The Intelligent Era

What's Hot in Technology 2023

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Chief Executive

Global Futures and Foresight

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Global Futures
& Foresight

Preface

We are emerging from three years when the Covid-19 Pandemic changed how we lived and worked and put many sectors under extreme financial pressure. Just when we felt we deserved some stability, Putin set his army on Ukraine, delivering heartache and upheaval in people's lives and in worldwide supply chains. At the same time, increased costs resulted in inflation, and consequently higher interest rates, impacting food, energy, borrowing and operational costs. In addition, China has upped the rhetoric in its demands for unification with Taiwan, where 65% of the world's semiconductors are made, so again, supply chains are in turmoil and are likely to remain that way for a while, whatever happens next.

However, one thing we do know about Pandemics is that they bring change:

> *'Pandemics change history by transforming populations, states, societies, economies, norms, and governing structures.'[i]*
>
> J. Stephen Morrison and Anna Carroll
> Centre for Strategic and International Studies

McKinsey, the global management firm, surveyed over 200 organizations across industries and found that more than 90 percent of executives expect the fallout from COVID-19 to fundamentally change the way they do business over the next five years. Almost as many asserted that the crisis will have a lasting impact on their customers' needs. Over three-quarters said that the crisis will create significant new opportunities for growth, although this varies by industry.[ii]

In our 2020 report, 'The Big Break', we reported that the following characteristics would emerge post pandemic:

1. The death of distance.
2. New customer expectations.
3. Tech in everything, everywhere.
4. Information overload.
5. The Intelligent era.
6. Widespread innovation.
7. New working & business models.
8. New technical skills.
9. New globalisation and reshoring.
10. Refocus on sustainability and BREXIT.

There are a great many challenges to consider along with the explosive power of new and emerging technologies. To some it spells a great opportunity, to others an end to so much that has been stable and reliable. In any case, it will be a time of fundamental change.

Introduction

In this new Intelligent Era, we will see significant enhancement to the assets we built during the Digital Era and the augmentation and replacement of many professional and Knowledge Workers skills, tasks and roles. The Fourth Industrial Revolution is widely heralded and set to change how we execute most business, but it is often only in hindsight we can say when it started. In the meantime, we can confidently say that the 'Intelligent Era' is with us today.

Previous technologies augmented and replaced clerical, supervisory and managerial tasks and roles and made workers more productive and long-honed skills redundant. Often those skills did not disappear but demand for them was dramatically reduced. For example, coal mining, filing and gas street lighters, all of which are still required today but far less so than when they provided a service that enabled everyday life. The good news is that new skills are increasingly in demand and new roles are being created in the Intelligent Era, for example, in blockchain, extended reality, digital ethics, robotics, analytics, innumerable techs and of course, Artificial Intelligence (AI).

It is a time that will be characterised by being:

- Virtual
- Quantified
- Automated
- Smart
- Predictive
- Networked
- Hyper-personalised

We'll examine these further and consider the opportunities and consequences of each.

Created By Chat AI DALL.E "Create Intelligent Era in style of Sci-Fi"
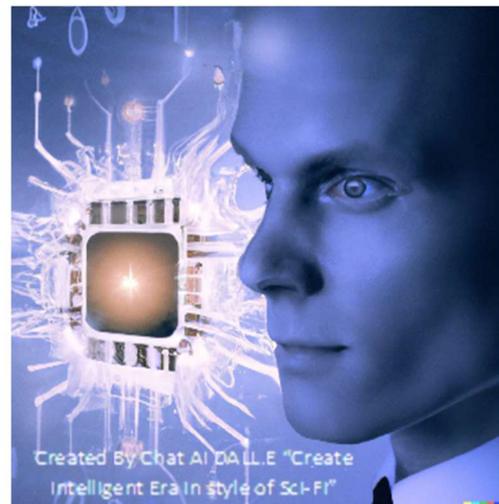
Artificial Intelligence (AI) will move away from being primarily used for customer service chatbots to become increasingly cognitive and human-like, making its own decisions to achieve the goals we set. ChatGPT and many other generative AI systems, have loudly proclaimed the start of the Intelligent Era and recently grabbed our attention.

Here are some amazing exponential forecasts for the Intelligent Era:

1. Artificial Intelligence - Could contribute up to US$15.7 trillion to the global economy in 2030, more than the current output of China and India combined. More than 100 million people are using ChatGPT in just 3 months of it being launched, making it the fastest growing application in technology history.

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2.   Communications – The number of satellites will increase from around 2,500 today to potentially 100,000 within this decade. 40 times connection capability.

3.   6G - Begins to be rolled out by 2028. In lab tests it has been shown to be up to 1,000 times faster than 5G with lower latency.

4.   Computing power - Moves beyond binary to Quantum with speeds of up to 158 million times faster than the best supercomputer today, more practically maybe 'just' 1,000 to 5,000 times faster.

5.   Data - IDC forecasts that the Global DataSphere is expected to more than double in size from 2022 to 2026.

6.   Analytics - Moves from Predictive to Prescriptive to Cognitive to Autonomous, enabling forecasting to be more automated and accurate than ever before.

7.   Connected sensors and online devices – Will be increasingly embedded in anything and anybody. As the Internet of Things is augmented with the Internet of Nano Things, the number of connected devices is expected to grow from 14.4 billion today to a trillion by the end of the decade. This enables the quantified era, a time when everything is measurable.

More information will be pumped out by more devices, analysed by smarter tools on lightning-fast quantum computers or actioned where the data is captured, connected via a massive array of satellites and earth stations across rapid 6G networks, using more applied intelligent than ever before.

