311 INSTITUTE

# ANNUAL TRENDS CODEX

CODEX OF THE FUTURE SERIES

311 INSTITUTE

3RD ANNUAL EDITION . BOOKLET 5 OF 7

# TECHNOLOGICAL TRENDS

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# BE BOLD . EXPLORE .

# BUT FIRST COFFEE .

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# ABOUT THE AUTHOR

Matthew Griffin, multi-award winning geopolitical advisor, leadership coach, and Futurist, and 15 times author of the smash Codex of the Future series, is described by his clients as a "Walking encyclopedia of the future" and a "Futurist polymath." Matthew is the Founder and Futurist in Chief of the 311 Institute, a global Futures and Deep Futures advisory looking up to 50 years out, as well as the World Futures Forum and XPotential University - two philanthropic organisations whose mission it is to solve global inequality and the world's greatest challenges.

Regularly featured in the global media including the AP, BBC, Bloomberg, CNBC, Discovery, Forbes, Khaleej Times, RT, the Telegraph, ViacomCBS, WIRED, and the WSJ, Matthew's ability to identify, track, and explain the impacts of hundreds of exponential emerging technologies and trends on global business, culture, and society is unparalleled.

Recognised as one of the world's most reknowned futurists, disruption, foresight, and strategy experts Matthew is an international advisor and keynote speaker who helps the world's most respected brands, governments, investors, NGO's, and royal households, explore, envision, and shape our collective future.

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ABB
accenture
AXA
BCG
Disney
DP WORLD
NOKIA
NOVARTIS
sky
standard chartered


adidas
Adobe
AON
ARM
citi
centrica
Coca-Cola
Deloitte.
EY
KPMG
LEGO
Legal & General
PEPSICO
Microsoft
Qualcomm
SAMSUNG
T-Mobile
UBS
VISA
WPP

# WELCOME
## FROM THE AUTHOR

# PEOPLE . PLANET . PURPOSE . PROSPERITY

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

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

THE **311 Annual Trends Codex** contains explicit details about hundreds of trends that affect everything you care about - whether that's you, your business, your industry, your country, our planet, or all of them. Designed to be a one stop shop for everything that's trendy and trending it also contains everything you need to run your very own strategic foresight programs, model scenarios, and develop actionable initiatives and strategies to help you rule the future like a boss.

Furthermore, as our main trends Codex grows exponentially larger I've taken the liberty of splitting it into separate **Minibooks**, like this one, that make it easier for you zero in and focus on only the categories of trends that matter to you.

Most trends are like tides - relentless forces that are hard to control or influence. And, just like tides they can impact a great many things - both directly and indirectly. Having written Codexes that cover the latest emerging technologies and the latest disruptive business thinking, innovation, and strategy, I felt that creating the trends Codex was a natural next step to compliment them, and ergo provide you with a valuable expert set of resources that contain everything you need to design, debate, create, and shape your own future.

This Codex, like all my others, is a living book, it's always being updated with the latest trends and information so that you always have access to the latest insights and research, but perhaps its biggest benefit is that you can see every trend for everything in one place. This is important because since everything in our world is connected, as I've shared many times during my keynotes, this convenience allows you to easily stay abreast of changes in individual regions or sectors, technologies or trends - any one of which could impact the things you care about, even if the changes occur in areas that at first you don't think are relevant to you.

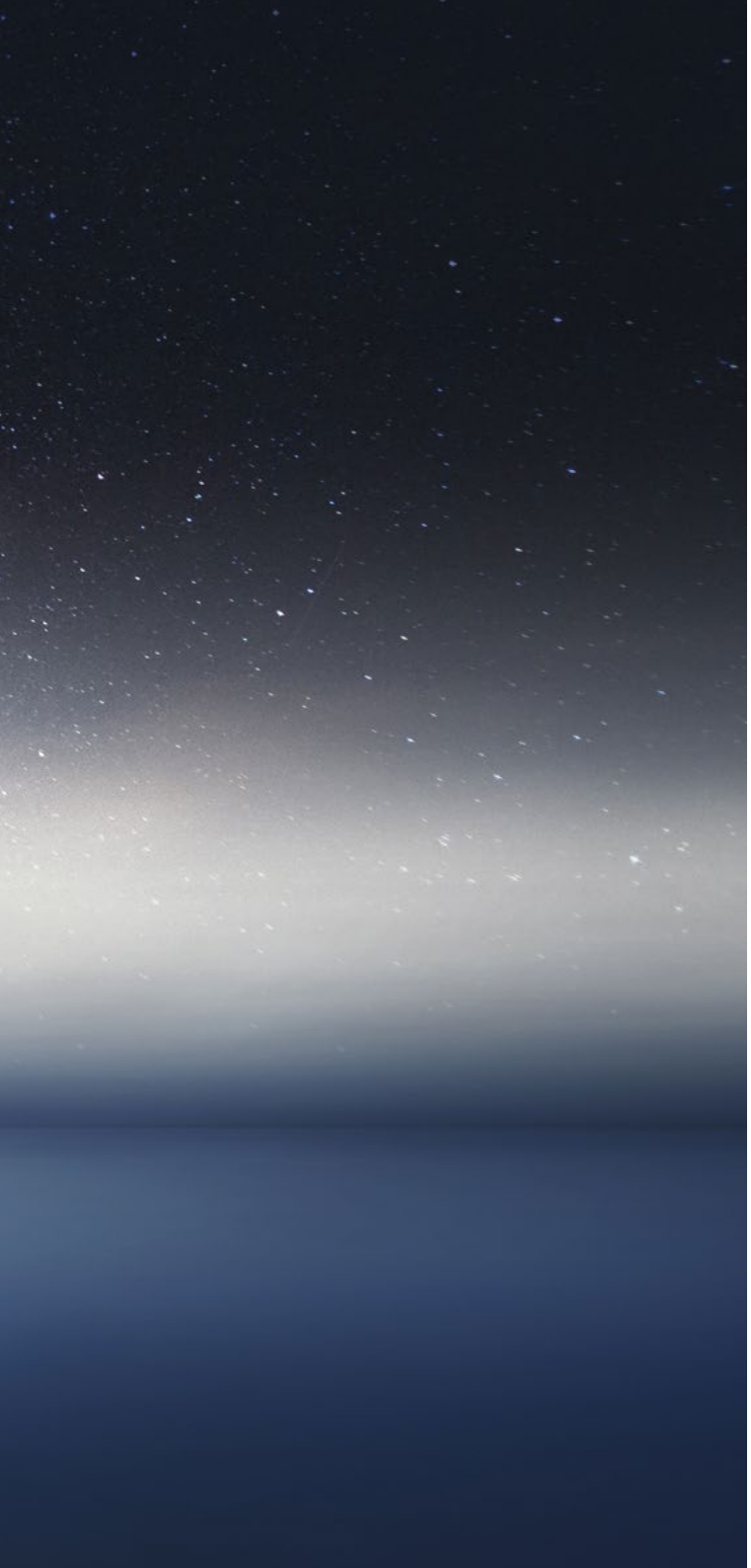
A simple but powerful example of this are the changes we see in the Energy sector where new energy generation and distribution technologies and trends are impacting everything from the business models and product development in the Transport sector, corporate ESG initiatives and Government policy making, climate change and other environmental trends, as well as the multi-trillion dollar investment portfolios of the global Financial Services sector - and far beyond.


No other trends book puts so many trends across so many categories, lines of business, and sectors in one place, or makes them so accessible, and that you might say is this books USP. That is, of course, if tens of thousands of insights and statistics at your fingertips aren't enough already!

Explore More,

**Matthew** Griffin
Founder and Futurist in Chief

# USING THIS TRENDS MINIBOOK



WITH SO many trends shaping our world and with more emerging all the time it's easy to get overwhelmed and fail to grasp their individual and collective impact on the things you care about. As a result I've done my utmost to make this Minibook, which is a verbatim extract from my main **311 Institute Annual Trends and Foresight Codex** and that you can download in full from our company website, as easy to use as possible.

In this section you can learn more about how to use the Trend Sheets to get the information you need, and can see the complete list of trends included in this minibook - with more being added all the time.

# CLIMATE CHANGE

**2ND YEAR ON THE LIST**

## QUICK TAKE

Scientists saw it coming in the 1950's. They called it out and made films about it in the 1980's. And now, over forty years later individuals, governments, and organisations are starting to take unilateral global action to tackle Climate Change with many scientist arguing that we are now too late to avoid a "life altering" 1.5C increase in average global temperatures, and that we are within years of crossing a climate tipping point which will see its devastating global effects accelerate and create a run away cascade of **Extreme Weather** and devastation.

*Data sources: IPCC, National Geographic, WWF, and various.*

## IMPACT

The impact of Climate Change can be seen everywhere - from the changes of the seasons, and the subtle changes in the flora and fauna in peoples gardens, to the tree covered mountain slopes that used to be buried by glaciers and snow, to the expanding deserts of the Sahara, and the deep of the oceans. It impacts every living thing and every natural system on Earth.

From longer frost free growing seasons, to changes in global rain patterns, longer droughts and more intense heat waves, and more extreme weather, to more powerful hurricanes and higher sea levels, the consequences are as varied as they are acute.

If the world warms by 1.5C then the Arctic Ocean will become ice free once every 100 years, with extreme hot days in the mid-latitudes being at least 3C hotter than pre-industrial levels, and sea levels could rise by up to 0.77m, with a further decrease in global bio-diversity of between 5% and 8%. Meanwhile corals could decline by at least 70% with marine fisheries annual productivity declining by at least 1.5 Million tons. And a 2C rise would be exponentially worse for people and planet.

