the moment, and we can already see quantum computing's successor, DNA computing, which will make quantum computing platforms look as modern, and as capable, as the stones we stand on.

When we discuss quantum computing there are two types of platform emerging - proprietary platforms, that some argue the quantum computing company DWave, who has sold it's platforms to Google and NASA, fits into, and universal platforms.

The latter is arguably the most interesting at the moment because unlike proprietary platforms that require a high degree of algorithmic and application tuning and optimisation the universal quantum computers, hence their name, will be able to run algorithms and applications that only require a minimal adjustment, and while DWave has had its platforms on the market for many years,

with each machine typically coming in at \$10 million a pop, it looks like the first universal quantum computing platforms will be available via a commercial cloud service, albeit a very, very limited one, in 2020.

From an insurance perspective, what does quantum computing offer?

Quantum computers will bring insurers and their clients great benefits, but also great threats. One of the first threats, which is should also be said could be an opportunity for insurers, is the fact that once "true" quantum computers hit the 1,000 to 2,000 Qubit mark they will increasingly be able to be used to crack at least 70 percent of all of today's encryption standards, and in the hands of a cyber criminal I don't need to spell out that picture...

On the benefits side though, these new platforms will let insurers process vastly more amounts of information than they do today and help them calculate risks, of almost any nature, in real time – from instantaneously modelling the impact of an approaching hurricane on a specific region to modelling the life expectancies of everyone on the planet, and everything in between, only the amount of data they have, or have access to, will

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limit them.

Are we seeing much interaction between the insurance industry and quantum algorithm companies?

There are a few insurers who are dipping their toe in the water and working with quantum algorithm companies to explore the technology and prod the bear so to speak, but not many.

I put this down to a few factors – firstly many insurers are still battling the day to day challenges of digital transformation, the fact of the matter is that quantum computing, like blockchain, and other impactful technologies, still come quite a way down the priority list because in some respects they’re still seen as technologies that are on the distant horizon and not in their face like artificial intelligence.

The second factor that affects experimentation and adoption, as I see it, is the fact that, like many companies, many insurance organisations rely on analyst predictions to help them formulate their technology and business timelines. Analysts seem to have a poor track record of predicting when a particular technology, or trend, will emerge, for example, 2017 is supposed

to, again, be the year of VR, and autonomous vehicles were supposed to be a 2035 phenomenon – and we all know how that’s working out.

Technology, and the pace of innovation and change, is accelerating rapidly, and quantum computing falls into that same bucket – a technology that is supposed to be available in earnest in 2040 we’ll start seeing the first, albeit very small scale systems, available in just two to three years time. Advanced technologies are emerging faster than ever before, and they are democratising faster than ever before and that’s only going to continue to accelerate – today is the slowest rate of change that any of us will ever experience again.

How insurers be looking to engage with quantum computing?

I would suggest they go and explore the technology, talk to people within the quantum computing ecosystem and talk to their peers in other industries, such as financial services, who are gently prodding the bear. Being informed about the benefits and the pitfalls of a new technology is the first step in creating a well thought through strategy to embrace it, or not, as the case may be. At the moment there are four

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countries, for example, who are leading the quantum computing revolution and investing heavily in commercialising the technology, namely China, the UK, the US and Germany, and there are plenty of people and consortia that executives can sit down and talk to.

Given that it’s a very new and relatively untested technology, are there opportunities for insurers to create related products?

Technology is always great at helping organisations and industries create net new value – just as it’s also great at helping destroy old paradigms and “old” value. As with most technologies most companies first look at how these new technologies can save them money, and, or improve operational efficiency, and then they look at net new value creation.

I’d argue that in this time of rapid change organisations should try to quickly evaluate all three, and evaluating the upsides of these technologies can be done in days and weeks not months and years. From an insurance perspective some of their new opportunities will revolve around the fact that they can analyse more data, faster to extrapolate better risk projections which, on the one hand could let them provide dynamic

pricing, but also help them better model systemic risk patterns that are an increasing by product of the world that we live in, for example, in the fields of cybersecurity, healthcare and Internet of Things, to name but a fraction of the opportunities.

The immense data analysing power delivered by quantum computing has the potential to greatly reduce uncertainty levels in predicting outcomes. Given that the industry essentially provides protection against uncertainty, could it spell the end of insurance as we know it? Quantum computing will certainly change the way insurers operate their businesses and model their risks, but overall the amount of risk in the world, whether it’s social, technological, economic, environmental or political, is reaching epidemic proportions and that’s only something that’s going to escalate.

Take quantum computing itself, for example, its ability to brute force crack so many of today’s most popular encryption standards will mean that the risk of a criminal taking down a critical national system, such as a power grid or an air traffic control system, increases not decreases and, from an insurance perspective, with increased risk comes increased opportunity – that is provided you can model the impact correctly and

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that will be the skill that differentiates the insurance companies of the future. Ergo, the opportunity for insurers to carve out new markets for themselves and build out new revenue streams is staggering.

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AN ABUNDANCE OF RISK AND OPPORTUNITY

IT IS clear that many insurers feel that their established approaches to risk management are being outflanked and outpaced by the accelerating pace of change and the new inter-connectedness of new, and evolving risks.

There are a multitude of intersecting, disruptive forces that are helping to reshape the global risk landscape, and I believe that their impact on businesses, brokers, insurers, re-insurers and governments can be best summarised using the STEEP framework, although, of course, the devils are in the details.



SOCIAL

NOT ONLY is social media and the increasing inter-connectedness of global society changing how customers and businesses engage with one another but it is also helping organisations surface and analyse huge volumes of otherwise hidden, valuable data which can be used to increasingly help personalise customers services and experiences.

However, these benefits come with the cost of virality, where negative or fake news can damage reputations and destroy brand equity quicker than ever before, leading to value erosion and destruction, that can ripple through an industry, or ecosystem, in real time.

TECHNOLOGY

TECHNOLOGY ENABLES, enhances and underpins almost every aspect of our every day lives, and it is no secret that society's inter-connectedness has led to the dramatic acceleration of the adoption of new technological trends and behaviours which are transforming the world at an increasingly rapid rate. This new reality brings both challenges and opportunity.

For brokers technology can streamline and enhance information flows while at the same time helping them to surface new patterns and risks and reducing the cost of distribution and service provision. Consequently, it is opening up new ways of working with risk managers, insurers and reinsurers, and providing the basis for richer discussions and sharper insights.

However, the rapid pace of business, cultural and societal technology fuelled change brings challenges across all of the different market segments that insurers operate in. For brokers whose client base includes large risk management accounts there is an ever present disparity regarding fees and expenses. Standardised placement options would allow for greater cost controls but consulting activities and the requisite intellectual capital to provide appropriate solutions to emerging issues

will create alternative costs that must be divided between clients and insurers.