This time around it is the automation of professional knowledge, skills and tasks. People who have invested enormous effort to gain their qualifications, capabilities, experience, positions and reputations, to generate a good standard of living and lead comfortable lifestyles. This is all changing because of what's happening in the Intelligent Era. Some roles will be significantly enhanced, and others will be made all-but redundant. The important thing to remember is that new roles are emerging, requiring new skills and capabilities and the role of the human being will remain essential.

This is a distinctly new era, with new pressures on organisations to consider how they adapt and take advantage of this rapidly changing environment. It is a time when we live, work, learn and communicate are transformed. It is a time in which, without fundamentally reimagining your purpose, proposition and processes, it would be easy to become irrelevant.

Executive Summary

For all new technologies, first we do things differently, in this case faster, smarter and more securely. Then we do completely different things, because we can, and they add value.

David Smith
Futurist

This report was produced in March 2023 and covers the key technologies that will enable the Intelligent Era. It has been hard enough adapting technology, organisation, processes, business model and offerings to the Digital Era now we are confronted by the automation of 'everything'. When once the idea of Artificial Intelligence and robots were the domain of science fiction writers, it is now the business or organisations and workers alike. We will all being impacted by it.

If we are comfortable with change, it will be an exciting time. If we are fearful or reticent to change, then it will be an unwanted upheaval of nearly everything you do.

Key points:

1. Technology is going to get exponentially smarter, faster and more able to capture data, almost anywhere.
2. Processing and analytics will be lightning fast and autonomously smart, creating new engagements in unexpected ways.
3. Communications has hollowed out past practices and enabled new lifestyles and processes. Connectedness will increase by a factor of at least 40 enabling new processes hitherto impractical.
4. Data will enable and define our interactions rather than just record them and multiply in quantity, importance and availability exponentially.
5. Most sectors will face dramatic change and it will need organisations to adapt. Or as Deming said, 'You don't need to change, survival isn't mandatory'. It sounds threatening but I hope you hear how vital it is to take notice of the collective change technology is delivering.
6. Most knowledge worker skills and professionals' skills will be enhanced but many skills and job roles will change, and many disappear, almost completely.
7. What we produce will change as we become more familiar with Additive Manufacturing. Everything from internal human organs to skyscrapers.

Being ready for this will separate the winners and losers and I hope you are a winner.

The Intelligent Era

Sometimes we are not so great at preparing for what comes next after the issue we're dealing with today. Maybe it's because we see the future as a problem that we don't have to deal with yet. Looking ahead, however, often shows us new issues and opportunities we should factor into the decisions we are making today. That's never been truer than in the field of technology and it has never been truer than today.

> *'Change is the law of life and those who look only to the past or present are certain to miss the future.'*
> President John F. Kennedy

This time is characterised by the intelligence and automation which is enabled by a combination of increasingly capable technologies. Consequently, the world around us is going to undergo a fundamental change, transforming the way we live, learn, work, and play and even redefine what it is to be human.

ChatGPT[iii] from OpenAI[iv], was launched to the public on 30[Th] November 2022 and has shown us the myriad ways AI and, in this case, generative AI, can help us in creative, knowledge worker and professional tasks. It is based on the GPT-3.5 using autoregressive, deep-learning to produce human-like output. Now GPT-4 is released to 'Plus' users and already in operation by many large organisations including Morgan Stanley, Stripe, and Khan Academy

and by Microsoft in their Bing search engine. GPT-4 is significantly more performant and indicates the tasks and functions that could be readily automated and challenges many established ways we currently make a living. The good news is that we've seen automation before, and we always find new ways to work and earn a living. AI has been forecast for decades and yet its arrival has caused such a surprise to a great many people.

Technology has moved in one long continuum and will continue to do so, and to that extent is predictable.

Created By Chat AI DALL·E "Create Intelligent Era in style of Sci-Fi"

However, predicting the exact timing when individual technologies become ubiquitous or combine with other factors and circumstances to be impactful, is more of a challenge. From automating manual work, including the invention of the wheel, the printing press, mechanical diggers and cranes, to automating clerical work with data processing and then managerial duties with decision support tools and smart systems and now it's the turn of

professionals to be the subject of automation. Technology will increasingly replace current tasks and highly valued skills with information fed intelligent systems and machines. We humans will still have a huge role to play in most fields, but it will not be the same. There are good questions to answer such as: How will education and learning on-the-job change? What will the role of professional bodies be during this upheaval? Will they resist and if so, to what degree? Or will they embrace this change whole-heartedly?

We've lived through the Information and Digital eras, and each has profoundly changed how we learn, live, work, research, innovate and play. The Intelligent era is a time when we are beginning to apply cognitive and affective artificial intelligence to everyday issues using vast quantities of data and particularly real-time data. It is an era characterised by the quantification of everything from human beings to structures and machinery in and on the land, sea, and skies. It is a time when everything can be measured, and it will be. The data that emanates from this will be analysed and combined with the world's repository of data. New propositions will be created which are both novel and predictive. In essence, everything will be hyperconnected and outcomes hyper personalised and predictive.

The GDP capacity of a country has traditionally been limited by the size of its population and education and machines were its multiplier, now it is data, connectivity, and the combination of new powerful technologies. A time when government policy will be the result of an algorithm examining all information and the behaviours, attitudes and sentiments of citizens applied at any level of government. How do you govern in this environment? What's the role of a political party? Or even a nation?