## EXAMPLES

Earth is mission critical for humanity and all life on Earth. And as the rate of Climate Change accelerates we continue to see a variety of records being set and smashed with climactic events that used to be once in a century becoming once a decade, and then the norm. And examples of these are plentiful.

Greenland's ice sheet, the world's second largest after Antarctica, is now melting 12 times faster than in the past 12,000 years and loosing over 532 Billion tons of ice a year - and that rate is accelerating. Not only does this melt account for almost 25% of today's sea level rise, but in 2021 the melt rate accelerated even further when, during a time when temperatures in the region were already 18C higher than average, three days worth of rain - where the rain itself was a first for the region - dumped over 7 Billion tons of rain water onto the ice sheet.

And, from the world's biggest, deadliest, and most damaging floods, to the world's biggest, deadliest, and most damaging droughts, heatwaves, hurricanes, and wildfires almost every country on the planet is now feeing the damaging impacts of climate change.

## ACT NOW

As we see elsewhere in our universe, from the dust dunes of Mars to the acidic oceans of Venus, our planet will always be able to adapt to new climactic conditions. But life on Earth will find it increasingly difficult as Climate Change accelerates and its effects become more extreme and pronounced. Therefore, ironically, tackling this trend is more about saving humanity's future than the planets.

**EXPLORE:**

- Carbon Capture and Storage
- Emerging technologies and technology roadmaps
- Future of Agriculture, Energy, Government, Manufacturing, Sustainability, Transportation, and Work
- Net Zero Pledges
- Unilateral global accords and coordinated global action

# USING THE TREND SHEETS

**IN THIS** codex we've gone to great lengths to document the major trends affecting all sectors and line of business operations and simplify them for you. Furthermore, we're always surfacing more trends which is why this codex is regularly updated. As a result each trend contains all manner of action points, details, insights, and stats that you can use to your advantage, whether it's developing scenarios and strategies using the frameworks in this and our **other codexes**, or whether it's just exploring the art of the possible. This is the key to the sheets:

### 1 / UNITED NATIONS SDG NUMBER

The UN SDG most impacted if you act on the trend.

### 2 / TREND NAME

The most appropriate name for the trend.

### 3 / YEARS IN THE CODEX

How many years the trend has been listed in our codex since the first edition.

### 4 / TREND LONGEVITY

LONG MEDIUM SHORT

The trends longevity and how long it is expected to have an impact for.

### 5 / TREND PRIORITY

The higher the number the more attention and weight you should give the trend.

### 6 / TREND MOMENTUM

ASCENDING FLAT DESCENDING

The overall momentum of the trend.

### 7 / TIMING OF THE TREND

HERE NOW EMERGING DISTANT

When the trend is expected to have a measurable and pronounced impact.

### 8 / RELATED TRENDS

Other trends that either impact the trend or are impacted by it.

### 9 / DATA SOURCES

A list of our data sources for the trend.

### 10 / IMAGE

An image to portray the trend.

### 11 / ACTION

The action we suggest organisations take now based on the available data.

### 12 / EXPLORE

Other things you can or should explore to better understand the trend and how to solve or use it to your advantage.

### 13 / DISCOVER MORE

Click or scan the QR code to access more website resources related to the trend.

TRENDS CONTENTS

# SECTION CONTENTS

# " FOLLOW THE TRENDLINES NOT THE HEADLINES . "

- William B. Clinton, 42nd US President

# SUMMARY UPDATE

TODAY IS a relatively unique time in human history - there are not a few but several sci-fi like technologies emerging and converging, any one of which has the potential to reshape our world in profound ways.

Firstly, quantum computing continues to advance at a rapid clip with breakthroughs enabling the development of increasingly complex quantum algorithms. And, while still nascent practical applications relating to Artificial Intelligence (AI), cryptography, and optimisation problems are now within our grasp bringing both opportunities and threats - namely the promise of new solutions for currently insurmountable problems juxtaposed with the risk of obsoleting many of the contemporary encryption standards that we rely on.

The numer of AI-backed Synthetic Biology breakthroughs has also exploded with AI designing new enzymes, organisms, and proteins that can produce everything from biofuels and climate resilient crops to plastic degrading bacteria and carbon negative CCS materials - all of which carry enormous potential to help us solve many of today's pressing environmental issues.

Furthermore, Blockchain continues to expand beyond cryptocurrency with the Decentralised Finance (DeFi) trend especially providing new opportunities for unbanked individuals to access financial services, as well as for Blockchain-based supply chains offering unprecedented transparency.

Lastly, the Metaverse is now more tangible, fueled by advances in AI, Augmented Reality (AR), and Virtual Reailty (VR), with a multitude of new immersive environments for play, social, and work continuing to emerge. But, as the line between the digital and physical world blurs, new questions around data privacy and ownership of digital assets are rearing their heads.

Overall, all these technologies and many others, such as 3D Printing and 5G, hold tremendous potential but many of them also highlight the ever growing need for strong ethical guidelines and comprehensive regulations.

## STATS THAT MATTER

**70%**

ENCRYPTION HACKABLE BY QUANTUM COMPUTERS

NIST

**8 HRS**

TIME TO CRACK 2,048-BIT ENCRYPTION WITH QC

MIT

**430 PB**

DATA STORED IN 1 GRAM OF 11-BASE DNA STORAGE

ILLINOIS UNI

**1.7 PBS**

FASTEST FIBER OPTIC DATA TRANSFER SPEED

MACQUARIE UNI

**x 1,000**

VOLUME OF GENERAL KNOWLEDGE CONTAINED IN OPENAI GPT-4 COMPARED TO ANY HUMAN MIND, 2023

OPENAI

**155**

THE VERBAL IQ OF OPENAI CHATGPT, 2023

SCIENTIFIC AMERICAN

**1.8 TR**

TOTAL OPENAI GPT-4 PARAMETERS, 2023

SEMI-ANALYSIS

## TECHNOLOGY

**$ 7 TR**

EST. GLOBAL COST OF CYBER ATTACKS, 2022

CS VENTURES

**x 300 MILLION**

SPEED OPENAI GPT-4 LEARNS COMPARED TO THE HUMAN BRAIN, 2023

OPENAI

**1 DAY**

TIME FOR THREADS TO HIT 100 MILLION USERS

META

# 5G

**2ND YEAR ON THE LIST**


## QUICK TAKE

5G is the fifth generation mobile communications standard. One of many **General Purpose Technologies** it represents a giant leap in capability from 4G with latencies in the 1ms range, speeds in the 1.5gbps to 10gbps range, and cell densities over100 times greater than what came previously.

The net result of these, and other advances, means 5G enables a host of interesting use cases many of which impact every corner of global business, culture, and society, whether it's in the form of **Continuous Innovation**, **Tele-Operations**, or many others.

*Data sources: Grand View, GSMA, PWC, and various.*

## IMPACT

The impact of 5G goes far beyond its technical specifications and capabilities. While revolutionary in themselves 5G was first thrust into the public limelight when it was used as a political football by especially China and the US who used it as a pawn in the ongoing **Innovation Cold War** and **Standards Shadow War** as the reality of life in a **Bi-Polar and Multi-Polar World** dawns on the world.

Ironically it's 5G's power and capability, as well as it's central and pivotal role in the so called future "Data Economy" that made it a prime pawn in today's modern political theatre in the first place.

All that aside though it's believed that the 5G services market will grow by 46% CAGR to reach $856 Billion by 2028, and that by 2030 it will boost global GDP by $1.34 Trillion. Both of which, as we've seen historically with other mobile standards, are likely low balled.

5G's greatest impact though comes from its ability to disrupt and transform how almost all organisations operate and go to market in all sectors.

## EXAMPLES

When it comes to examples of 5G's "disruptive" potential there are many so I will highlight what I consider to be the most interesting, and let it not be lost on you that 5G unites the Digital, Physical, and Virtual worlds.

With **Work from Anywhere** we have gotten increasingly used to being able to work from where we like but 5G takes that a step further by enabling workers to do physical work in remote locations while they are based elsewhere - via Tele-Operations - with examples including surgeons operating on people hundreds of miles away and construction workers building communities on other continents by controlling drone machinery.

Another good example of 5G's impact is Continuous Innovation where live sensor data from products is fed back to **Creative Machines** in real time which then use it to innovate and iterate new, next generation products before sending the designs off to be 3D printed on demand ... And then, of course, there's the ability to perform site inspections in VR, speed through **Digital Twins** and the **Metaverse**, and all manner of other astounding use cases.

## ACT NOW

As we have seen previously the introduction and deployment of a new mobile communications standard often affects every corner of global business, culture, and society, and it is no different with 5G. However, as the world becomes more connected and digitised 5G's significant technological gains represent nothing less than a disruptive shift in the global status quo that will have far reaching consequences for everyone and everything it connects.

**EXPLORE:**

- Best practises and case studies
- Business and impact assessments
- Emerging technologies and technology roadmaps
- Future of Communications, Creativity and Innovation, and Work
- New business models
- Partner ecosystems and solutions

# ACCELERATING RATE OF CHANGE

**2ND YEAR ON THE LIST**


## QUICK TAKE

Thanks our increasingly digital and connected world, and fuelled by **Exponential Technologies**, there has been more change in the last decade than in the previous hundred years. And this rate of change is accelerating.

Today we live in a world where digital products and services can be adopted by billions of people almost instantaneously, and in a world where increasingly powerful technologies can be combined together to create increasingly powerful and disruptive new products and services - and that is both an opportunity and a threat.

*Data sources: Various.*

## IMPACT

When it comes to forecasting any kind of future and creating corresponding business, horizon, or vision strategies the ability to think exponentially rather than linearly is of utmost importance - especially bearing in mind that the rate of change, which is accelerating, is itself accelerating.