Similarly, while new placement platforms can provide cost effective options for commission based mid-market clients, greater systems compatibility and easier information flows between brokers and carriers may be needed to realise the full value of these developments.

Technology also increases the chances of contagion and systemic risk. As the world becomes increasingly inter-connected cyber is obviously a top concern, but of as much of a concern to insurers should be the architecture of the internet itself. As every business on increases their reliance on cloud computing and internet enabled services an attack on the centralised systems at the heart of the internet, for example, the Domain Name Server (DNS) systems, can have a continental wide effect - a topic that is especially pertinent in the aftermath of one of the world's largest DDoS attacks which knocked most of the US east coast and Europe offline in October this year.

Many organisations, by their own admissions, struggle to protect themselves against increasingly sophisticated cyber attacks, which are growing in number and magnitude every year, and the war, if that's what we want to call it, is

just beginning as a new generation of AI powered “Robo-hackers,” which can outperform their human counterparts by factors of millions, not thousands or tens, to one, ascend and move on from just targeting confidential and personal data, to targeting, and perhaps even holding to ransom, fleets of autonomous vehicles, connected “things” - such as Implanted Medical Devices (IMD’s) and industrial equipment - or Critical National Infrastructure (CNI).

Meanwhile developments in other fields, such as 3D printing, genetics and nanotechnology, to name but three, also present new, hitherto unquantified risks, and the opportunity for mischief and new forms of value destruction.

3D printing is swiftly ushering in a new era of healthcare where we will be able to print generic, or customised body, parts on demand, then down the hall, in the world of genetics, revolutionary new gene editing and transmission technologies such as CRISPR, and the Gene Drive - which are both capable of great good - have already shown that they can also be used to create new terrifying bio-weapons and eliminate entire categories of species, such as mosquitoes, and potentially even humans, within short time frames, all with unquantified consequences.

Additionally, new advanced manufacturing techniques have also helped to significantly lower the bar, and cost, of creating new nano based products. A multitude of companies, ranging from small independents to giant multi nationals are now bringing it to market new nano, or nano enhanced products that range from cosmetics and food to new materials and healthcare treatments, any one of which could produce unforeseen consequences and risks.

ECONOMIC

BETTER RISK awareness, mitigation and protection play an essential role in helping to bolster, and sustain global growth, but today there is a widening protection gap. As a consequence under insurance poses a significant threat to growth and their ability to adequately, and swiftly, recover from disasters or other catastrophic events. Meanwhile increasing globalisation, and the increasing rise of distributed supply chains are also causing concern among insurers who are increasingly concerned about the potential domino effects where a catastrophe in one area could have negative, unintended and unforeseen consequences in another.



ENVIRONMENTAL

INSURERS CATASTROPHE liabilities are also being heightened by the increasing value of assets present in APJ, LATAM and other fast growing regions where huge territories are often subject to, and vulnerable to, extreme climactic and, or seismic events. Additionally poor risk management and governance practises in these regions, coupled with inadequate information are often insufficient enough to ensure risk and pricing adequacy.



POLITICAL

INCREASINGLY THE governments of many state run insurance sectors, such as China and India lack the desire and capability to absorb their countries fast rising insured values, and even in more mature markets many governments have demonstrated that they are less able, and less willing, to play the role of “insurer of last resort,” especially if a major, or multiple, loss event occurred.



SUMMARY

IN MANY respects insurers are starting to face the perfect storm. While each of the STEEP drivers can create new and difficult to navigate challenges most insurers are concerned about the disruption that comes about as and when they combine, and we've already seen examples of this so called perfect storm. Such as the virtually simultaneous occurrences of Hurricane Ike, fears over a possible avian flu pandemic and the collapse of Lehman Brothers in 2008.

As a result it is only natural for insurers to ask "What if?" as the risk of loss is likely to continue to increase, not decrease.

Given the potential for sharply rising losses and ever more complex loss drivers the evolving risk environment can no longer be managed solely using traditional approaches.

Solving these complex and potentially dangerous, or disastrous, challenges requires a comprehensive risk facilitation leader to educate, promote and co-ordinate solutions across a range of stakeholders including corporations, insurance and reinsurance companies, capital markets, and policymakers.

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IMPACT ON LINES OF BUSINESS

FROM THE impact of analytics, digitisation and greater customer expectations to the disruptive effect of regulation, geopolitical instability and two speed global economic growth, the insurance marketplace might not look very different in 2020 but it will certainly feel different.

In the face of rising commoditisation and renewed pressure on prices forward looking insurers are already envisioning new ways to capitalise on higher margin opportunities and grow their footprint in new fast growth markets. The future belongs to those organisations who can filter out the noise, see the wood for the trees, and who can develop and execute a proactive, rather than a reactionary, response.

While some of the drivers of change in the insurance industry are common to all of their lines of business the impacts will be seen in different ways and occur at different speeds.

So what are the implications for each key insurance segment and how can organisations capitalise on them?



ANNUITIES, LIFE AND PENSIONS

- The ascension of new wearable and connected technologies, as well as the quantified self, allow insurers to take a more proactive and preventative stance and lead to the formation of new relationships with a new ecosystem of partners that includes gyms, diet and fitness advisors and health care providers. As these technologies become more widely available and adopted there is increasing interest in these types of well-being solutions from an increasing range of demographic groups

- Increasingly advanced analytics capabilities that improve the accuracy, flexibility and personalisation of new financial planning and risk protection solutions will pave the way for solutions that can quickly adapt to an individuals changing circumstances and stretch beyond insurance to encompass a range of financial needs

- New biotech, nanotech and sensor technologies will lead to tighter integration and better information sharing between insurers and healthcare providers which will help insurers gain a better understanding of the risks and costs involved and potentially provide better access to cover for people with pre-existing conditions, as well as helping to promote health and longevity throughout the general population

- New well-being solutions would allow insurers to offer shorter term life cover contracts, which, against a backdrop of growing apathy towards longer term contracts, something that is particularly prevalent in the Millennial generation, might help to encourage people to more readily take up cover



COMMERCIAL

- As the broader marketplace continues to evolve the risk environment is more dynamic now than it has ever been. Consequently commercial lines insurers have a significant number of growth opportunities, many of which might not be obvious at first, that are yet to be fully realised. These include, but are not limited to, artificial intelligence, bots, cyber, drones and “robo” systems, nanotechnology, personalised healthcare, supply chains and many more

- Alternative risk transfer will continue to develop and expand, moving beyond catastrophe into areas such as cyber and supply chain risk

- The use of advanced analytics, combined with access to an increasing variety of data sources, will help insurers better quantify exposure patterns that could help to mitigate the frequency of accidents, business interruption and other losses.