Created by DALL.E Chat AI
"Create digital twin"
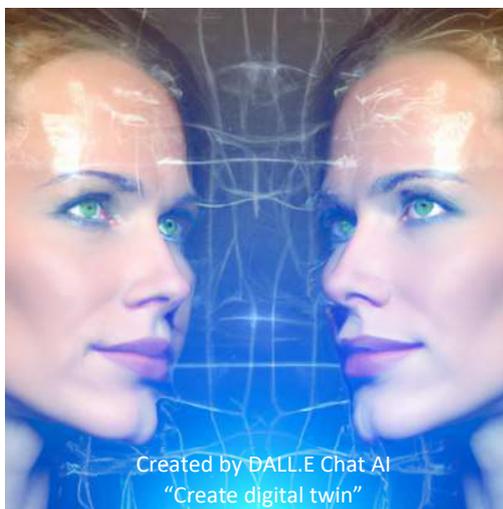
When health and wellness is determined by an algorithm and intervention is often pre-symptom. When digital twins, a digital representation of a physical object, let medical researchers interact with millions, or hundreds of millions, of sample patients, at molecular level, in minutes. When understanding the whole of humanity's genome becomes increasingly possible; - this leads to highly personalised medicine and remedies for everything in novel and unexpected ways. Even remedies for problems we have so far not lived long enough to confront. Will cancers become curable and old age be treated as a chronic disease? Will life expectancy reach many hundreds of years? What will this mean for a working life and a pension? What will this mean for the cost and penalty of shortening a life in the future? What will it mean for living a life? What will this mean for the resources of the planet? What will it mean for relationships?

Capital invested in technology will increasingly generate wealth and is currently owned by a small percentage of the people. How do you share wealth with humans when the term 'welfare' is so pejorative? Is universal income the answer? How and when will the owners of

capital, data and machines be persuaded to share the wealth they generate? Is philanthropy the norm associated with wealth generation, and does it increasingly replace state support or even some of the purpose of a country? Is capital and machine-generated wealth increasingly concentrated in the hands of a few or is this capability democratised and widely shared?

In 2021, the Big Five tech giants—Apple, Amazon, Google (Alphabet), Meta, and Microsoft—generated a combined US$1.4 trillion in revenue. That's more than the combined GDP of over half the countries in the world. The 2021 GDP of the smallest 110 countries was US$ 1.376 trillion. Where is this balance likely to be by the end of this decade?

Created by DALL.E Chat AI "Create graphic Intelligent Era"

On warfare, is it the size of an army, its equipment, motivation and leadership that will win the day or will it be the machine generated intelligence and the means to produce drones and weapons using 3D/4D advanced additive manufacturing methods? Creating unmanned land, sea and air vehicles of innovative and specific capability for the immediate task, in just a few hours. How will ground be taken and kept? Who will have the greatest military might? How does the world govern this – will the UN have a role? Yet today, the Russian invasion of the sovereign nation of Ukraine turns this on its head with its hard-fought land battles, reminiscent of trench warfare during the First World War.
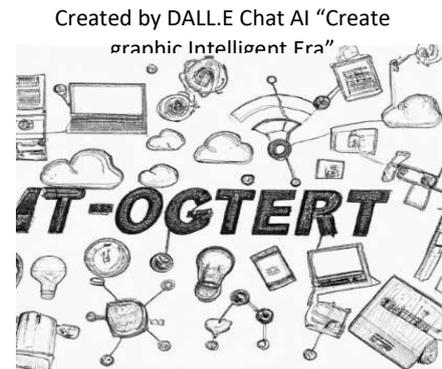
Created by DALL.E "diverging business goals in watercolour"

Machine capability will increasingly link disconnected data looking at unforeseen issues producing new solutions. Generating new solutions to problems we aren't experiencing yet. A time when we will be massively able to accurately forecast everything and pretty much anything. Then what do you do with the unpredictable human being? Is that one of our inherent strengths? In the Intelligent Era we will discover how AI, the Internet of Things (IoT) and mass satellites will connect across 6G and fast networks, accessing vast amounts of data, analysed by exponentially faster quantum machines in real-time. It will be vital for all organisations, whatever their role or position in a supply-chain, or more likely an ecosystem, to understand their implication. This is not just about how you support your business goals using the latest technology but what those goals are.

The Intelligent Era

Shouldn't we try and understand the Intelligent Era a little more and particularly how the siloed development of these and other technologies will combine and alter how we live on Earth?

It is the convergence of multiple technologies that will define this Era, including:

1. Artificial Intelligence, automation and robotics

2. Internet of Things (IoT)/Nano Things (IoNT)/Behaviours (IoB)/Emotions (IoE)

3. Data/Analytics/Twins

4. Blockchain

5. Quantum computing

6. Additive Manufacturing (3D/4D fabrication)

7. 5G/6G/micro satellite communications

8. Extended Reality, Virtual, Augmented, Mixed

9. Holograms

It cannot be emphasised enough that it is the combination of these varying technologies that brings exponential and existential change. Yet, this report is sectioned by technology in order to focus on each in turn.

In 2019 we foresaw that we were leaving the Digital era and entering this very different time - The Intelligent Era - and it would be as transformative as the creation of the internet.

In our 'What's Hot in Technology 2020' report we foresaw that …*"The emerging era, marked by pervasive and ambient connectivity together with artificial intelligence will rewrite the foundation of many of our assumptions about business. It has been said that '…everything invented in the past 150 years will be reinvented using artificial intelligence within the next 15 years.' New competitors, collaboration partners and platforms will help drive this change. If anything can be certain, it is that technological change will compel incumbents to redefine themselves as consumer-centric businesses. Industries, from banking and insurance to retail and even healthcare are finding that this often necessitates not just new talent and skills, but whole new organisation models.*
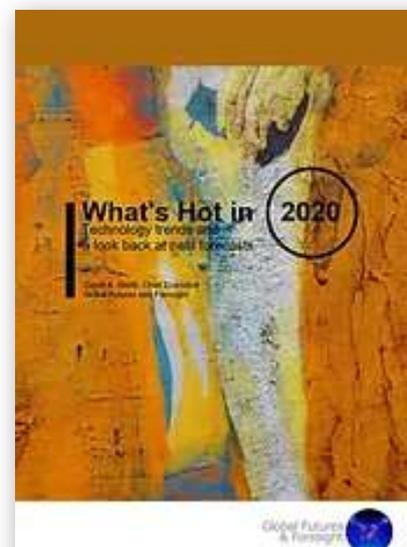
That time is now upon us in a very real and impactful way and this paper describes the next chapter in that story.