If the accelerating rate of change is not taken into account during planning processes then this trend can have serious business consequences as executives both underestimate what will be possible in the future and when those changes will have a quantitative impact their business. Furthermore, it is also important to bear in mind that in an exponential world what you would normally expect to happen in a 10 year time frame, in a linear world, will actually occur in 5 to 7, and what would happen in 5 will actually happen in 3. Or sooner.

This simple but often overlooked trend has led to the downfall of numerous giants and incumbents, but it has also fuelled the rise to dominance of companies that can see the future and "skate to the puck" as they say.

## EXAMPLES

When it comes to examples of organisations using this trend for gain, as well as organisations who have felt its sharp end, there are plenty to choose from. Since 1955 90% of the S&P 500 have vanished and it's estimated that within the next decade 40% of today's will also disappear meaning that in just a few decades the average tenure of companies in the S&P 500 will shrink from 33 years to just 12.

While some companies vanish because they are bought or merge, others simply fail. What they all generally have in common though is that they have all failed to adapt to new market conditions. Sometimes company culture is to blame, sometimes it's execution, but increasingly it's because they underestimate the future, its impact, and most crucially its timing.

Companies who failed to adapt to their detriment include giants such as AOL, Blockbuster, Boeing, HP, IBM, Kodak,Motorola, Nokia, Xerox, Yahoo, and others. But there are also plenty of new "giants" who have become experts in surfing the trend including Alibaba, Alphabet, Amazon, Apple, Netflix, Tesla, SpaceX, and many others.

## ACT NOW

The rate of change is often overlooked when it comes to business planning but if ignored at best it can clip your revenues and profits as new competitors and realities disrupt your market, and at worst it can bankrupt your company. While the future in all its diversity should be explored thoroughly executives must keep an open mind because what's possible tomorrow will often look radically different to today.

**EXPLORE:**

- Crazy ideas and developments in alternative industries and other countries
- Emerging technologies and technology roadmaps
- Future of Disruption
- Innovation and Partner ecosystems and solutions
- Transforming company culture

# ALGORITHMIC AUDITS

**2ND YEAR ON THE LIST**

## QUICK TAKE

As algorithms take a more dominant role in our society in everything from automating processes and tasks, as well as making decisions, it is clear that the they way they have been trained is causing algorithmic bias. And, needless to say, this is having a variety of negative consequences on individuals and society.

As a result it is becoming increasingly important that these algorithms are audited to evaluate their utility, and certify they are fair and safe.

## IMPACT

Today algorithms are ubiquitous. They accelerate the spread of disinformation and misinformation, amplify societal echo chambers, hijack our attention, and encode, heighten, and exaggerate human bias, with all their negative consequences. Therefore ensuring that human and societal values are reflected in these algorithms is increasingly important.

While the benefit and impact of algorithmic audits is currently hard to determine, in part because there are so few organisations offering them and in part because there are so few organisations taking them up because there's no legal requirement and they don't want third parties examining their proprietary algorithms, based on the negative impacts algorithms can have on individuals and society it's no wonder that many experts say they should be as "ubiquitous as seatbelts." And they have a point.

However, the wholesale regulation of automated decision making tools is not far off, and organisations should be ready for When not If.

## EXAMPLES

Unsurprisingly the algorithmic auditing industry is a relatively new phenomenon with many organisations in the space talking about the methodologies they use to "examine the Black Box," or "score the algorithms that score us" as part of the **Algorithmic Society** trend. Both of which, when you think about it, are pertinent viewpoints that both highlight the scale of the challenge we have ahead of us as a society.

Current examples of organisations who have undertaken algorithmic audits include AI hiring company HireVue who employed a third party to examine the levels of bias in their models - which many experts then instantly piled on top of calling the study "too narrow and misrepresented." Which then highlights another issue with such auditing practises - organisations using them as a toothless tick box exercise.

## ACT NOW

Being able to prove that the algorithms that enable and underpin our digital society are fair and safe is of critical importance, especially as their influence over our personal and professional lives increases. And while many organisations might be reluctant to have their algorithms audited it is becoming increasingly clear that law makers are circling to make it a requirement.

**EXPLORE:**

- Best practise and case studies
- Emerging technologies and technology roadmaps
- Explainable AI
- Ethics and oversight boards
- Future of Artificial Intelligence
- Universal AI ethics frameworks and regulations

*Data sources: Accenture, Brookings, Harvard University, MIT, and various.*

# ARTIFICIAL INTELLIGENCE

**2ND YEAR ON THE LIST**

## QUICK TAKE

Perhaps the most game changing technology in human history Artificial Intelligence (AI), one of the **General Purpose Technologies**, could help humanity transcend to a new Utopian state - or destroy it. And even though the likelihood is that it's going to be somewhere in between we have to be mindful of the consequences of living in an **Algorithmic Society**.

Technology used to be our prosthetic - automobiles and hammers - but in the future it will increasingly be our boss, co-worker, confidant, and partner. And AI is at the center of it all.

*Data sources: Forbes, IDC, PWC, and various.*

## IMPACT

Today most AI is what we call Artificial Narrow Intelligence (ANI) with models being based on either Machine Learning (ML) or Deep Learning (DL) methodologies, but by 2035 we should see Artificial General Intelligence (AGI) which will have human-level intelligence, and by 2045 Artificial Super Intelligence (ASI), which will bring about global System Level Change. And we are already seeing AI's that are capable of self-design, self-evolution, and self-replication, and Zero Shot Learning AI.

Within three years it's estimated that overall AI venture capital investment will hit $100 Billion, up from $18.5 Billion today, and by 2030 it's estimated that AI, which can automate and augment human jobs, workers, and work, could add an extra $15.7 Trillion to **Global GDP Growth** with just over half of that being recognised by Asian economies.

One of AI's greatest promises though is to improve global productivity, with many experts estimating that on average it will help improve global productivity across sectors by at least 40% - with the final figure likely being much higher - while at the same time impacting over 50% of all human jobs.

## EXAMPLES

AI is by far the world's greatest commercial opportunity - and it has already been credited with the invention of several products. But, while people talk up its ability to automate and augment human jobs, workers and work, it's already capable of alot more.

Automation is simply the unintelligent automation of process flows, but AI is already exhibiting autonomous behaviours which are much more impactful and powerful. Think, for example, about the difference between an automated expense system and a self-driving car and you quickly realise the difference. And as for AI examples, there are millions.

There are **Creative Machines** that can ideate and generate new products and **Synthetic Content**, AI based decision systems which are used in business and the military, AI's that run **Autonomous Organisations,** and new forms of AI that learn without data and which can share "knowledge" and experiences via **Hive Mind Systems**. Then, of course, there are the more everyday examples we're all familiar with such as those that power our news feeds, search engines, and all the different services we rely on.

## ACT NOW

AI is undoubtedly a game changer, and it is already influencing global human behaviours and decision making. While it's capable of **Accelerating the Rate of Change** it can also be used as an authoritarian tool of control and oppression which means that we, as a society, must guide its development and use carefully and wisely with both eyes wide open - something that, ironically, we aren't doing very well today.

**EXPLORE:**

- AI Bias, AI Ethics, and Algorithmic Audits
- Best practises
- Emerging technology and technology roadmaps
- Future of Artificial Intelligence, Creativity and Innovation, and Work
- Policy and Regulation reform
- Standards Shadow War
- Synthetic Data

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EXPLORE STARTUPS & MORE

# BLOCKCHAIN

**2ND YEAR ON THE LIST**


## QUICK TAKE

Blockchain is a digitally distributed, decentralised, public ledger technology (DLT) that exists across a peer to peer network and that in most cases is immutable - except for a few rare circumstances such as what's known as a 51% Attack. It's most important attributes include helping third parties trust one another without the need for intermediaries and enabling low cost real time settlements. As a result it is a highly disruptive **General Purpose Technology** (GPT) with wide ranging applications across every sector, and as such it is increasingly becoming a key part of the world's digital fabric.

*Data sources: Accenture, Deloitte, Gartner, Microsoft, and various.*

## IMPACT

For most people blockchain is an invisible technology. It's like the electrical wiring in your house - it fulfils a very important function but it's hidden from view. As a GPT blockchain is a disruptive and transformative technology that today handles approximately 3 transactions per second and that in many cases is helping organisations in all sectors and operating areas of the economy disintermediate intermediaries and revolutionise their business and operating models and product offerings.

The impact of this technology is significant and should not be underestimated - from helping all manner of different transaction types become real time and almost zero cost, to giving organisations the ability to disintermediate industry intermediaries like the global SWIFT payment network, and upending the world of finance with the arrival of **Crypto Cities**, **Cryptocurrencies**, and RegTech, there are few limits to what this technology can do. In 2020 estimates suggest that 20% of the **Internet of Things** (IoT) trend was blockchain enabled, and with a growth rate of 69% CAGR it's believed that the global blockchain market will be over $163 Bn by 2027.

## EXAMPLES

While there are millions of examples of blockchain in use today, whether it's as the foundational technology supporting cryptocurrencies and **Decentralised Exchanges**, or helping authorities regulate illegal fishing activities, or helping enforce copyright and helping artists sell their **Non-Fungible Tokens** (NFT) artwork, there are no shortage of interesting and impactful examples.

Some of the more notable ones though include the use of blockchain to create **Digital Identities** that would finally give the 2 billion people on the planet who today have no way of proving their identities, and therefore no way of getting loans or proving property ownership, with the means to do so. And then there's it's role in helping improve the efficiency of global supply chains and supply chain transparency.