- The potential for rapidly escalating losses in an environment that is increasingly packed with complicated and inter-connected loss drivers means that there will be a growing need for co-ordinated risk management solutions that bring together a range of traditional and non-traditional stakeholders, including

academia, capital markets, corporations, insurance and reinsurance companies and policy makers. And there may be examples, particularly in more complex situations, where brokers will need to facilitate the creation of effective solutions.

PROPERTY AND CASUAL



- The increasing use of automation in underwriting, and increasing pressure from top line aggregators look set to increase the downward pressure on prices for motor, property and other core lines of business. However, in the information led economy, new opportunities will continue to present themselves in both traditional areas of insurance coverage as well as new areas where insurers will find that they have access to more personalised information on their customers, and their customers environments and living circumstances.

- Some customers, particularly Millennials, have indicated that they would be willing to give insurers greater access to their personal data - including blood results - provided they receive clear benefits

- Continued downward pressure on costs will make agency channels less economically viable and could lead to digital becoming the channel of choice. That said, there will continue to be a strong role for agents who can help asset rich, or asset heavy, time poor customers navigate and manage complicated protection needs

- New opportunities exist to form new relationships further up the chain with a new ecosystem of automotive,

construction, manufacturing and transportation organisations, however, by forming new relationships insurers must be careful that these don't supplant, or degrade, their own customer relationships or insights

- Individual, aggregated and crowd sourced vehicle and consumer telematics offer new opportunities for data sharing and new insights into product and consumer behaviours that will bring on a new age of predictive and proactive insurance that will allow insurers to predict, intervene and remedy issues before they happen, or before they grow into larger claims

- As autonomous vehicles become more commonplace it is inevitable that the number of vehicle related claims will reduce but the emphasis will move from driver liability to product liability, meanwhile connected vehicles will also be more susceptible to new risks, such as cyber and software, or AI related, malfunctions

- Insurers revenue models will change, in some areas premiums will decline, but the impact of this could be offset by a growth in new subscription services that focus more on maintenance, management, prevention and support

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AROUND THE WORLD IN 18 INDUSTRIES

THE WORLD around us all is being reshaped, and changed, with increasing velocity and voracity, and, for the prepared insurer, these changes, which are already starting to permeate every corner of society present them with an almost limitless supply of opportunities.

Driven by human ingenuity and fuelled by increasingly accessible and powerful technologies we live in one of the most rapidly changing times in human history. Arguably, as you'll witness for yourself by reading what follows, we are standing on the edge of a new human epoch where no corner of society will be left untouched by the transformation taking place right before our eyes.

As I shared in the preface I believe that the insurance industry is unique because, unlike many other industries, its services help support and protect every conceivable activity and every industry - both on and off world.

As a consequence it's this unique, and often acute exposure, to every strata of society, that on the one hand keeps executives awake at night, but on the other presents the industry with a limitless amount of opportunity to manage risk, and protect people and assets, that makes the insurance industry one of the

most exciting industries to be a part of today.

What follows is a very brief summary of every industry on Earth and how they're being impacted by the emergence of new technologies and products.



AGRICULTURE

THE PACE of change within the agricultural sector over the past decade has been slow. However, with the rise of new technologies and operating platforms I expect the pace of change to become moderate during the course of the next decade, after which it will begin to accelerate further. Key developments in this sector include:

- Automated vertical farms; which are now being rolled out in New York and other urban centers, especially Japan, can produce nine crops a season at hitherto unseen levels of efficiency.
- Disease mitigation; new genetically engineered symbiotic insect delivery systems are being developed in the US that will re-vitalise, and rejuvenate dying, and diseased crops.
- Gene editing and Gene Drives; researchers are now able to create, and bring to market, new crops with new traits, such as drought resistance and improved photosynthesis, at least ten times faster than before.
- Microbiome agriculture; breakthroughs in gene editing and mass culture manufacturing are helping farmers to boost crop yields by at least 20%
- Drone survey systems; new

autonomous hyperspectral drone systems can help farmers boost crop yields by 30% and reduce the use of chemicals.

- Lab produced foods; created using a mixture of stem cells and 3D bioprinting technologies, some of which now have FDA approval.
- Precision agriculture; using a combination of sensors, sensor fusion networks and Internet of Things technologies farmers are able to precisely target specific.
- Real time satellite tasking; new, massive satellite networks that now cover every square inch of Earth's landmass can monitor crops with hitherto unprecedented detail.



AUTOMOTIVE

THE PACE of change within the automotive sector over the past decade has been slow to moderate. However, with the rise of new business models, technologies and operating platforms I expect the pace of change to become fast during the course of the next decade, a rate that will continue to at least 2037. Observers will begin to see the industry flip, moving from the traditional business and operating model that promotes car ownership, to a new service based model in 2020 and 2021. Key developments in this sector include:

- Autonomous cars; there have been significant advances in the technology and platforms but, according to DHTSA reports, over 2,500 "bugs" still remain, that said though regulators are softening their stance with respect to autonomous cars and Michigan and Singapore have become the first territories to allow autonomous cars on their public roads without the need for a driver to be present.
- Electric vehicles; new high density batteries, three times as dense as today's systems will come into production this year, led by Tesla, increasing the range, and reducing the cost of today's EV's by multiples
- EV charging networks; China, Europe

and the US have all announced that they will be investing in, and deploying hundreds of thousands of miles of electric charging corridors over the next decade.

- Polymers; a new breakthrough polymer developed in the UK will let electric vehicle customers fully charge their vehicles within twenty seconds, and the technology has the potential to completely replace today's current Lithium-ion battery technology.
- Sensors; the cost, complexity and size of the sensor systems, such as Lidar and new metamaterials, that are used to improve the performance and safety of autonomous car platforms have fallen dramatically, in some cases by a factor of more than fifteen.



AVIATION

THE PACE of change within the civil aviation sector over the past decade has been slow and steady, however, with the rise of new technologies and operating platforms I expect the pace of change to become moderate during the course of the next decade, after which it will begin to accelerate again. Key developments in this sector include:

- Biofuels; the industry's attempts to commercialise and bring to market low emission, low cost biofuels has been peppered with disappointment but now significant advances in gene editing and new forms of algal and cellulose biofuels could put them back on the agenda.
- Electric flight; many industry players believe that the future of aviation specifically regional aviation, is electric, at worst hybrid, and now vendors such as GE and Rolls Royce are slating the delivery of fully electric, fan driven power plants by 2030.
- High altitude systems; if you want to fly faster without burning insane amounts of fuel then you have to fly higher, as a consequence most new aircraft platforms are being trialled at altitudes in excess of 60,000ft.
- Hypersonic and supersonic aircraft; it is clear that the industry has not given

up on developing, or commercialising, high speed aircraft capable of mach flight. The field is being pushed forward, albeit slowly, by the development of new heat resistant hypersonic materials and new aircraft designs that suppress the sonic boom. The ability to counter act, or suppress the sonic boom would allow these new aircraft to fly at mach speeds over land, a problem that has plagued operators since the first Concorde entered service in 1969.