Artificial Intelligence and Humanoid Robots

It may seem obvious to include AI as a contributing technology to the Intelligent Era but alone it is insufficient to create a whole new era, although it is a major component.

AI will be a major influence on our lives during the next decade and will enhance our productivity, efficiency, creativity and ability to make use of vast amount of data and inform our vision of the future. It will transform our processes and enable new forms of organisation, reduce our risks and enable accurate forecasting from weather to manpower requirements to human behaviour and wellness bringing new insights, products and services.

AI rarely lives in a vacuum and needs vast quantities of accurate information, often provided on a real-time basis, in order to make good decisions. This will require collaborating technologies such as the Internet of Things (IoT), the Internet of Nano Things (IoNT) the Internet of Behaviours (IoB) and the Internet of Emotions (IoE) and the vast amount of data they produce, Internet 3.0, 5G and 6G communications, Giga and Tera bit broadband and for engagement with the physical world. Additive Manufacturing (AM)(3D and 4D printing) and Extended Reality (XR) and ultimately the power of Quantum computing and super-fast cognitive and forward looking analytics.

Whilst the list below doesn't represent a linear progression in the development of AI, it does indicate its increasing capability. Today we are familiar with the first four and have been generally surprised that it is so capable and appears to come from nowhere. It didn't of course and has been in development for over twenty years.

1. Natural Language Processing/Chatbots
2. Virtual Personal Assistants
3. Machine Learning
4. Robotic Process Automation
5. Cognitive Computing
6. Affective Computing
7. Artificial Life
8. Neural Networks / Deep Learning
9. Swarm Intelligence

The last five are set to surprise us in the next few years. They will magnify how AI, in new forms, will impact us. To understand them a little better here is a brief description of them:

5. Cognitive computing (CC) is broadly speaking based on the scientific disciplines of artificial intelligence and signal processing. It encompasses machine learning, reasoning, natural language processing, speech recognition and vision (object recognition), human–computer interaction, dialogue and narrative generation, among other technologies and capabilities.

6.   Affective computing (AC) is the study and development of systems and devices that can recognize, interpret, process, and simulate human affects – emotions, feelings etc. It is an interdisciplinary field spanning computer science, psychology, and cognitive science.

7.   Artificial life (often abbreviated ALife or A-Life) is a field of study wherein researchers examine systems related to natural life, its processes, and its evolution, using simulations with computer models, robotics, and biochemistry.

8.   Neural networks are a network or circuit of neurons, or in a modern sense, an artificial neural network, composed of artificial neurons or nodes. Thus, a neural network is either a biological neural network, made up of biological neurons, or an artificial neural network, for solving AI problems.

9.   Swarm intelligence is a subfield of AI based on the collective behaviour of decentralised and self-organized systems comprised of relatively simple agents interacting locally with one another and with the environment, much like the way natural swarms behave. In fact, the inspiration for this field typically comes from nature, where different biological systems show very similar features. This is a field commonly associated with both the IoT and AI.[v]

Created by DALL.E "The intelligent Era in digital 3D

There are a great many other streams of research and development in AI, some of which we will examine later, but these will have a significant impact on most organisations which is why they have been included.

For a more linear look at the development and future state of AI I asked ChatGPT:

Artificial Intelligence can be broadly classified into the following categories:

- *Rule-Based AI: It is the simplest form of AI, where the system follows pre-defined rules and logical statements to provide an output.*

- *Machine Learning (ML): It is a type of AI that enables systems to learn and improve automatically from experience without being explicitly programmed. It uses algorithms that can detect patterns in data and make predictions based on that.*

- *Deep Learning: It is a subset of ML that uses neural networks to analyze vast amounts of data to identify patterns and make predictions.*

- *Natural Language Processing (NLP): It is a field of AI that enables machines to understand and interpret human language.*

- *Computer Vision: It is a field of AI that enables machines to interpret and understand visual information from the world around them.*
- *Robotics: It is an area of AI that involves the development of intelligent machines that can perform tasks autonomously.*
- *Expert Systems: It is a type of AI that emulates the decision-making ability of a human expert in a specific field.*
- *Artificial General Intelligence (AGI): It is a hypothetical form of AI that would possess the intelligence and cognitive abilities of a human being.*
- *Artificial Super Intelligence (ASI): It is a theoretical form of AI that would surpass human intelligence and ability in every possible way.*

The recent public launch of OpenAI's ChatGPT language-generation model, with its capability to generate paragraphs of convincing text and code at speed, has shown us the disruptive power of AI. Large language models, such as GPT-3.5, which ChatGPT is based on, has been trained on vast amounts of data and is almost immediately able to respond to text queries on a wide range of topics, generating text and computer code. Amazfit, a renowned global brand for smart wearables announced the world's first smartwatch using ChatGPT.

The recently released GPT-4 solves difficult problems with greater accuracy, thanks to its broader general knowledge and problem-solving abilities. It brings stunning performance and adds multi-mode capabilities analysing and generating sound and video. This is both exciting and alarming as it distributes the ability to create convincing fake voices and videos. GPT-5 won't be far away.

Other AI tools such as DALL-E specialise in capabilities including creating and editing images using natural language, as was used to create the image on the front cover of this report. Similarly, Jukebox with music and CoPilot writing computer code. Text to video models have also been developed by Meta (Make-A-Video) and Google (Imagen) but not released as products. This month, Microsoft researchers introduced Kosmos-1, an AI that can analyse images for content, solve visual puzzles, perform visual text recognition and pass visual IQ tests. They also released a paper on a new AI called VALL-E that can accurately simulate anyone's voice based on a sample just three seconds long.