Elsewhere organisations like Fetch.ai are combining **Artificial Intelligence** (AI) and blockchain to help democratise peoples and notably robots access to AI, and others are using it to build **Decentralised Finance** (DeFi) ecosystems. And that's before we discuss its role in helping build the future **Meta-Economy** and the **Metaverse**.

## ACT NOW

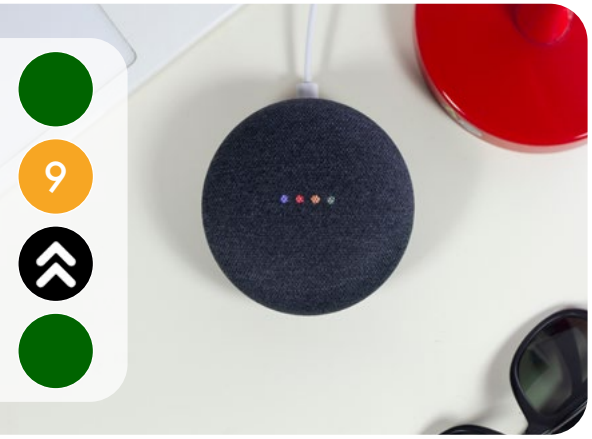
Blockchain is a game changing technology that in many respects has single handedly re-written the rules of business across different sectors and business functions. Furthermore, as we continue to see the rise of **Digitisation**, **Tokenisation**, **Web 3.0**, and other trends, its influence on the global economy and society is only going to grow.

**EXPLORE:**

- Business and impact assessments
- Emerging technologies and technology roadmaps
- Future of Technology
- GRC impact
- New business and operating models
- Partner ecosystems and solutions
- Policy and regulation reform

# BEHAVIOURAL COMPUTING

**2ND YEAR ON THE LIST**



## QUICK TAKE

Fuelled by dramatic advances in **Artificial Intelligence** (AI), communications, computing, **Digitisation**, and several other **General Purpose Technologies** the way we interact with technology is changing beyond all recognition.

No longer limited to just using decades old input devices such as keyboards and mice behavioural computing, which allows us to use a mix of natural language, voice, and other inputs such as gestures and touch, is transforming how we use technology and its role in our personal and professional lives.

*Data sources: Various.*

## IMPACT

Behavioural computing, especially when coupled with **Affective Computing**, represents nothing less than a paradigm shift in computer interfaces and how people everywhere interact and use the devices and technology that are near us, on us, and as the **Singularity** approaches, increasingly within us.

Perhaps the greatest impact of this trend is the fact that it makes technology, and by association all the services it gives us access to, accessible to people irrespective of their technical ability.

Behavioural computing refers to any natural human "behaviours" that we can use to interact with technology including everything from eye movements, gestures, thoughts, touch, and voice, to all manner of other less obvious behaviours including biomarker and biometric cues - especially as those relate to user authentication, identity, and security.

The ultimate impact of this trend is that it makes technology and the services it gives us access to simple to use and interact with, in turn meaning billions more people can unlock the benefits and value technology has to offer.

## EXAMPLES

While many of us are used to some of the more common examples of this trend, such as the use of Smart Speakers in our homes that let us access different services and perform different actions using nothing more than our voices, there are some more sci-fi like examples I can walk you through as well.

Examples such as the use of **Neural Interfaces** that even today are letting people with ALS use computers and communicate with loved ones by converting thoughts into text, as well as letting others control drone swarms, exosuits, prosthetics, and even F-35 fighters with nothing more than their thoughts. The latter is also perhaps the most extreme example of just how much this trend lowers the bar when it comes to letting people to control and interact with the world's most sophisticated and complex technologies.

Elsewhere we see users using eye motion, gestures, as well as thoughts to navigate **Immersive Reality** (A/M/VR) environments, and others using natural language to debate with AI's such as IBM Watson. And, as Conversational AI matures this trend will unlock even more opportunity.

## ACT NOW

The ability to control and interact with technology using natural behaviours and natural language democratises access to all manner of valuable and potentially life changing services for the people who today don't know how to access them using conventional user interfaces. This is therefore a revolutionary shift and not one to be ignored.

**EXPLORE:**

- Best practises and case studies
- Accessibility initiatives
- Emerging technologies and technology roadmaps
- Future of Artificial Intelligence, Computing, and Work
- New business and operating models
- Partner ecosystems and solutions
- Policy and regulation reform

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EXPLORE STARTUPS & MORE

# CREATIVE MACHINES

**2ND YEAR ON THE LIST**

## QUICK TAKE

Many think that human creativity cannot be encoded in machine form. But they are wrong. Outside of those ingenious flashes of inspiration most human creativity is the result of a set of exquisitely interlinked processes and steps. And those can be encoded in algorithmic form.

As a result today we have Creative Machines that are capable of basic product design, innovation, and iteration, and they can do it billions of times faster than humans. And, as they evolve the content and products they create will increasingly shake the world.

*Data sources: Various.*

## IMPACT

In the coming decades the impact Creative Machines will have, on everything from computer chip design and drug development, through to the generation of Synthetic Content and all manner of alternative products, from batteries and robotics to vehicles, will be nothing short of world changing.

By cutting down product development times by upto 99% while also speeding up concept to shelf times and reducing the costs associated with product development by multiples they will be a game changer in every sense of the word that allows organisations to accelerate their R&D efforts by millions to billions fold - with all the benefits that brings.

Today over $1.7Tn is spent on product R&D globally and that has been increasing at an average annualised rate of 12% for the past decade, with the top 1,000 companies alone spending over $782Bn last year.

Creative Machines will have a material impact on all R&D and will also democratise innovation and product development for everyone on the planet once it is provided as a service.

## EXAMPLES

Creative machines are able to design, innovate, and iterate an increasingly wide variety of products, and they are also using these same constructs to generate Synthetic Content in all its forms - from audio and imagery, to characters, video, and virtual worlds.

Today Creative Machines are being used by Airbus to design aircraft, Amazon to design fashion lines, GM to design cars, Google to design new AI chipsets, by Insilico to design 30,000 new drugs in 21 days, by NASA to design lunar landers, by Toyota to design new EV batteries in weeks, and Under Armor to design sneakers. And a myriad of other examples.

Meanwhile, in the Synthetic Content space they are being used to generate all manner of content that ranges from books and music, with the latter being signed by Sony and Warner, procedural games, television adverts, videos, and virtual worlds - which are then used to further accelerate product design and innovation in simulation. Furthermore, when combined with other technologies such as 5G, advanced manufacturing, Digital Twins, and IOE, this trend becomes even more impactful.

## ACT NOW

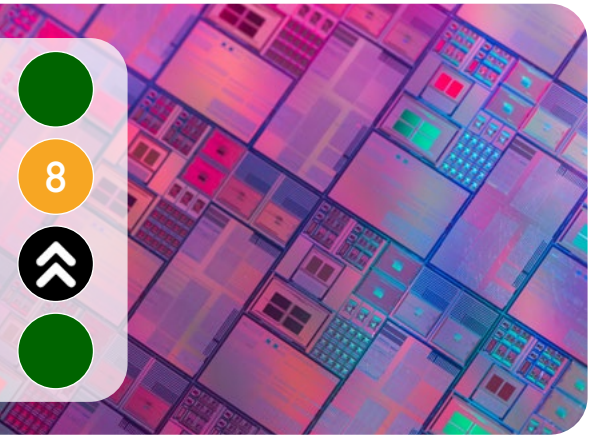
The impact of this trend should not be underestimated and while it is still a nascent trend it is accelerating fast and generating results that are already having a disruptive impact on multiple parts of society and industry as a whole. Furthermore, when it is combined with new advanced manufacturing technologies organisations have already demonstrated their ability to design and manufacture goods that would have taken years to develop in days.

**EXPLORE:**

- Best practises and case studies
- Business and impact assessments
- Emerging technologies and technology roadmaps
- Future of Artificial Intelligence, Creative Machines, Entrepreneurship, Manufacturing, and Media and Entertainment
- IP and patent reform
- Policy and regulation reform

# EXPONENTIAL TECHNOLOGIES

**2ND YEAR ON THE LIST**




## QUICK TAKE

Exponential Technologies are a class of technologies whose performance doubles in a set time period. Think computer chips and Moore's Law, where processor power doubled every 18 months for decades, and you have the idea. When we talk about these technologies though there's often more to it than just some simple rule. Firstly, "Performance" can relate to almost anything - bandwidth, camera resolution, computing power, and so on. Secondly the "Cost" of purchasing this new "Performance," which often comes in a smaller form factor, also often falls exponentially over time.

*Data sources: 311 Institute, World Futures Forum, and various.*

## IMPACT

Many of the world's most impactful and powerful **General Purpose Technologies** (GPT) are Exponential Technologies whose overall Cost-Performance improves at an exponential rate - rather than a linear one. And the impact of this is that, from a buyers perspective, we can all buy increasingly powerful technological capabilities for significantly less money than they used to cost.

One famous example that people like to refer to is the fact that today the devices in our pockets have more computing power than the Apollo 11 computers that put man on the Moon in 1969. In real terms each of these computers cost $1.5 Million and had a processing speed of 0.043MHz with 12k of fixed memory and was the size of a suitcase. Today, to put exponential technologies in context, you can buy a 4 GHz Intel i7 processor with 8Mb of Cache that comfortably fits in your hand for $50.

The impact of being able to access more technological "Performance" for less cost, like in my example, has not only transformed human society, but it has also been the main driving force behind record **Global GDP Growth**.