BUSINESS SERVICES

THE PACE of change within the business services sector over the past decade has been slow. However, with the rise of new business models, technologies and operating platforms I expect the pace of change to become moderate during the course of the next decade, after which it will begin to accelerate to moderate to fast. Key developments in this sector include:

- Artificial intelligence; it is easy to argue that AI will, and to some degree already is, transforming the heart of the industry. However, in future years it is likely that AI will be the core around which all other products, operations and services are built. Additionally, as AI's capabilities improve and expand, especially as we head towards the point where we finally realise Artificial General Intelligence (AGI) in circa 2035, the pace and scope of automation, of both knowledge workers and operations, will undoubtedly increase to the point where in the mid 2030's I would expect us to see the rise of the first viable, enterprise grade autonomous organisation.
- Blockchain; still very much a nascent technology it is already clear that blockchain's impact on the industry will be nothing less than transformational. It's ability to help organisations lower costs, cut complexity, enable realtime

processing and settlement, aswell as its ability to streamline and automate the execution of contracts and dramatically enhance today's security models, will continue to be the drivers that accelerate its adoption and use throughout the industry.



COMMUNICATIONS

THE PACE of change within the communications sector over the past decade has been slow with most incumbents embracing M&A and content driven strategies to gain market share. However, with the rise of new business models, technologies and operating platforms, and the emergence of new, well backed disruptors I expect the pace of change to become moderate to fast during the course of the next decade, after which it will begin to stabilise again. Key developments in this sector include:

- 5G; Ericsson recently demonstrated the world's first end to end 5G capability running at 19 Gbps. SK Telecom in South Korea, Telstra in Australia and Verizon in the US look set to be the first companies to roll out 5G services starting 2018, two years before the standard is globally ratified.
- High altitude platforms; many of today's operators realise the limitations, and cost, of burying and installing fibre optic cable. As a consequence new disruptors, including Google, Facebook and SpaceX are now building out stratospheric drone systems and low orbit satellite networks that will connect the last 3.5 billion people and deliver internet connectivity to every point on Earth, disintermediating the incumbents in

the process.



DEFENCE

THE PACE of change within the defence sector over the past decade has been moderate and steady. However, with the rise of new technologies and operating platforms I expect the pace of change to become fast during the course of the next decade, after which it will accelerate again, to become fast to exponential. Key developments in this sector include:

- 3D printing; while this technology is still in the ascending phase of its development companies, including GE, have managed to demonstrate that it is capable of being used to manufacture industrial grade avionics components. In 2016 we saw the first use of 3D printing by the US Marines to create the world's first printed munitions and ordnance.
- Artificial intelligence; while artificial general intelligence is still regarded as some way off AI is already being used by the US military, and others, to help automate and optimise a wide variety of military operations, including the "Kill chain." It is also beginning to turn into the preferred offensive and defensive weapon of choice, both in the real world and the cyber world. In 2016 we saw the first time an AI managed to out perform US Top Guns in autonomous aerial manoeuvres by a factor of 250:1 and we saw the creation of the first pure play AI

robo-hacking systems, a trend that will continue to accelerate over the coming decade.

- Autonomous weapons platforms; at the moment, officially, there are no fully autonomous "Kill chain" systems operating anywhere in the world. However, it is clear that the ability to conduct fully autonomous war, using autonomous-capable platforms, that include the \$4.5Bn US Navy Zumwalt destroyer class and minesweepers, Russian autonomous nuclear drone submarines and an over whelming number of multi national autonomous drone platforms, is already here. In 2016 Lockheed Martin successfully demonstrated the world's first fully autonomous Kill chain system using a combination of Autonomous Underwater Vehicles, Autonomous Aerial Vehicles and a fully automated, and integrated, command and control system.
- Blockchain; the Pentagon have recently announced that they plan to move the entire US military, and all its assets, onto the blockchain. This will have a significant impact on the efficiency of their supply chain and their operations.
- Drones; in 2017 the US Air Force will stand up the world's first, fully autonomous drone squadron based

out of Jacksonville, Florida. Drones, and more specifically, drone swarms, are increasingly being used alongside existing weapons platforms including the combat aircraft, ships, submarines and tanks to augment their capabilities and range, these new drone systems can be controlled either using AI, or directly via human input.

- High altitude stratospheric platforms; over the next five years five global organisations will be deploying stratospheric, and low Earth orbit, drones and satellites that will blanket the entire planet with internet connectivity and that will help to connect the last 3.5 billion people on the planet. This means that armed forces, who often operate in extremely remote areas will be able to leverage all of the benefits of today's connected world to deploy new platforms and improve the efficiency and effectiveness of their operations.

- Molecular assemblers; a technology that supersedes 3D and 4D printing, in 2016 the UK Ministry of Defence (MOD) and British Aerospace (BAE) announced the first successful trial of a molecular assembler to "grow" a basic drone.

- Quantum computing; the ability to complete complex calculations and optimisation problems 100 million

times faster than today's logic based computing systems means that within the next ten to fifteen years over 70% of all of today's encryption algorithms will be cracked, potentially opening up a new era of cyber warfare. In addition, however, it will also open the door to new AI, energy and materials breakthroughs which will push the defence sector into a new era of exponential innovation.

- Quantum networks; in 2016 Canada and China were the first two countries to build the first significant implementations of two quantum networks. However, once thought to be unhackable researchers have now proved that these new, ultra secure networks can be hacked.

- Robots; there have been some significant advances in robotics, particularly from companies such as Boston Dynamics. Most of these developments have focused on agility, manoeuvrability and speed and as a result robots are increasingly being used by the world's military to carry and help transport supplies and arms.

EDUCATION

THE PACE of change within the education sector, specifically the lower education sector, over the past decade has been slow and I expect this pace to continue during the next decade. In the higher education sector, however, it is clear that the pace of change is moving from slow to moderate as we continue to see the emergence of new business models and a steady increase in the amount of investment and resources being poured into a broad range of research activities. Key developments in this sector include:

- Virtual reality; more schools are beginning to experiment with augmented and virtual reality systems as a means to teach people, and immerse them in new educational experiences.



ENERGY

THE PACE of change within the energy sector has always been slow, in part because of the size and the complexity of the projects involved in bringing energy to the mass market, and also in part, arguably, because the fundamentals of the industry have changed little since the 19th Century. However, with the rise of new business models, technologies and operating platforms I expect the pace of change to become moderate during the course of the next decade. Key developments in this sector include:

- Blockchain; this technology is the great leveller, before it's emergence there were very few ways to disrupt the sector. In 2016 we saw the first blockchain application, from GE and Nasdaq, which creates the world's first distributed energy system that disintermediates the current incumbents and all of their associated infrastructure.