A list of current generative AI tools, services and engines is included in the appendix 1.[vi]
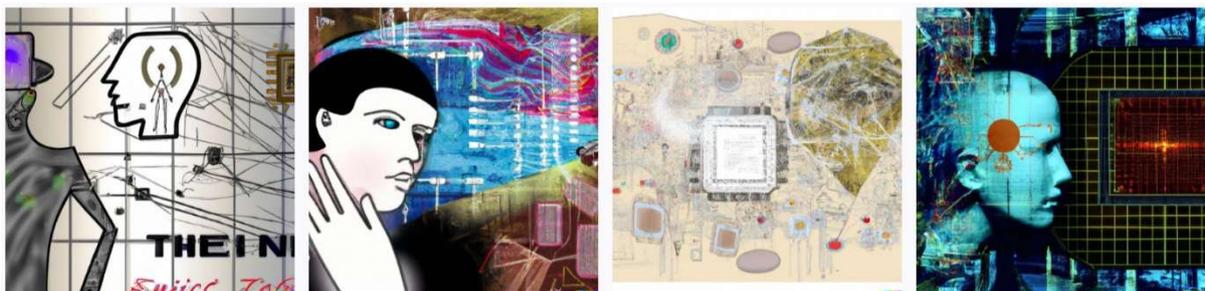
Created by DALL.E in response to "The intelligent Era in technology in graphic art".

The popularity of "low code/no code" software platforms, for example, will enable increasing numbers of non-expert users to create their own powerful mobile and web apps.

I asked ChatGPT to create the simple Java code to 'tell the time'. This is what it generated:

"To tell how old someone is, you would need to know their birthdate. The code below shows an example of how to calculate a person's age based on their birthdate using the java.time package.

```java
import java.time.LocalDate;
import java.time.Period;

public class TellAge {
    public static void main(String[] args) {
        LocalDate birthdate = LocalDate.of(1999, 1, 1); // January 1st, 1999
        LocalDate currentDate = LocalDate.now();
        Period age = Period.between(birthdate, currentDate);
        System.out.println("You are " + age.getYears() + " years, " +
age.getMonths() + " months, and " + age.getDays() + " days old.");
    }
}
```

This code uses the LocalDate class from the java.time package to get the current date and a birthdate. The of() method of the LocalDate class is used to create a date object representing the birthdate. Then, the now() method of the LocalDate class returns the current date.

Then, the Period.between(birthdate,currentDate) will give the difference between the two dates which can be broken down into years, months and days using Period class's method getYears(), getMonths() and getDays() respectively.

Please note that you need to replace the birthdate in the example above with your own birthdate in order to get the accurate age."

AI has been with us for a while and has emerged in what we now see in forms such as Natural Language (Speech synthesis) chatbots and varying forms of robotics and robotic Process Automation (RPA). It is through Machine Learning, visualisation, Neural Networks for human like code generation and smart pathology identifying illness, that we can increasingly see how we can automate what previously only humans could do.

We are now moving to a time when we can ask AI to examine vast amounts of information, to create new capabilities, remedies, processes, actions, and organisations and to even make accurate decisions and predictions in many fields. The drivers being experienced by

many sectors all include the impact of AI and automation. For example, here are some of the principal drivers in these ten industries:

1.	Banking & Finance	Automated, personalised, predictive, product.
2.	Insurance	From compensation to prevention, AI, digital.
3.	Accounting	AI/Automation, analytics, predictive, skills.
4.	IT/Comms	XR, Edge, AI/automate, fast, ambient, secure.
5.	Logistics/Warehouse	End of JIT, reshore, automation, less people.
6.	Transport	Environment, automation, circular economy.
7.	Real Estate	Flexible structures, Smart Buildings, green.
8.	Food & Farm	More tech, automation, local markets.
9.	Education	Distance, lifetime, flexible learning, AI.
10.	Energy oil & gas	Diversification, partnerships. AI/automate.

As we see the dramatic impact of automation across industry sectors, organisations will gain benefits in many ways. I asked ChatGPT to define in what ways it thinks it can help business and this was its reply:

As a language model, ChatGPT can help businesses in several ways, including:

- *Customer Support: ChatGPT can be integrated into a business's website or app to provide customers with instant support. It can answer frequently asked questions, provide assistance with product inquiries, and resolve simple issues without the need for human intervention.*

- *Sales and Marketing: ChatGPT can be used to generate leads, qualify prospects, and provide personalized product recommendations. It can also assist in creating targeted marketing campaigns by analyzing customer behavior and preferences.*

- *Market Research: ChatGPT can assist businesses in conducting market research by analyzing customer feedback and sentiment, identifying trends, and providing insights into customer needs and preferences.*

- *Employee Training: ChatGPT can be used to develop training programs and provide on-demand support to employees. It can provide information on company policies, procedures, and best practices, and answer employee questions.*

- *Translation: ChatGPT can help businesses communicate with customers and employees in multiple languages. It can translate text or speech in real-time, making it easier to reach a globalaudience.*

Overall, ChatGPT can help businesses save time and money by automating routine tasks, improving customer experience, and providing valuable insights into customer behavior and market trends.

Digital models will be built to represent any real-world entity (Digital Twins), including the human body. We will be able to apply AI to rapidly generate and test new measures to

impact that model in order to achieve a desired goal. Potentially enabling new and personalised treatments of human disease and impacting every other form of human endeavour.

Cognitive AI is one of the many areas of development in AI and it refers to systems that are designed to mimic human thought processes and cognitive abilities, such as perception, reasoning, learning, and problem-solving. They typically rely on a combination of machine learning algorithms, natural language processing, computer vision, and other AI techniques to simulate the way humans think and process information.