## EXAMPLES

Most of the technologies we use today are exponential technologies. From the computer chips, computer storage, and camera sensors in our devices, and the wireless networks they connect to, from the gene sequencing machines doctors use in hospitals to the **Artificial Intelligence** (AI) systems that interpret the results, to the 3D printers that today print everything from cars and rockets, to trainers and transplant organs, and beyond. And here are some common examples for you ...

In 1976 the first Kodak digital camera sensor had a resolution of 0.01 Megapixels, weighed 1.8Kg, and cost $72,000 in real terms - or $7,200,000 per Megapixel. Today, a 48 Megapixel sensor weighs 0.002Kg and costs just $0.041 per Megapixel - a staggering 1,756,097,560x Cost-Performance reduction.

Meanwhile, Intels first IC chip in 1971, the 4004, had 2,300 transistors at a size of 10,000nm each, and a speed of 0.00074 GHz for a real cost of $13 per transistor. By 2018 the 4.80 GHz i9 had 7 Billion 14nm transistors at a cost of $0.00000024 each - a 4,166,666x Cost-Performance reduction.

## ACT NOW

We live in an age dominated by exponential technologies with the **Algorithmic Society** being a prime example. Additionally, the **Accelerating Rate of Change** also means the time we have to see and prepare for new technology innovations, that are multiple times more affordable, powerful, and ubiquitous than their predecessors is shrinking. And while this alone presents society with challenges exciting things lie ahead for those who are willing to explore what the future holds.

**EXPLORE:**

- Emerging technologies and emerging roadmaps
- Future of Disruption and Exponential Technology

# GENERAL PURPOSE TECHNOLOGIES

**2ND YEAR ON THE LIST**

## QUICK TAKE

General Purpose Technologies (GPTs) can best be described as technologies that are pervasive, with the ability to affect multiple sectors of global business culture, and society, that improve rapidly, and often exponentially, and which spawn innovation.

They include technologies such as **5G**, **Additive Manufacturing**, **Artificial Intelligence** (AI), Augmented and Virtual Reality, **Blockchain**, Gene Editing, **Quantum Technologies**, robotics, semiconductors, as well as electricity, electronics, the internet, steam engines, and many others.

*Data sources: 311 Institute, Bloomberg, PWC, and various.*

## IMPACT

Today, investment in and the development of modern day GPTs that can be combined together to create powerful, next generation products and services are the strategic focus of many governments around the world who see them as a way to disrupt the global status quo and dominate and profit from the future. This is made even more pertinent as we race head long into a **Bi-Polar and Multi-Polar World** and see new **Standards Shadow Wars**.

Needless to say when to comes to highlighting examples of their impact you need look no further than the device in your hands, the cell towers in your town, the search bar in your browser, or the products on your table - their influence is everywhere.

From a commercial perspective though it's estimated that AI alone will add $15.7 Trillion to **Global GDP Growth**, and that Quantum Computing and 5G will add a further $3.7 Trillion and $1.3 Trillion respectively - all of which are likely under estimated. And if just three GPTs can help grow the global economy by more than 20% by 2030 then just imagine what happens when we factor them all in ...

## EXAMPLES

The emphasis that countries are putting on controlling and owning future GPTs and their associated standards is best highlighted by China who are investing over $1.4 Trillion up to 2025 as part of their "Made in China 2025" strategy as they look to "Change lanes and overtake" the EU, US, and the rest of the world in their quest to become the world's dominant economy and super power.

Just to put this ambition into perspective the US is investing $325 Billion over the same period under their Research and Innovation Plan, and the EU will invest $177 Billion "to develop emerging and other novel technologies." In short, it doesn't take a maths computer to see who has the greater ambition. And we haven't even factored in industry contributions yet ...

The development and adoption of GPTs has the power to transform the future of entire economies and their citizens, but over the past 200 or so years they have also been the primary drivers behind massive increases in global productivity and GDP - yesterday with the Industrial Revolution, and tomorrow with many other exponential technologies.

## ACT NOW

In many respects GPTs are literally the technologies that create and unlock the future - they are the key. And this makes them extremely valuable. It is no surprise therefore that an **Innovation Cold War** is brewing between different world powers, as well as global organisations, who want to control and dominate their future development for their own ends.

**EXPLORE:**

- Creative Machines
- Emerging technologies and technology roadmaps
- Future of Exponential Technology
- Policy and regulation reform
- Strong global institutions
- Unilateral global accords and coordinated global action

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# IMMERSIVE REALITY

**2ND YEAR ON THE LIST**

## QUICK TAKE

Immersive Reality (IR) is an umbrella term for a wide collection of technologies, including Augmented (AR), Mixed (MR), and Virtual Reality (VR), as well as Sensory Reality (MXR) and other complimentary technologies such as **Neural Interfaces**, Haptics, and others, that are being used to combine and merge the digital, physical, and virtual worlds into one seamless, increasingly "realistic," consumer experience. While trends such as **Digital Twins** and the **Metaverse** get a lot of the attention overall this trend is already having a seismic impact on global business, culture, and society.

*Data sources: Bank of America, Grand View Research, and various.*

## IMPACT

Over the past five or so decades we have been busy creating multiple digital and virtual worlds and ecosystems that run parallel alongside the real world, but over the past decade as different technologies have improved, matured, converged, and commercialised these worlds themselves are now converging and merging - so much so that it's becoming increasingly possible for us to flit in and out of these different "realities" at will to do and perform all manner of different activities.

In 2020 the overall IM market was worth an estimated $24.7 Bn and by 2026 it's estimated that it will grow by at least 50% CAGR to reach over $37.8 Bn. We can also see the trend becoming much more ubiquitous in our lives and daily professions as **5G** enabled smartphones and other devices packed with powerful compute components gain the ability to stream authentic AR, MR, MXR, and VR experiences from the **Cloud**. Furthermore, as new materials help reduce the form factor of today's bulky VR headsets into little more than some funky **Wearable Technology** and regular sized glasses there's no doubt that the cultural embrace of this trend will also improve and accelerate.

## EXAMPLES

There are millions of examples of this trend in action, from AR games like Angry Birds and Pokemon Go, to the use of MXR to create new haptic team sports, and VR in education and training and **Virtual Malls**.

Some of the more notable and odd examples though include the use of VR to help people re-connect with their dead loved ones, the use of VR in drug development and surgery settings, and to help rehabilitate patients, as well as perhaps one of the best examples I've seen, namely the use of VR to help parents empathise and visualise their children's upcoming surgeries and post-op lifestyles.

Meanwhile AR, MR, and MXR, are also being used to bring holographic video calls to life by giving family members who are wearing Smart Glasses the ability to play virtual games with one another including baseball, and hug one another virtually - something you have to see to believe. And then elsewhere we have organisations like Meta working on beaming these virtual worlds straight into our heads using neural interface technologies, Industry 4.0 applications, and many more.

## ACT NOW

The ability to unify the digital, physical, and virtual worlds into one seamless and convenient experience that consumers can easily "step into" will have all kinds of ramifications for humankind and our world, from helping build the **Meta-Economy** to helping re-invent every sector and almost every conceivable human experience. As a consequence this is a trend not to ignore and I urge all organisations to experiment with it.

**EXPLORE:**

- Best practises and case studies
- Emerging technologies and technology roadmaps
- Future of Artificial Intelligence, Communications, Education, Financial Services, Healthcare, Media and Entertainment, Manufacturing, Retail, and the Workplace and Workforce
- Partner ecosystems and solutions

# INTERNET OF THINGS

**2ND YEAR ON THE LIST**

*An example of a Living Sensor, DARPA*

## QUICK TAKE

The Internet of Things (IoT) is a slow burn megatrend that will not only change how our world operates but also how we interact with it, especially when it's combined with the **Immersive Reality** trend. Broadly defined as anything - literally anything - that has a sensor in it that communicates data via a network today advances in multiple technology fields no longer mean this trend is confined to transforming dumb objects into smart ones, because as trends such as **Synthetic Biology** and **Nano-Manufacturing** improve we now even have the capability to turn living organisms into IoT devices.

*Data sources: Bain, Cisco, Fortune, Gartner, IDC, and various.*

## IMPACT

The ultimate impact of this trend will be to turn everything in our world into a smart device or node that can intelligently capture, analyse, and communicate data which can then be used for a multitude of purposes. As a result this trends market opportunity is almost unlimited, which is why the valuations of this market vary wildly. On average though analysts peg its value at $450 Bn today and estimate that in 2028 it will be worth just under $2 Tr, both of which are likely under estimates.

By 2025 it's estimated that there will be over 75 Bn IoT devices connected, also likely a massive under estimate, and that the amount of data collected by them all will top 73 Zettabytes. However, as we see the increased adoption of **Edge Computing** it's also likely that most of this data will be analysed at the edges of the network rather than having to be communicated back to **Cloud Computing** datacenters for processing.

With general ROI being 3 years on IoT related investments and 61% of organisations believing they have a high level of IoT maturity it's clear this trend is moving, but it will still take decades for us to realise its full potential.

## EXAMPLES

While there are millions of examples, from using this trend to help utilities and transportation organisations predict and identify equipment and infrastructure problems in real time, to the development of **Smart Cities** and **Smart Homes**, and **Wearable Technology** devices that help analyse, monitor, and improve human well-being, some of the more notable examples of this trend include **Continuous Innovation**, a trend that when combined with **Synthetic Innovation**, will completely transform how products are designed and innovated, with another example being **Autonomous Vehicles** which will use it to generate their own **Spatial Intelligence**.

However, from Smart Supply Chains with **Product Traceability** built into every asset and product that in time can be fully automated using logistical **Control Towers**, to the **3D Bio-Printing** of human hybrid organs that are embedded with sensors that, in the case of 3D printed human hearts could predict the onset of a heart attack and shock the heart back into the right rhythm using printed batteries and energy films, this trend has no shortage of amazing and useful applications.