- Gene editing; an unexpected addition, however it's importance the energy sector should not be underestimated, especially in APJ, where it is increasingly being used to engineer new biological organisms that can produce new forms of high density, clean energy.

- Global energy grid; in 2016 a number of consortium's from China, Europe,

Japan, Korea and Russia began working together on a project to join the world's energy grids together. Starting in 2021 this will democratise the global energy system and allow consumers to draw power generated from almost any point on the planet, from any source.

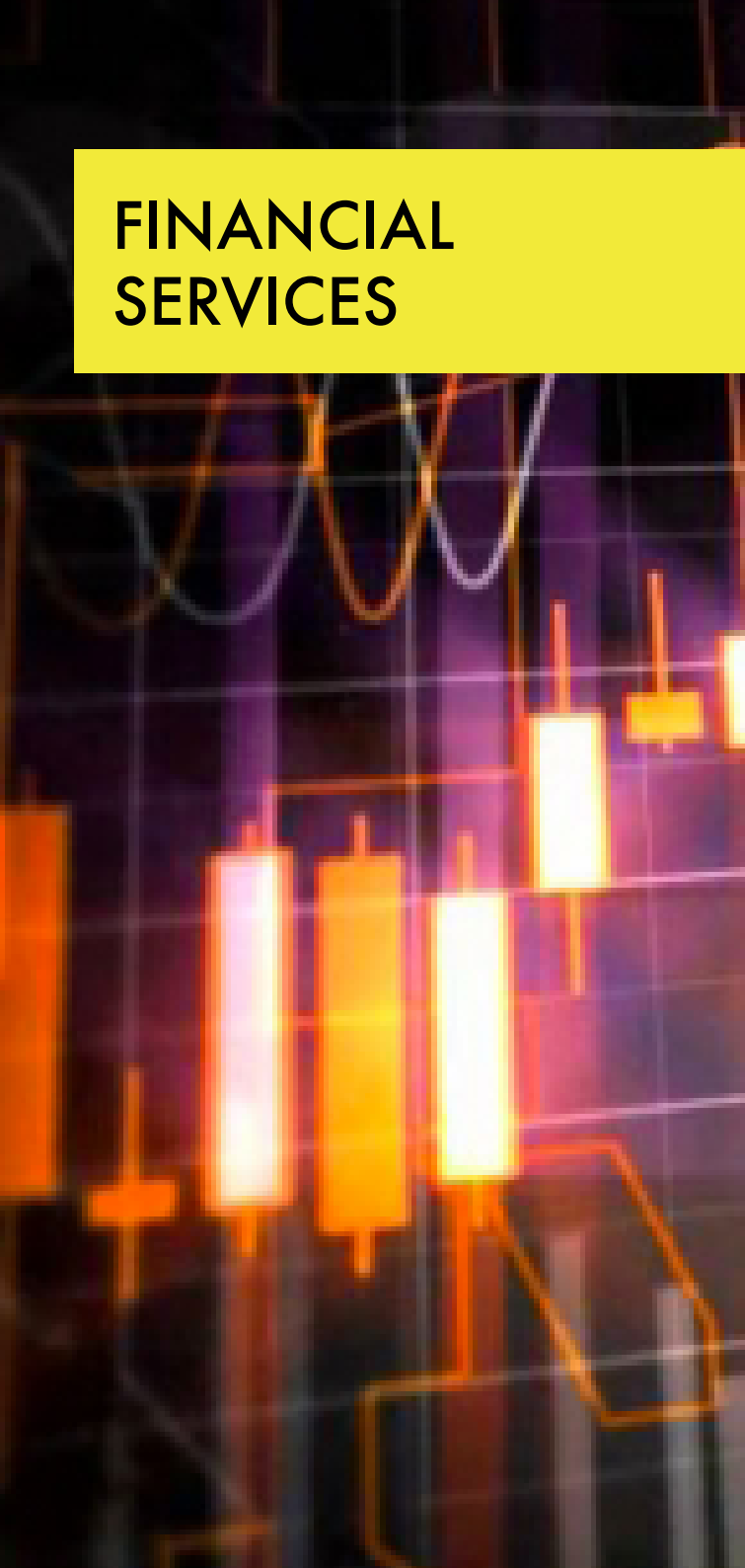
- Graphene; this wonder material has recently been used to create new "all weather" solar panels that produce electricity from both rain and sun.

- Grid scale storage; in 2016 we saw significant developments in the field of supercapacitors, including the world's first carbon free supercapacitor, which could finally move the industry away from large and expensive sodium and urea based battery systems. The lack of true grid scale storage systems is arguably one of the very few things preventing us from realising the full benefits of renewable energy whose peaks and troughs in power generation still make it a relatively unstable, power source.

- Renewable energy; in the past year solar power has become the cheapest form of energy in over 58 non-OECD countries, and with tens more Gigawatts of capacity coming online in Africa, China, India and the US the costs will be sure to fall further. Meanwhile advances

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in tidal and wind power platforms are also eating into fossil fuel's market share, albeit at a slower rate.

A background image for the Financial Services section featuring a dark, abstract design with glowing orange and yellow lines and shapes, resembling a stylized financial chart or data visualization.

FINANCIAL SERVICES

THE PACE of change within the financial services sector over the past decade has been slow and steady. However, with the rise of new business models, technologies and operating platforms I expect the pace of change to become moderate during the course of the next decade, after which it will accelerate again, albeit incrementally. Key developments in this sector include:

- Artificial intelligence; while many people will be familiar with the traditional uses cases associated with artificial intelligence in the financial services sector, such as automation and big data analysis, fewer will perhaps be aware that it is now being used as the to build fully autonomous organisations such as Aidyia, a fully autonomous hedge fund, and Bridgewater Associates, the world's largest hedge fund which it is estimated will be fully automated by 2030.
- Blockchain; often associated with phrases such as the "Internet of finance," blockchain shows great promise but as with any new technology, especially one as revolutionary as blockchain, there is a long period of discovery and due diligence as organisations, and regulators, try to understand both the upside and the downsides of the technology. At the moment the majority

of organisations are experimenting with the technology, but not prioritising it, and we're seeing a rise in the number of patent applications. That said though many financial services organisations expect to publish their first production blockchain applications in, or around 2019 and we can see clear signs that organisations are increasingly serious about using the technology for their advantage, whether that is to automate back office functions, simplify and streamline regulatory processes, speed up claims handling or simply to transform the \$5.1 Trillion a day FX industry.

A background image for the Healthcare section featuring a blue, glowing, abstract design with a central DNA double helix structure and other organic, flowing lines, suggesting a high-tech medical or biological theme.