The goal of cognitive AI is to create more advanced and sophisticated capabilities that can perform tasks that were previously only possible for humans. For example, a cognitive AI system might be able to understand natural language queries and provide nuanced and contextually relevant responses, or it might be able to recognise and interpret images and videos with a high degree of accuracy.

Cognitive AI is still a relatively new and rapidly evolving field, and researchers and developers are continuing to explore new applications and use cases for these systems. Some potential applications of cognitive AI include healthcare, finance, education, and customer service, among many others.

Artificial general intelligence (AGI) is the machine's ability to understand or learn any intellectual task that human beings currently do. AGI is also called strong AI which has been forecast by futurist, such as Ray Kurzweil, for over 20 years. Some will say that the term "strong AI" is reserved for systems that experience sentience or consciousness. AGI will ultimately move AI beyond emulating and replacing tasks that we humans currently do, to it starting to 'think' for itself and act accordingly.

We can forecast a time when AI will develop new business propositions, employing novel business models, acquiring the physical capabilities to execute the business. These Digital Autonomous Corporations (DAC's) will be capable of appearing in any sector and create new sub-sectors crossing established industrial boundaries.

Artificial Super Intelligence (ASI) describes a capability where AI exceeds human intelligence. For the Artificial Super Intelligence to become real, computing programs must surpass human intelligence in all parameters and contexts. Only when AI becomes more intelligent than humans, with all the feelings, instincts and emotions of humans, can ASI become a reality. This is still a long way off but will need to be carefully monitored and controlled.

We will see all these technologies make significant breakthroughs in this decade and as a result, transform the landscape for knowledge workers, citizens, organisations and governments alike. In fact, everybody and everything.

Humanoid Robotics

The word 'robot' is drawn from an old Slavonic word, robota, for "servitude," "forced labour" or "drudgery." The word was a product of the central European system of serfdom by which a tenant's rent was paid for in forced labour or service. In our imagination, AI and the automation of human-like machines has a strong association and to some it is a blessing, others a worry. Japan has led the development of such machines as the new generation needed some way of looking after their ageing, and in many cases long-aged, parents in a shrinking population available to provide care services and it wasn't something they relished

Image credit: Boston-Dynamics

doing themselves. It seemed obvious. Combine the advancement in more cognitive forms of AI and Robot motor and joint nimbleness and we are nearly there. The Boston-Dynamics Atlas™ robot development platform is a great example. The post-human era is near, and we can soon expect help in many areas of our lives by two legged, 'thinking' robots. Maybe robots will take over tasks that we will look back on as a real drudgery, even serfdom?

Some examples where robots are in use today include:

Hospitality: Humanoid robots, like Kime, are pouring and serving customer drinks and snacks at kiosks in Spain. Some are even working as hotel receptionists and concierges and in other customer facing roles.

Education: Humanoid Robots Nao and Pepper are working with students in educational settings, creating content and teaching programming.

Healthcare: Humanoid robots are providing services in healthcare settings, like communicating patient information and measuring vital signs.[vii]

There are many examples of walking, jumping, climbing, talking humanoid robots. Tesla recently announced that they "envisage a time when their robot sales outstrip their electric vehicle sales" which illustrates how near they are to becoming commercial propositions. In their words – in the 'Tesla Bot, they plan to develop the next generation of automation, including a general purpose, bi-pedal, humanoid robot capable of performing tasks that are unsafe, repetitive or boring (for humans).'[viii]

The Intelligent Era

The humanoid robot market was valued at $1.5 billion in 2022, according to research firm MarketsandMarkets, and is predicted to increase to more than $17 billion over the next five years.

This will be the first time on Earth when we mix human beings with human-like machines, and they'll be all around us and getting better, smarter, more nimble, more human like every year. A current example of human-likeness in robotics is 'Sophia' – Greek word for wisdom – from Hanson Robotics.

We explore the implications on skills and work in a later chapter.

I suppose the most important question for us might be – how will this impact me? How will our organisation make use of these capabilities?

Image credit: Hanson Robotics

Internet of Things/Nano/Behaviour/Emotions

We've become accustomed to the transformative effect of the internet and its content, and we can now see that we are just a few years away from a major transformation because of connected devices. They will allow us to search the physical world in much the same way we search the digital world today.

For example, microchipped bridges could report when they needed maintenance. Billions of tiny computers affixed to buildings could monitor air quality and traffic patterns. Sensors scattered across fields will enable computers to analyse the nutrients and water in the soil.

Arm believes that there could be a trillion connected devices in the world by 2035, more than 100 for every person on the planet and that we will interact with them every 18 seconds, or 4800 times a day.[ix] Other forecasters define the devices differently and predict 130 billion by 2030, either way it's a huge number relative to an estimate of just 15 billion this year.[x] Whether these numbers are correct or not, the fact is that the number of connected devices will increase exponentially in the coming years.[xi]

'Internet of Things (IoT) networks are continuing to mature and are now 2 to 5 years away from making a transformational impact on supply chain operations.'

Gartner Inc. said 9th September 2020.

IoT is producing data like never before. A 2018 report from the International Data Corporation (IDC), says total data generated by 2025 is expected to be around 175 zettabytes (ZB) with about 80 ZB attributable to IoT devices.[xii]

If the forecast Gartner made in September 2020 is anywhere near accurate, today we should be seeing the impact of the IoT, and its variants, on everyday life and commerce. That is exactly what we are seeing right now. The gradual automation and interrogation of everything by sensors and cameras. Making our lives more efficient, easier, secure, and predictable.

Any company that has not evaluated the potential impact of such devices on their organisation will be lagging what will soon become a truly quantified world. The implications of this are myriad; one being that we may be able to know the pressure we have exerted on workers and calculate the potential impact on them. The cost of remedying any unwellness that may result in the individual could be identified and companies made responsible for their recuperation. This could become government policy, particularly given the limited level of mental wellbeing services governments are able to provide.