## ACT NOW

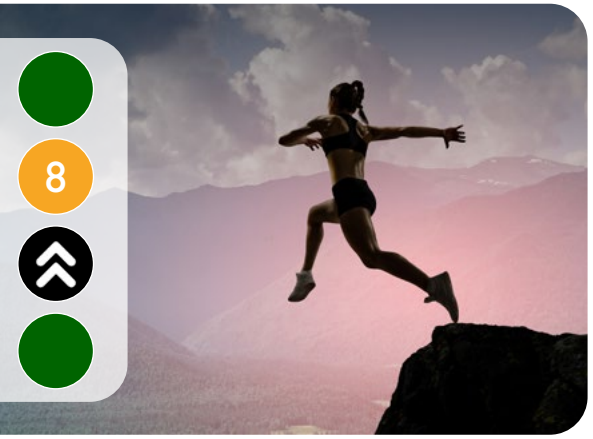
This trend is completely transformative and it lets us capture and analyse all manner of actionable data on everything in our world - with all the benefits and consequences that brings. While this is a revolutionary trend which dovetails into many other trends such as **Digitisation** and **Digital Twins**, among others, and has many benefits, organisations must also be aware of its potential downsides, such as its broad threat surface which could leave organisations vulnerable to cyber attacks.

**EXPLORE:**

- Best practices and case studies
- Business and impact assessments
- Emerging technologies and technology roadmaps
- Future of Artificial Intelligence, Communications, Healthcare, Manufacturing, Sensors, Technology, and the Workforce
- Partner ecosystems and solutions

# JUMPING S-CURVES

**2ND YEAR ON THE LIST**




## QUICK TAKE

Inevitably squeezing new performance gains from even the most advanced technologies eventually becomes far too costly and difficult to do, and when that happens researchers jump to a new technology. This is called Jumping S-Curves. The word S-Curve comes from the fact that when a new technology emerges it often develops at a slow rate - from a Cost-Performance perspective at least - then the rate of development accelerates, and then eventually the improvements slow down and flatten off. The examples of this are everywhere, from 4G to **5G** to 6G, and from silicon to quantum computers and beyond.

*Data sources: 311Institute, ARK Investment, and various.*

## IMPACT

Ultimately the impact of being able to jump S-Curves, and move from one **Exponential Technology**, which has run out of steam so to speak to a new technology that has the potential for even greater performance and gains, is that our entire society moves forwards and that in time science fiction becomes science fact.

It also means that ultimately over time almost all of our technologies become increasingly capable and powerful, which then means that their disruptive potential increases. Furthermore, this potential is then magnified even more as **Technology Convergence** takes place, which then leads to the almost complete re-invention of global business, culture, and society.

While it is difficult to give precise details about the impact of this trend, because it's so complete and so wide spread, one of the most notable impacts is its impact on the economy and Global GDP Growth. One the one experts estimate that many of these exponential technologies will destroy over $41 Tr in economic (GDP) value, and on the other they estimate that they will then create over $200 Tr of new economic value.

## EXAMPLES

While there are many examples of jumping S-Curves some are more obvious than others such as the "jump" we made from 1G to 2G to 3G to 4G and now 5G mobile communications, with 6G already in the wings. These are all prime examples of jumping the S-Curve as we move from one technology that's increasingly difficult to improve on and then jumping to the next.

Elsewhere we have the likes of WiFi 6 and the jump to WiFi 7, 3D Printing and the jump to 4D Printing and even to weird technologies like Xolographic 3D Printing that let us print working Nano-Machines straight out of the gate.

In the computing space we're moving from Silicon based computing to Quantum and Neuromorphic computing, which then in turn will themselves give way in time to Biological, Chemical, DNA, Photonic, and possibly even Liquid and Wave computers, and in the sensor space we're starting to make the jump from MEMS sensors to Quantum and DNA sensors that are millions of times more sensitive.

And the list goes on ...

## ACT NOW

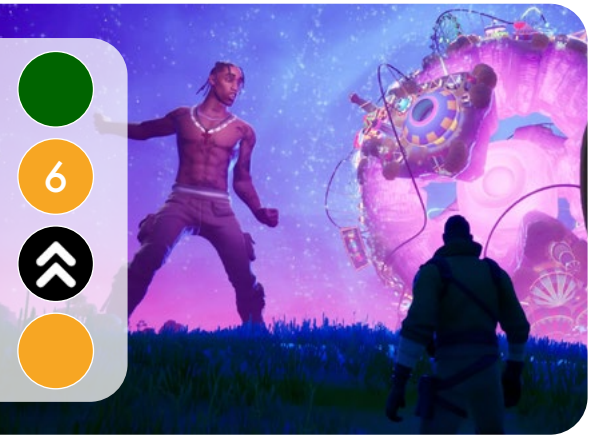
When one technology runs out of road, or runs out of steam - whichever analogy you prefer - human ingenuity almost always finds a way to move beyond it and as one famous ICT company used to say "Invent the next." As such if you, like I, like predicting the future then this is a trend you have to get to grips with and understand, do that and suddenly predicting the future and deep future becomes "less difficult."

**EXPLORE:**

- Benefits and impact assessments
- Emerging technologies and technology roadmaps
- Future of Technology
- Partner ecosystems and solutions

# METAVERSE

**2ND YEAR ON THE LIST**




*Travis Scott, Fortnite*

## QUICK TAKE

The Metaverse is as an infinite collection of traditional **Immersive Reality** (A/M/VR) experiences and sensory immersive (MXR) experiences and virtual worlds which can be accessed via gadgets and the web - even though ironically the Metaverse's ultimate vision is to replace the web as part of the **Web 3.0** trend. As a result many of the organisations racing to dominate and monetise it are already building walled gardens which, unless there's a common set of standards, won't let users move their avatars or digital assets between different worlds - even though **Blockchain** makes that possible today.

*Data sources: Emergen, PWC, and various.*

## IMPACT

Arguably the equivalent of being plugged into a 21st century Matrix the Metaverse is perhaps one of the most exciting trends of them all because of the commercial, personal, and professional opportunities it creates, such as the ability to be anyone or anything doing anything anywhere where the only limit is your imagination or the imagination of those around you. And the only thing that's holding everyone back from literally jumping into it is culture and the maturity and usability of the technology underpinning it - all of which are obviously massive challenges.

Estimated to grow at a rate of 43% CAGR it's expected that by 2028 the Metaverse will be worth $829 Billion, especially as new smaller and less obtrusive AR and VR glasses and gadgets emerge, especially as we see the expansion of the ecosystem, and a significant increase in both the resolution and richness of the content. It's also likely that many of the organisations who eventually dominate this space will hail from the entertainment, gaming, and technology sectors, but that shouldn't dissuade others from being bold.

## EXAMPLES

As the Metaverse takes shape organisations are already reaping lucrative commercial rewards with the best known being Epic, under the auspices of Fortnite, and Meta. In Epic's case they have been experimenting with virtual gigs within a Metaverse construct for a while with their most popular gigs drawing over 12 million people. Then, in Meta's case, not only have they been building a vertical stack spanning hardware and software for years now but in 2021 Mark Zuckerberg pivoted his entire empire, including Facebook and Oculus, to focus on it and the **Meta-Economy**.

Elsewhere **Exergaming** and **Virtual Malls** are on the rise, and Microsoft, Sony, Warner, and others are pivoting their businesses, including investments, to capitalise on it whether it's for communication, collaboration, entertainment, or other purposes. Meanwhile others are developing Blockchain platforms that let people move avatars and digital assets between platforms, and even LVHM have developed new **Non-Fungible Tokens** (NFT) monetisation models to let people buy, sell, and trade luxury **PhyDigital Products** such as handbags.

## ACT NOW

To older generations the concept of the Metaverse will be almost completely alien and foreign, but for today's younger generations it will increasingly become their go to "world" which means that at the very least it's important that you experience this trend first hand and develop a point of view.

**EXPLORE:**

- Best practises and case studies
- Business and impact assessments
- Digital asset and product development, including Digital Twins
- Future of Communications, Creativity and Innovation, Entertainment, Finance, Retail, Technology, and Work
- New business and operating models
- Partner ecosystems and solutions
- Policy and regulation reform

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EXPLORE STARTUPS & MORE

# POWER OF THE INDIVIDUAL

**2ND YEAR ON THE LIST**

## QUICK TAKE

We live in an exponential society where one persons ideas and products, which can increasingly be created and marketed by **Creative Machines**, can be discovered and consumed by the billions of digitally connected people on the planet at unimaginable speed and scale. The upshot of this is that, literally, one person or entrepreneur can change the world and shape the future faster than ever - for better and worse. Not only does this mean individuals have more power than ancient rulers but it also means we all have an obligation to ensure this power is used to benefit all of society.

*Data sources: Guardian, MDPI, Visual Capitalist, and various.*

## IMPACT

With easier, faster, and simpler access to finance, ideas, markets, and resources, today it costs less to start, operate, and scale a global business, or reach a global audience, than ever before. It also costs almost nothing to communicate and sell an idea, opinion, or product, and collaborate with others - the combination of which means that influencing society, creating or shaping the future, and making an impact has never been so affordable or easy. Which then puts global and societal level change within everyone's reach for the first time in human history.

While this is obviously highly beneficial though without the right oversight, policies, and regulations, in place the businesses and individuals who capitalise on this trend, such as Mark Zuckerberg whose platforms now connects and algorithmically influence over 3 Billion people, or to put it another way almost everyone on the planet with a decent internet connection, this trend is open to being abused - as was neatly illustrated back in 2014 when Facebook adjusted the platforms algorithms to conduct an illicit and highly unethical "Mood-Manipulation" experiment ...