HEALTHCARE

THE PACE of change within the healthcare sector over the past decade has been moderate. However, with the rise of new technologies and operating platforms I expect the pace of change to become moderate to fast during the course of the next decade, after which it will begin to accelerate to fast. Key developments in this sector include:

- 3D bioprinting; over the course of the past year 3D bioprinting technology has come a long way and scientists have now used the technology to print functioning, personalised human blood vessels, bone, brain structures, heart tissue, kidneys and skin on demand. As the technology continues to develop one day we will see the end of organ donation programs and a corresponding decrease in mortality rates.
- Designer babies; in 2016 we saw the birth of the world's first designer baby in Mexico, quickly followed up by two designer baby births in the UK. These were the first approved designer babies to be born, and they were born without their parents hereditary diseases. The UK's NHS has now cleared the path for more designer babies to be born over the coming year and more are expected in China and the US. This will be the beginning of a new trend.

- Digital twins; researchers have been able to combine fMRI, MRI, ultrasound and X-Ray scans to create complete digital twins, or avatars, of people and now the technology has been adopted by the US Army to help it better treat wounded soldiers on the battlefield. Healthcare providers can use these digital twins, which can be manipulated using touch screen tables, to create a baseline of a person's physiology so in the event they are injured, or succumb to disease, doctors can instruct 3D bioprinters to print out personalised replacement body parts on demand.

- Gene drives; one of the most promising, but also the most dangerous technologies in existence, and the subject of a recent UN vote, gene drives, when combined with new gene editing techniques, will allow doctors to permanently eradicate a multitude of inherited genetic diseases.

- Gene editing; recent, significant advances in real time gene editing, using technologies such as CRISPR-Cas9 and CRISPR-Cas3 have opened the door to new treatments that can create vaccines for cancer, cures for blindness, deafness, Ebola and HIV and cure over 6,000 of today's incurable diseases, as well as create new lifeforms that are resistant to

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every known virus on Earth.

- Human genome project; scientists from Harvard, MIT and UCL have announced that by 2036 they want to be able to create the world's first artificial human genome, while this first requires the entire human genome be mapped, it also means that by 2036 we could create the world's first completely artificial human.
- Nanotechnology; one of the biggest problems with many of today's drug delivery systems is that they are often indiscriminate and flood all of, or large parts of, the body with drugs, creating side effects and reducing their efficiency. New nanotechnology delivery systems, which can either be controlled using a person's brainwaves, steered using light or magnets, or which can propel themselves using small enzyme engines in the same way submarines move around an ocean, have all demonstrated that they can deliver drugs in a precise and targeted manner to where they're needed. In addition to this use case though researchers have also been able to use small nanites to find, engage and genetically edit diseased and cancerous cells, and repair tissue.
- Personalised medicine; the low cost of gene sequencing, combined with the rise in new 3D bioprinting, human-hybrid

chimera's, gene editing and stem cell technologies means that for the first time healthcare providers are beginning to get to the point where they can offer, albeit on a limited scale for now, truly personalised drugs, therapies and treatments.

- Regenerative medicine; new advances in stem cell technology, and a relaxation in regulations, are helping to push this field forwards, as a consequence scientists are now getting closer than ever before to being able to create, grow and personalise new human organs in the lab.
- Stem cells; this technology has been on a slow burn for the past two decades, but now it is on a tear. Recent breakthroughs in creating generic stem cells, which are magnitudes easier to store and process than their traditional counterparts, as well as the creation of new synthetic stem cells have meant that they are much easier, and much more practical, to work with than before. As a result doctors have now been able to use stem cells to 3D bioprint new, personalised human organs and organelles, repair damaged heart tissue, reverse blindness and paralysis and halt the development of Multiple Sclerosis, all of which is just the beginning.

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- Virtual reality; researchers from the UK's Cancer Research Institute are using virtual reality tool kits to create walk through simulations of patients tumours. These walk through simulations, which allow doctors to zoom in to the cellular level, and augment the tumours with additional data, have already been shown to reduce patient mortality rates.



MANUFACTURING

THE PACE of change within the manufacturing sector over the past decade has been slow, however, with the rise of new technologies and operating platforms I expect the pace of change to become moderate during the course of the next decade, after which it will begin to accelerate, potentially becoming fast. Key developments in this sector include:

- 3D printing; sometimes also known as additive manufacturing is perhaps one of the biggest elephants in the room. The rise and advance of 3D printing over the past five years has been staggering. While the technology has by no means hit the mainstream yet the fact that it is increasingly cost effective, portable, sustainable and versatile, coupled with its ability to help organisations collapse supply chains, print products - that range from bones and human hearts, to buildings and shoes - on demand, offer new personalisation options and discrete low volume runs means that it is inevitable that over time it will be the manufacturing technology of choice.
- Biomanufacturing; in many cases it is easy to pass this technology by, however, new gene editing and synthetic biology tools and techniques mean that organisations are increasingly able to use

biomanufacturing as a means to produce new chemicals, drugs, energy products and materials.

- Generative design; still a relatively new discipline this is the new name being assigned to a new generation of creative machines that are increasingly being used by companies as diverse as General Electric and Under Armour to design, and more specifically innovate, new products and services.
- Molecular assemblers; while still very much a nascent emerging technology molecular assemblers represent the future of manufacturing and will one day usurp 3D and 4D printing as the main way to manufacture and produce goods. Certain organisations and universities have already shown that it is possible to use molecular assemblers to “grow” simple drugs, such as painkillers, and products, such as drones, in what essentially what amounts to vats of liquid. In the past three years the technology has advanced significantly.
- Nano-manufacturing; it can be said that nano-manufacturing is now beginning to see its day in the sun as it is used to manufacture everything from new nano-ceramics, that will help countries build significantly more powerful nuclear reactors, to new drugs and new virus

Notes:

sized transistors and computing devices. One of the most promising fields however is nano-materials where industries as diverse as sports and defense are increasingly coming to rely on new nano products to create competitive advantage.



MEDIA AND ENTERTAINMENT

THE PACE of change within the media and entertainment sector over the past decade has been moderate to fast. However, with the rise of new business models, technologies and operating platforms I expect the pace of change to become moderate to fast during the course of the next decade, after which it will potentially move to fast. Key developments in this sector include:

- Artificial intelligence; increasingly artificial intelligence, specifically machine learning and cognitive computing, is being used to curate and distribute new content. In the movies it's writing the scripts, and in journalism circles, the news; managing casting and hiring, directing autonomous camera drones and shooting scenes, constructing new CGI artefacts and music, and editing movies.
- Hi definition rendering; over the past two years this technology has come on leaps and bounds, and it has now overcome the problems associated with "canny valley" to the point where consumers are no longer able to tell the difference between a real actor, object or scene, and the real thing.
- Wavenets; new advances in WaveNet technology, primarily thanks to Deep Learning platforms like DeepMind, now mean that computers, bots, and smart

assistants are able to communicate and talk with users not just in natural language but, more importantly, in natural voices. The technology is now so advanced that people can't tell the difference between machine systems and real operators, with the added benefit that these new systems can be simply programmed to talk with regional accents, and real feelings.