The number of installed IoT devices, sensors, and actuators in 2022 is a whopping 42.62 billion. A significant rise from the 2021 and 2020 figures, 35.82 billion and 30.73 billion, respectively. This growth is predicted to continue at full speed as we find even more

applications for these devices. If you need more proof, just keep in mind that by 2023, global spending on IoT is predicted to reach $1.1 trillion! According to Statista. By 2025, 75.44 billion IoT devices will be installed worldwide.

The number of radio transmitting, short-range, short-distance transmitters (RDF tags) are likely to be in the hundreds of billions. Every package has the capacity to have a smart tag on it. This tag will indicate the provenance of the package in many measurable respects, from temperature and humidity to impacts and security.

IoT is everywhere. It is more than the sum of devices labelled IoT and connected devices. It surrounds us from the moment we get out of bed, to the second we go back home. We are talking about lots of devices, gadgets, machines, buildings, infrastructure and more, that connect to the Web.

I suppose we should be asking ourselves, what data are we collecting via these devices and how are we using it to add value to our clients and customers? If not use, who in our sector is?

Internet of Nano, Bio-Nano, Biodegradable and Ingestible Things

In recent years, advances in biotechnology, nanotechnology and materials science have led to a revolution in the applications in Internet of Things (IoT). In particular, the interconnection of nanomaterials, nanoimplants and nanobiosensors with existing IoT networks has inspired the concepts of Internet of Nano Things (IoNT), Internet of Bio-Nano Things (IoBNT), Internet of Biodegradable Things (IoBDT) and Internet of Ingestible Things (IoIT). [xiii]

The applications of the Internet of Nano Things can revolutionise many industries like agriculture, healthcare, food industry, and smart homes, even the capabilities of IoT and mobile devices themselves.

For example, researchers at the University of Sheffield are developing nanorobots that can identify defects in roads and carry out repairs using cement or adhesives.

The Internet of Nano Things infrastructure will contain nanodevices that are 10 to 1000 nanometres in size – very small! This combination of nanotechnology and IoT will transform current IoT applications, making them more functional, robust, and compact. Soon, business leaders will be able to adopt IoNT applications to help streamline multiple tasks and transform business models.

Nanodevices will be deployed along with other advanced technologies such as cloud computing, 5 and 6G and machine learning, collecting and analysing vast quantities of data they collect both on and in anything. This will help improve business processes, insights, propositions and models.

Applications of Internet of Nano Things

Healthcare
Internet of Nano Things can be used to develop a Body Sensor Network using in-body nanosensors that can monitor any patient's health and biological activity.

Agriculture
Nanosensors can collect real-time data about crop health and growth, soil moisture and quality, and usage of pesticides and insecticides.

Environmental monitoring
Nanosensors can precisely monitor air pollution and temperature in public places like parks, railway stations, airports, bus stops, and restaurants.

Food products quality control
IoNT can be utilized to check the quality of food products.

Smart homes and factories
Nanosensors can maintain specific temperatures, identify harmful gases, and monitor carbon emissions in smart homes and factories.

Chart Source: Allerin[xiv]

As nanodevices are able to collect large volumes of confidential and potentially highly personal data, concerns regarding privacy and security will need to be addressed. Users of IoNT infrastructure need to be well informed regarding who has access to their data and how their data will be used. Also, the collected data needs to be stored in a secure location with encryption and state-of-the-art cybersecurity protocols.

Compatibility is a major challenge in developing medical nano sensors, as it is for the great many IoT devices manufactured today. Developers must ensure that they will not have any side effects on a patient's body, as well as support uninterrupted connectivity with wearable devices.

The Internet of Nano Things technology is still in its early stages and researchers will overcome its existing challenges soon. The IoNT will be adopted alongside other modern technologies such as virtual reality and augmented reality to develop devices that are more compact and functional compared to conventional ones.

The one thing we can be sure of in technology is that the smaller devices get the more cost effective and practical they become to use, the more we take them up in their millions and billions. [xv]

Global Futures
& Foresight

Internet of Behaviour

The Internet of Behaviour (IoB) is a concept that brings together the best of data analysis, behavioural analysis, and technology along with human psychology. Through their combination, we are increasingly able to predict human behaviour, draw insights from available data, and even influence human behaviour based on the activities and interests of a person. Content can be curated specifically for an individual based on their preferences and interactions in order to influence them and their behaviour and buying preferences.

IoB collects information from transactions, geo-tagging activities to relate locations to interests, browser history and cookies and social media interactions to understand what users relate to, and other online activities that reflect personal behaviour. A few of them are illustrated below:

a. Digital Marketing and Advertising/ Social Media

Based on customer interactions with specific products, marketing agencies and organizations can personalise advertisements so that every individual sees what piques their interests the most. For example, if a sensor or a device understands that a person spends more time at the gym, then they would get advertisements about brands that sell protein supplements, gym trainers, equipment, etc. Today it is based on the interests we show on the likes of Facebook and Google search. Tomorrow it is based on the sensors tracking our actions and predicting our intent.

b. Healthcare

Much of the world's population currently suffer from chronic illnesses. Healthcare providers can monitor their patients' behaviour in real-time. What's more, IoB devices can be trained to give out insights based on user activities so that the healthcare providers can easily form diagnoses.

c. Government/Policymaking

Government can undertake surveys to understand what the citizens are collectively interested in and track behavioural patterns of large groups to maintain social stability and happiness.

d. Insurance

In sectors like vehicle insurance, insurance companies could monitor the activities of drivers using IoB to gauge their roles in accidents so that insurance companies can correctly identify whose fault the mishap was. These devices could also play a role in preventing driving under the influence of alcohol or drugs or even identify medical emergencies and generate an emergency response.