## EXAMPLES

Examples of the ability of individuals and **Solopreneurs** to change and shape the future at a speed and scale that would have been unimaginable just two decades ago, are everywhere.

From climate change activists like Greta Thunberg who used social media to galvanise over 1.5 Million students into direct action across 125 countries, and triggered over 483,000 mentions in 2019 - up from just 4,000 in 2018 - to celerities including Cristiano Ronaldo and Justin Bieber with 517 Million and 455 Million followers respectively who, in their own way, also have the ability to influence popular culture.

However, this trend, which leverages connectivity, "digital," and technology as force multipliers, is also highly advantageous for entrepreneurs who, like their celebrity counterparts, can use it to build, operate, and scale huge businesses easier and faster than ever before with prime examples being Fortnite, Minecraft, Roblox, as well as industry behemoths such as Alibaba, Amazon, Apple, ByteDance, Google, Netflix, and Tencent, as well as newer "Unicorns" such as Airbnb, Deliveroo, GitHub, Uber, and thousands more.

## ACT NOW

As we look into the future the power of entrepreneurs and individuals, to change and shape future business, culture, and society, will only increase. Then in time this trend will be augmented by new automated and autonomous technologies which will accelerate it exponentially as machines take on more of the heavy lifting. As a consequence we face both an exciting and perilous time, and it will be crucial that individuals act ethically and with a higher purpose in a way that benefits people and planet alike.

**EXPLORE:**

- Accelerator programs
- Emerging technologies and technology roadmaps
- Future of Communications, Creativity and Innovation, Education, Entrepreneurship, Financial Services, Manufacturing, Society, Work and the Workplace
- Policy and regulation reform
- Social trends

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EXPLORE STARTUPS & MORE

# ROBOTICS

**2ND YEAR ON THE LIST**

## QUICK TAKE

When I say the word Robotics it's likely that two things pop into your head - hardware based robots like those you find on the factory floor and in your home, and or **Robotic Process Automation** (RPA). But there's a lot more to robotics than just those two categories.

Today we have these kinds of robots, but we also have software robots, often known as just "Bots" for short, as well as Co-Bots, inflatable robots, soft robots, and even Crystal, DNA, Molecular, and Nano Robots. Although, again, the latter are often just called Nanobots.

*Data sources: Boston Dynamics, and various.*

## IMPACT

While we have already seen the arrival of robots of that are capable of designing themselves, evolving themselves, using **Creative Machine** technologies, and then printing themselves off using **Additive Manufacturing** technologies many people still think most robots are basic. But that's increasingly not the case.

In the financial services sector trading bots are now so ubiquitous and sophisticated that traders believe if they go rogue they could collapse the global financial markets in mere seconds - something we saw happen in 2018 when Bloomberg misreported Facebook's results and bots sent the stock down by over $32 Bn within milliseconds. Furthermore, whether they're running **Dark Factories** and **Dark Warehouses**, driving **Job Automation** or running **Autonomous Organisations**, or simply being used to automate low level tasks, as we see technologies such as **Artificial Intelligence** (AI), **Blockchain**, and **Machine Vision**, improve we'll also see an exponential improvement in the development of Generalised Robots, as well as ones that learn autonomously, and that share **Hive Mind Systems**.

## EXAMPLES

Robots are more ubiquitous than you might think. While the Roomba robot moves around vacuuming your home other software based robots are busy at work in the digital ether automating tasks that include everything from share dealing and **Synthetic Content** to expense approvals and much more. Some of the most interesting examples of robots in action though include ATLAS the world's most sophisticated humanoid robot that can dance and do parkour alongside it's Spot the robot dog colleagues, as well as robots that can evolve their own code in the same way animals do with DNA.

We then have DNA and Molecular robots that have been used to create molecule sized production lines and create molecular products - the first Molecular Assemblers in action. Elsewhere MIT have used **Neural Interfaces** to train robots new skills telepathically, and Google has linked multiple robots up to AI and **Cloud Computing** to develop Generalised Robots that learn by themselves and that can share their new experiences and skills instantly with "the collective" via hive minds. And these are just a few of the amazing examples I could mention.

## ACT NOW

When people think about robotics they are often very narrow focused, but today robots of all kinds are helping accelerate both manual and **Cognitive Automation** faster than ever before across all sectors and job and task categories. They are also becoming increasingly generalised and utilitarian which means it's only a matter of time before we all see much more of them, whether it's in the home, at work, or behind the scenes.

**EXPLORE:**

- Best practises and case studies
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# SINGULARITY

**2ND YEAR ON THE LIST**


## QUICK TAKE

Over the decades technology that was distant from us has been gradually getting closer to us and today it's near us, on us, and in some cases, in us.

However, as **Exponential Technologies** advance we can see a time when technology isn't only in near, on, and in us, but a time when we are technology - literally. And, as odd as that sounds today using **Synthetic Biology** we have already turned living human cells into powerful Biological and DNA **Computing Platforms**, and that's just the start of how this trend will transform the human condition forever.

## IMPACT

The ultimate impact of the Singularity will be to create the "next" version of Homo Sapiens sometimes referred to as Human 2.0. More than just Cyborgs augmented with technology human beings will become the technology. We will be connected with and fused with **Artificial Intelligence** (AI) and compute, be able to connect with one another and machines via **Hive Mind Systems** and Telepathy, and perhaps most intriguingly could be both immortal and freakishly powerful - both in the literal sense.

What toll all this will have on global culture or society, as well as the human psyche and sense of self, noone knows although we can assume that this "ascension" as some people are already calling it would create a super and a sub species of humans comprised of those who embrace the Singularity and those who don't. And, needless to say history has demonstrated time and time again that the cognitively superior species has almost always wiped out the less superior ones. Which then leads us into debates about Dystopia and Utopia - both of which are equally possible with this trend.

## EXAMPLES

While there are many definitions of the Singularity it's estimated it will become reality in the mid 2040's which would also coincide with the development of Artificial Super Intelligence (ASI).

However, while it might be possible to become Human 2.0 in this time frame it will likely be many more decades before we see this trend adopted en masse because, as we've seen time and time again, even though we already have sci-fi like technologies emerging today culture, ethics, law, liability, and regulations almost always slow down their ultimate adoption.

As I often say though the future is being written today and we have already used **Synthetic Biology** to turn living human cells into powerful biological supercomputers that are able to autonomously identify pathogens in the body and create Living Pharmacies that produce the drugs to defeat them. Additionally, we've also already seen human Brain-to-Brain (B2B) telepathy demonstrated numerous times, Cancer beating Nanobots, and the use of **Neural Interfaces** to help people communicate so, as you can see, we are already laying the foundations.

## ACT NOW

While we have a long time until this trend becomes a viable reality is underscores just how significantly all our lives could change within just a couple of generations. This trend should also serve as a warning that we need to be ever vigilant and prepared for what happens when sci-fi becomes our every day.

**EXPLORE:**

- Emerging technologies and technology roadmaps
- Future of Artificial Intelligence, Communications, Computing, Ethics, Healthcare, Manufacturing, and Robotics
- Policy and regulation reform

*Data sources: Harvard University, John Hopkins University, MIT, UCL, and various.*

# STANDARDS SHADOW WAR

**2ND YEAR ON THE LIST**


## QUICK TAKE

Think of a nation that rose to global dominance because of its ability to develop new technologies and technology standards and it's likely only one comes to mind: America. From **Artificial Intelligence** (AI), mobile phones, and semiconductors, to the internet and the standards that underpin it, the US has been a technology and standards leader for decades. And they've benefited and profited from it handsomely. Now though China, the EU, and others want that crown, and there's a "Shadow War" to develop and dominate future global technology standards.

*Data sources: Internet Association, PWC, SEC, and various.*

## IMPACT

While many people might not attribute too great a value with being the country behind the development of technology and technology standards the fact of the matter is that today the US internet sector alone - as it's own specific sector - now accounts for more than $2.1 Trillion of America's GDP, or about 10%, which makes it the fourth largest sector of the US economy behind the government, manufacturing, and real estate.

Furthermore, between 2012 and 2018 the internet sector grew nine times faster than any other part of the US economy, and I'm not even going to touch on the benefits it's bought every other sector.

Meanwhile, semiconductors may "only" account for 0.3% of US GDP but they play a mission critical role in supporting a further 12% - which is why we saw key sectors of the global and US economy, such as the automotive sector, come under pressure when the global pandemic cut supply. And as for AI, well, estimates say it could benefit the US economy by over $3.7 Trillion and the global economy by over $16 Trillion - all of which makes winning the Shadow War table stakes when it comes to owning the future ...

## EXAMPLES

Spurred in part by the 2019 China-US **Trade Wars** China's efforts to control and shape the future of global technology standards is well documented and they talk openly about the "golden opportunity for the country to realise the goal of overtaking [other countries] by changing lanes." Which is quite apt when you think about it - and worrying when you think about the control and surveillance implications.

To back this up in 2018 they released a strategy document entitled "China Standards 2035" which laid out their action plan to play a leading role in the development and formulation of future technology standards for technologies as diverse as **5G**, 6G, AI, Big Data, **Cloud Computing**, energy, the **Internet of Things** (IoT), payments, **Quantum Technology**, and many others. And, since then, they have translated more than 500 of their domestic standards into English and incorporated standards clauses into many of their MOU agreements with countries as part of a so called "Digital Silk Road" strategy that, arguably, uses **Soft Power Plays** to persuade countries to adopt their standards over others.