NATURAL RESOURCES

THE PACE of change within the natural resources sector over the past decade has been slow. However, with the rise of new technologies and operating models I expect the pace of change to become moderate during the course of the next decade, after which it is likely to stabilise and remain steady. Key developments in this sector include:

- 3D printing; an unlikely ally 3D printing technologies are now being used to, on the one hand, help organisations print replacement parts and products on demand, and on the other, helping conservationists rebuild dead and dying reef systems.
- Autonomous vehicles; the mining industry particularly is starting to embrace autonomous vehicles and they now operate some of the largest autonomous vehicles, such as the 250 ton Komatsu dump truck, in the world.
- High altitude stratospheric platforms; over the next five years five global organisations will be deploying stratospheric, and low Earth orbit, drones and satellites that will blanket the entire planet with internet connectivity and that will help to connect the last 3.5 billion people on the planet. This means that natural resource companies, such as BHP Billiton and Anglo American, who often

operate in extremely remote areas will be able to leverage all of the benefits of today's connected world to improve the efficiency and effectiveness of their operations.

- Blockchain; increasingly organisations in the natural resources sector are turning to blockchain to help them transform their supply chains, a good example of this is BHP Billiton who recently moved their platinum and rare earth's operations onto the blockchain.
- Robots; at first glance their relevance to this sector is unimportant, however, they are increasingly being used by conservationists to catch poachers, and kill invasive species such as Lionfish in Florida and the Crown of Thorns starfish on the Great Barrier reef.



PUBLIC SECTOR

THE PACE of change within the public sector over the past decade has been slow to moderate, but while the nature of public services, and how they are delivered are changing substantially, given the bureaucratic nature of the sector I expect the pace of change to at worst remain steady, and at best accelerate to moderate. Key developments in this sector include:

- Artificial intelligence; increasingly AI is being used to automate cognitive work in the public sector, over the next ten to fifteen years it is estimated that around 80% of all public sector works jobs could be at risk from AI - particularly those people in administrative, back office and customer service roles.
- Blockchain; in the past year we have seen a number of governments around the world consider moving their digital government programs onto the blockchain. The two best examples of this are the US government and the UAE whose programs are both ambitious, and all encompassing.
- Smarter cities; one of the greatest challenges faced by governments around the world is the fact that most departments, and decision making, sits in silos. As a consequence creating and deploying what we call “living

services” is often complex and politically problematic. Smarter cities that often help tear down these barriers are now being rolled out in earnest in Brazil, China, India, Korea, Spain, the UK and the US, with other countries following at a slower pace.



RETAIL

THE PACE of change within the retail sector over the past decade has been moderate to fast. However, with the rise of new business models, technologies and operating platforms I expect the pace of change to become moderate to fast during the course of the next decade, after which it will begin to accelerate to fast. Key developments in this sector include:

- Artificial intelligence; the primary role of AI within the retail sector is to help retailers automate and optimise operations and to help them improve customer insights and create and deliver new personalised messages and services.
- Bots; increasingly bots are being seen by retailers as an opportunity to both help them reduce costs and improve their quality of service to customers.
- Drones; increasingly drones are being deployed by both brick and mortar and online retailers to help them reduce delivery times.
- Machine vision; as artificial intelligence and deep learning improve their ability to recognise both still images and moving video, and as we see new AI chips being developed that allow the image processing to be done at the edge of the network, we will increasingly see

new camera and CCTV systems that can stream see, understand and respond to events in real time - whether those events are security events, or consumer behaviours.

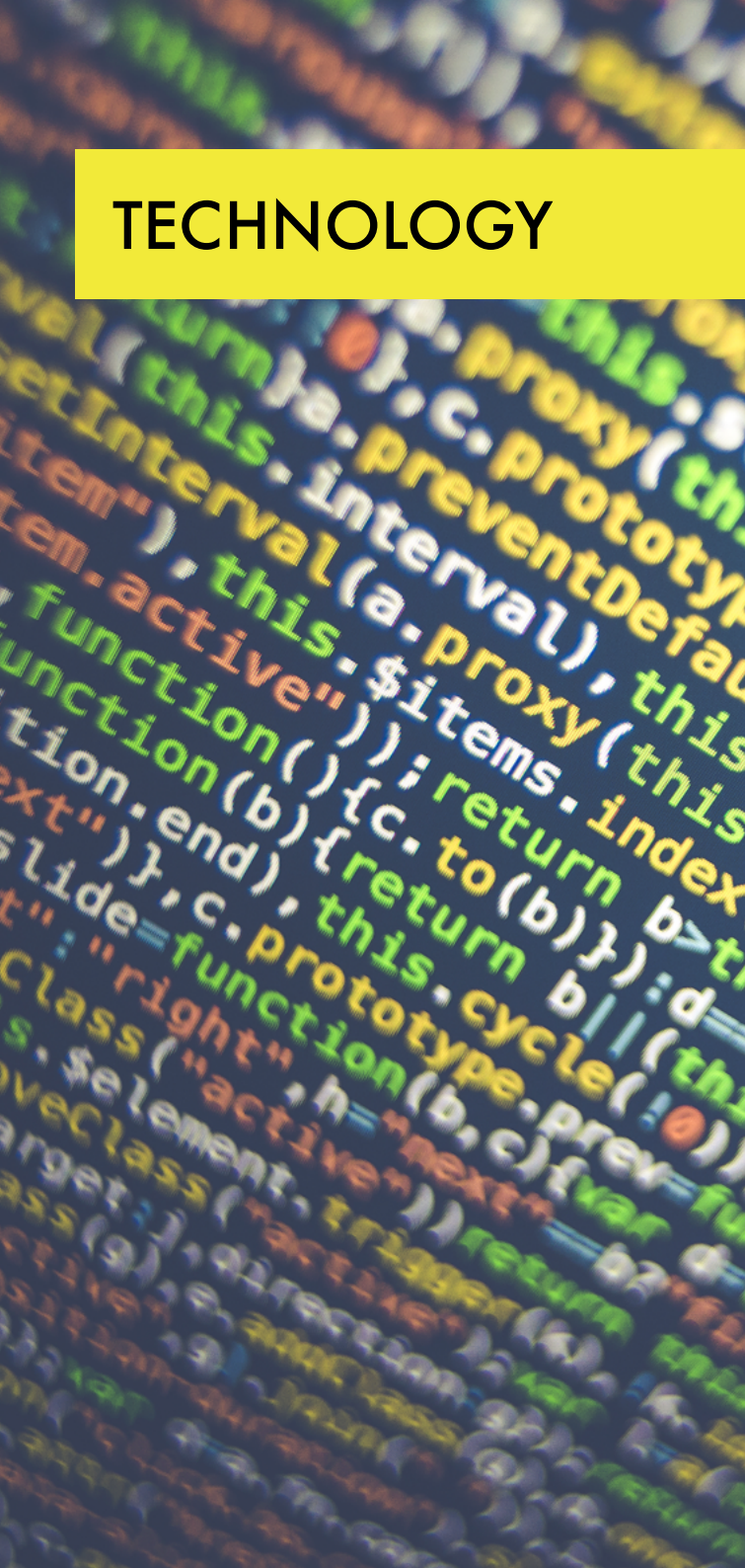
A close-up, low-angle shot of a SpaceX Falcon Heavy rocket during launch. The rocket is white with blue "SPACEX" lettering. Bright orange and white flames from the engines are visible at the bottom, and a plume of white smoke and steam rises from the side. The background is dark and out of focus.