## ACT NOW

While there is a Shadow War over the future of technology standards countries are also inflating their presence on international standards boards such as the IEC and ISO as they juxtaposition with one another, which then only fans the flames of the **Innovation Cold War**. As a consequence governments and organisations need to be vigilant, maintain investment in R&D, and double their efforts to ensure that standards don't become bifurcated or compromised.

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- Creative Machines
- Emerging technology and technology roadmaps
- Future of Exponential Technology
- Strong global institutions
- Unilateral global accords and coordinated global action

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# SYNTHETIC BIOLOGY

**2ND YEAR ON THE LIST**


## QUICK TAKE

Just take a look around you and you can see what being able to code software has done for the world. Then, take another look and you can see what mother nature has managed to achieve using just 4 base pair DNA.

Now imagine the power we hold in our hands, and the potential good and bad we could unleash, if we could program and re-write the code of life in the same way we do with software today. Then imagine what we could do with DNA that has 6, 8, 11, or even more base pairs, and I guarantee you haven't even started to scratch the surface yet.

*Data sources: BCC Research, CB Insights, and various.*

## IMPACT

Possibly the most impactful and powerful trend of them all - even surpassing the potential of almost every other **General Purpose Technology** (GPT) - Synthetic Biology has the potential to change everything about our world, from how we construct buildings, develop computers, food, materials, robots, and other technologies, manufacture products, all the way through to how we power and sense our world, treat disease, and via the **Singularity** even how humankind evolves. As such, even though it is an early stage trend, it is not to be underestimated.

Today the synthetic biology industry is worth an estimated $9.5 Bn and is expected to grow at a rate of 28% CAGR to reach $33.2 Bn by 2026, and as **Artificial Intelligence** (AI) and **Genetic Engineering** technologies such as CAST, CRISPR, and others improve it's certain that activity and investment in this trend will accelerate. However, while it's a slow burn megatrend with arguably no upper limit its overall progress both within and outside of the traditional biological life sciences sector will likely be slowed by enhanced regulator scrutiny as all of us head into the literal unknown.

## EXAMPLES

Today there are many examples that sound like science fiction, in fact, some make science fiction sound tame, such as using synthetic biology to turn human liver cells into dual core computers which, in turn, opens the door to turning humans into "Living Pharmacies" - AKA disease fighting biological supercomputers ...

Then there's the creation of **Designer Humans**, children who have been genetically modified in vitro so they don't inherit their parents inherited genetic conditions such as Hunters Syndrome and Thalassemia, both fatal disorders, using a technique that could cure over 6,000 genetically inherited conditions that today are widely regarded as being incurable.

We've also seen the development of genetically modified organisms, such as corals that don't bleach, and bacteria that quadruple the energy density of biofuels and the efficiency of solar panels. Then there's the use of 8 base pair synthetic DNA to create new forms of synthetic life, programmable living robots, biological and DNA computers, and DNA storage systems that can store over 500 Pb of data in a gram of DNA.

## ACT NOW

When it comes to this trend the sky is the literal limit, especially as AI and **Synthetic Innovation** platforms that can design and then, using the trends of **Additive Manufacturing** and **Bio-Manufacturing**, 3D bio-print their own synthetic biology creations at digital speed start to ramp up - something that sounds less like science fiction when you realise that AI has already managed to design its own synthetic human genome which could be used to create the world's first synthetic humans ... As a result this is very much a trend to watch.

**EXPLORE:**

- Best practises and case studies
- Business and impact assessments
- Emerging technologies and technology roadmaps
- Ethics and oversight boards
- Future of Healthcare, Manufacturing, and Synthetic Biology
- Policy and regulation reform

# TOKENISATION

**2ND YEAR ON THE LIST**

## QUICK TAKE

Tokenisation is the process of exchanging sensitive data, that can be of any nature, for non-sensitive data called Tokens that by themselves have no extrinsic or exploitable meaning or value. The process of tokenisation itself creates a bridge between digital and real-world assets and their storage, trading, and transfer in the digital world.

Ultimately the upshot of this is that this trend has the potential to unlock access to a huge range of different assets and services and thereby create a variety of disruptive, global scale opportunities.

*Data sources: HSBC, Nesta, OECD, Visa, WEF, and various.*

## IMPACT

While this trend has many implications such as being a key enabler of trends such as **Fractional Ownership** and **Non-Fungible Tokens** (NFTs), as well as letting individuals and organisations take stakes in previously illiquid assets such as art or realty, it'll be significantly accelerated by the arrival of **Web 3.0**.

Today though one of its biggest impacts is on the financial services markets where asset tokenisation has become one of the most prominent use cases of Distributed Ledger Technologies (DLT) technologies such as **Blockchain** and the accelerating **Decentralised Finance** (DeFi) movement. In turn not only this causing wide spread industry disintermediation, but it's also having an effect on trading and affecting the liquidity and volatility of all manner of related markets - especially in times of stress.

By 2027 it's estimated that up to 10% of global GDP will be stored and transacted via DLT and that tokenised markets could therefore be worth of upwards of $24 Tr, and that's before we look at all of the other non monetary stores of value it could attack and some of the other use cases.

## EXAMPLES

The main kinds of tokens include Asset or Commodity Tokens that are backed by standard assets that already have a value such as gold, oil, or sovereign currencies, Equity or Security Tokens that equate to ownership of something, and Reward, Social, or Utility Tokens that only have a value in the system they're used in. However, while these are the main types there are plenty of others being spawned all the time.

Some of the more notable examples of this trend include the tokenisation of electricity consumption, fund raising, shares, and voting, as well as the Reserve Bank of India's decision to force **E-Commerce** and online platforms to delete and replace all credit and debit card information on their platforms with surrogate tokens to secure the card details of customers. Elsewhere organisations such as Storj use it to create decentralised cloud storage systems, run ICO's, build **Decentralised Autonomous Organisations** (DAO), and even build **Temporary Organisations** that eventually dissolve themselves and leave behind unowned self-governing, decentralised systems or protocols like Bitcoin itself.

## ACT NOW

Tokenisation is the metaphorical glue that both accelerates and enables many of the other digial trends I discuss in this codex, and there are many that believe in the end the so called token economy, which will ultimately include any transferable asset of any kind, will rival the real world economy in size and exceed it in scale.

**EXPLORE:**

- Best practices and case studies
- Benefits and impact assessments
- Emerging technologies and technology roadmaps
- Future of Communications, Financial Services, Security, and Work
- Policy and regulation reform

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# WEB 3.0

**2ND YEAR ON THE LIST**

## QUICK TAKE

Web 1.0 as it was known was a basic decentralised read only system. Then came Web 2.0, the internet we know today - a centralised, participatory system that allows users to collaborate and create content.

What comes next, unsurprisingly, is Web 3.0, a truly decentralised internet with no intermediaries that's characterised by technologies and trends including **Artificial Intelligence** (AI), **Blockchain**, **Cloud**, Distributed Apps (dApps), **Immersive Reality** and the **Metaverse**, **Non-Fungible Tokens** (NFTs), and ubiquitous connectivity.

## IMPACT

Web 3.0 is a slow burn megatrend simply because of the scale of the task in hand and the amount of work needed to "evolve" the current web. However, despite this the momentum is gathering with more than 65% of all Web 3.0 developers joining in 2021 to help build and manage more than 500,000 Web 3.0 code repositories and more than 160 Million commits. Furthermore, when we look deeper into the statistics we see that 20% of new developers also joined the Ethereum ecosystem, which is a telling statistic in itself, and that over 2,500 developers are now working on **Decentralised Finance** (DeFi) projects - with that ecosystem growing at 76%.

Dubbed by many as the "Billion dollar Web 3.0 Industry" today these armies of developers are busy developing the ideals and the foundations of Web 3.0, including everything from "Cryptoeconomic" and **Meta-Economy** platforms to **Decentralised Autonomous Organisations** (DAO), and beyond, and while estimates about the future market size vary wildly countries such as India estimate that in the next decade Web 3.0 could add at least $1.1 Tr to their GDP, with other countries also likely to similarly benefit.

## EXAMPLES

With the likes of Sir Tim Berners-Lee, the inventor of Web 1.0 and his World Wide Web Consortium (W3C) voicing concerns over the current Web 2.0 internet, especially when it comes to Big Tech, the **Demise of Anonymity and Privacy**, and trends like **PsyOps**, it's clear that many of the people helping build out Web 3.0 see this as an opportunity to correct past mistakes.

However, while Sir Tim himself has developed a web decentralisation platform called Solid (SOcial LInked Data) that lets people store their data securely in "pods" it remains unclear whether or not Web 3.0 can truly be the "fresh start" that many people hope, especially as organisations like Meta start claiming their stake to it and tie it into their Metaverse plans.

Meanwhile, while organisations such as ThreeFold are encouraging people to join the peer to peer revolution others such as Elon Musk and Jack Dorsey are more critical of the public being able to "own" Web 3.0 saying that it and its overall agendas and goals will be driven by VCs and LPs and that ultimately "it will become a centralised entity with just a new shiny label."

## ACT NOW

While many people hope that Web 3.0 will fix many if not all of the problems we see today with Web 2.0 it's unlikely, which would be very unfortunate. However, that said it does represent a seismic shift in both the architecture and capability of the web, and while it will still likely be dominated by large and even larger tech platforms than we see today it should still nevertheless have a significant impact on how organisations and individuals conduct business and consume all manner of different services.

**EXPLORE:**

- Best practises and case studies
- Business and impact assessment
- Future of Artificial Intelligence, Communications, Media and Entertainment, and Work
- Partner ecosystems and solutions
- Policy and regulation reform

*Data sources: Consensys, Deloitte, Electric Capital, Goldman Sachs, and various.*

Notes:

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