SPACE

THE PACE of change within the space sector over the past decade has been slow to moderate. However, with the rise of new technologies and operating platforms, that have drastically reduced the cost of space exploration, and the emergence of new, well funded competitors I expect the pace of change during the next decade to become moderate to fast. Key developments in this sector include:

- 3D printing; one of the biggest challenges with space exploration was the cost of transporting pre-fabricated equipment to far off places, however, the advent of 3D printing now means that it is feasible to mine, process, print and assemble raw materials in situ on the surface of the Moon, and Mars. As a consequence this will dramatically reduce the amount of equipment that needs to be transported, and further reduce the costs of space exploration.
- Reusable platforms; the rise of new reusable rockets, particularly from the likes of SpaceX, has helped to reduce the cost of a rocket launch from \$100 million to \$35 million, and in some cases smaller rocket launches are now coming in at a reasonable \$2 million. As a consequence space is becoming increasingly accessible, and that opens up new frontiers in space based communications,

exploration, science and warfare.

An abstract background featuring a dense, overlapping pattern of colorful, blurred text that resembles computer code or data. The colors are primarily blue, green, and yellow, creating a vibrant, digital effect.

TECHNOLOGY

THE PACE of change within the technology sector over the past decade has been moderate to fast driven primarily by advancements in the internet and cloud. However, with the rise of new business models, technologies and operating models, all of which are hyper networked, I expect the pace of change over the next decade to become fast, after which it will become fast to exponential. Key developments in this sector include:

- Artificial intelligence; this technology is arguably the future of the technology industry and billions of dollars are being poured into its development. As a consequence it should come as no surprise that in 2016 we saw major advances across the board in the field of AI. Some of these advances include the emergence of AI's that could build new AI's, creative AI's that can both innovate and write their own programs and code, and the creation of the world's first intelligent AI-Robot hive mind.
- Blockchain; blockchain is not only being used by the technology industry to create new distributed ledger as a service (DLaaS) systems, it is increasingly being deployed as a way to disintermediate today's incumbent hyperscale public cloud companies and create new distributed computing

paradigms.

- Codeless computer systems; the rise of artificial intelligence has also spawned a new race to improve, and speed up, how they learn and come to conclusions. This has led to significant advancements in neural networks which are now able to learn by simply ingesting content. Whereas in the past programmers would have to tweak and fine tune the algorithms to get the right results today's deep learning systems are able to formulate their own conclusions, in a similar way to how the human brain forms its own conclusions without the need for new code. This jump, which some call the Black Box effect now means that we are entering an era where machines are able to self-learn and, dare we say "think" for themselves.

- DNA computing; just as we're beginning to see the emergence of quantum computers scientists have now published the first feasible architectures for the worlds first DNA based computing systems. The next stage will be to build them. Unlike traditional computers, and future quantum computers, DNA computers will be able to improve their computing performance by simply replicating and "growing." Not only will this turn the world of computer chips on its head but it will also mean that we see

the rise of a new computing platform that can grow, iterate and scale itself almost instantaneously, and that isn't, unlike today's systems, locked into eighteen month hardware development cycles.

- Quantum computing; in 2016 Google demonstrated a quantum computing system that was one hundred million times faster than an existing logic based computing system. While some experts recommend taking the result with a pinch of salt the fact remains that quantum computing platforms will usher in a new era of ultra high performance computing that will have an unprecedented impact on a wide range of sectors.

- Self-programming machines; just as developers are getting used to their new exalted status within the world we are now seeing the emergence of AI computing platforms that listen to someone's voice, understand their commands or "inputs" and then scavenge, scrape and assemble their own code to create new applications. While the technology is still young over the next few years its capability will improve dramatically and it signals a paradigm shift in the way coders, and, more specifically non-coders, create new applications.

TRANSPORTATION



THE PACE of change within the transportation sector over the past decade has been slow to moderate. However, with the rise of new business models, technologies and operating platforms I expect the pace of change to become moderate to fast during the course of the next decade, after which the pace of change will begin to settle again to a more sustainable level. Key developments in this sector include:

- Autonomous transportation platforms; just as we have seen in the Automotive sector there have been dramatic advances, almost across the board, throughout the entire transportation sector, the future of which is clearly autonomous - whether that's boats, buses, drones, semi-trucks, ships, spacecraft or trains.



CONCLUSION

PEOPLE SAY change is a constant. But in today's technology fuelled world this simple phrase can be deceiving and a misnomer. Change is exponential. And today those changes are rippling through culture, industry and society faster now than they have at any point in human history.

Over the next few years we will see the rate of digital transformation within the insurance industry increase as digital becomes the incumbents new operational and cultural standard but as insurers continue to digitise their DNA what many may not realise is that this simply gets them to the new starting line, one that their new breed of "Millennial" competitors reached, in some cases, many years ago.

The way that businesses were built and scaled in the past is different to how businesses are built and scaled today, and it can easily be argued that companies that run highly networked, extensible and open digital platforms rule the roost and command and capture the most value. It could also be said, and evidence abounds, that legacy organisations, from IBM and HP to GSK and Walmart, have often found it difficult to compete with a new generation of "Millennial" startups who have been digital by default from the day their

founders first put finger to keyboard.

Therefore, many insurers digital transformation programs are more than just about realising new cost and operational efficiencies, it's a race to catch up and improve upon the digital DNA that has so clearly benefited new market entrants across the board, from Box to Uber, from Alibaba to Netflix, from Amazon to Tesla, from Lemonade to Zen Benefits (you can argue the last one).

Once today's insurance incumbents realise their goals of becoming digital first organisations it will become much easier for them to plug into and exploit the world's new digital fabric - a fabric that so far has helped over 230 unicorns create and capture over \$1.5Tr of new value, and throughout all of the changes and upheavals over the past two century's the insurance industry's constant has always been the customer, and staying relevant to the connected customer in the future of tomorrow will go a long way in helping insurers build more resilient and sustainable businesses, capable of driving deeper and more relevant forms of engagement.

The future belongs to the brave and the visionary, not the meek and the mild.



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