These are only a few of the areas where the IoB can be of use. Other areas include defence, facial recognition, geolocation-based activity reminders, and predictions, finance management, efficiency and productivity, cutting costs, and industrial automation. [xvi]

Internet of Emotions

The new frontier of artificial intelligence and the internet of things is improving 3D facial recognition technology and emotional recognition. With the internet of emotions, new ways to capture human feelings through artificial intelligence are being developed. These devices are interconnected, and they use the processed data for a variety of purposes. This will deepen the interaction between humans and technology in a significant way.

Computers and robots are being trained to recognise people. Soon advertising will be even more personalised and intrusive than ever before. Triggered by the scans of our faces in shops and public spaces, companies will be able to detect our emotions in every circumstance, and consequently deliver even more hyper-personalised and in-the-moment based propositions. [xvii]

ADAPTED FROM AND REPRODUCED BY PERMISSION FROM JULIA WEST.	Intensity of Feelings	HAPPY	SAD	ANGRY	AFRAID	ASHAMED
	HIGH	Elated Excited Overjoyed Thrilled Exuberant Ecstatic Fired up Passionate	Depressed Agonized Alone Hurt Dejected Hopeless Sorrowful Miserable	Furious Enraged Outraged Boiling Irate Seething Loathsome Betrayed	Terrified Horrified Scared stiff Petrified Fearful Panicky Frantic Shocked	Sorrowful Remorseful Defamed Worthless Disgraced Dishonored Mortified Admonished
	MEDIUM	Cheerful Gratified Good Relieved Satisfied Glowing	Heartbroken Somber Lost Distressed Let down Melancholy	Upset Mad Defended Frustrated Agitated Disgusted	Apprehensive Frightened Threatened Insecure Uneasy Intimidated	Apologetic Unworthy Sneaky Guilty Embarrassed Secretive
	LOW	Glad Contented Pleasant Tender Pleased Mellow	Unhappy Moody Blue Upset Disappointed Dissatisfied	Perturbed Annoyed Uptight Resistant Irritated Touchy	Cautious Nervous Worried Timid Unsure Anxious	Bashful Ridiculous Regretful Uncomfortable Pitied Silly

The five core emotions run left to right across the top of the table. Manifestations of each emotion based upon the intensity felt are described down each of the columns in the table.

Utilising the capabilities enabled by the IoT, IoNT, IoB and IoE we will increasingly be able to create and receive a great many more highly personalised propositions that are valid for only a moment-in-time and for our current circumstances and emotion. In the first instance, the mass roll-out of these capabilities will likely be ham-fisted but in a short-while, any organisation not employing them will look flat-footed and increasingly irrelevant.

On a cautionary note, we need to be aware of the potential for a popular backlash, as this could increasingly look like the dystopian surveillance society George Orwell described in his book '1984'.

So how are we employing these technologies in our organisation? How could we augment our service offering? How might this benefit our customers and clients? How will we ensure their correct use?

Quantum computing

Quantum science must be one of the most impenetrable areas of science, yet its application to information technology (IT) is set to revolutionise computing power. It has the potential to open opportunities that we hitherto thought too slow or impossible to achieve. It's the very first change in digital computing that we've experienced since the dawn of digital computing technology in the early 50's. Since then, we've relied on computers being based on the binary digits of '0's or '1's. With Quantum computing that digit can have a great many states which can be discerned and utilised in processing power. The whole phenomenon is called superposition and lies at the core of quantum mechanics. Whilst it may not be widely available today there are great plans and intentions to deliver massively parallel quantum processing during this decade.

I asked ChatGPT how it saw the development of Quantum computing during this decade, and this is its reply:

"It is difficult to predict with certainty how quantum computing will develop in this decade, but there are a few trends and potential areas of growth that can be considered.

Firstly, one major trend is the continuing development of hardware, including the creation of larger and more powerful quantum computers. Companies such as IBM, Google, Microsoft, and Honeywell are all investing heavily in developing and improving their quantum computing hardware. As these computers become more powerful, they will be able to solve increasingly complex problems, including those that are currently intractable for classical computers.

Secondly, there will likely be advances in software and algorithms that are specifically designed to run on quantum computers. This will be important in order to fully realize the potential of quantum computing and to translate the theoretical advantages of quantum algorithms into practical applications. Researchers are already developing new quantum algorithms for applications such as optimization, machine learning, and cryptography.

Rigetti Computing's quantum computer.
Image: Rigetti Computing

Thirdly, we may see an increase in the availability of quantum computing resources through the use of cloud-based services. This could make it easier for researchers and companies to

access and use quantum computing resources without the need for significant upfront investment.

Finally, we may see increased interest and investment in the development of quantum-resistant cryptography as a response to the potential threat that quantum computers pose to current encryption methods. This could involve the development of new encryption protocols that are resistant to attacks from quantum computers or the implementation of existing protocols using post-quantum cryptography techniques.

Overall, it is clear that quantum computing will continue to be an area of active research and development in the coming decade, with the potential to revolutionize a wide range of industries and applications."

That's pretty useful. By way of an example of the development of Quantum computing, one manufacturer, IBM, has set out a development path that looks like this:

- In 2023: Launch classical parallelised quantum computing with multiple Heron processors connected by a single control system.
- In 2024: Debut Crossbill, the first single processor made from multiple chips. The same year we will also unveil our Flamingo processor incorporating quantum communication links comprising three Flamingo processors totalling 1,386 qubits.
- In 2025: Combine multi-chip processors and quantum communication Kookaburra processors. 3 Kookaburra processors totalling 4,158 qubits.
- Near future: Clear path to 100,000 qubits and beyond.[xviii]

Source: IBM
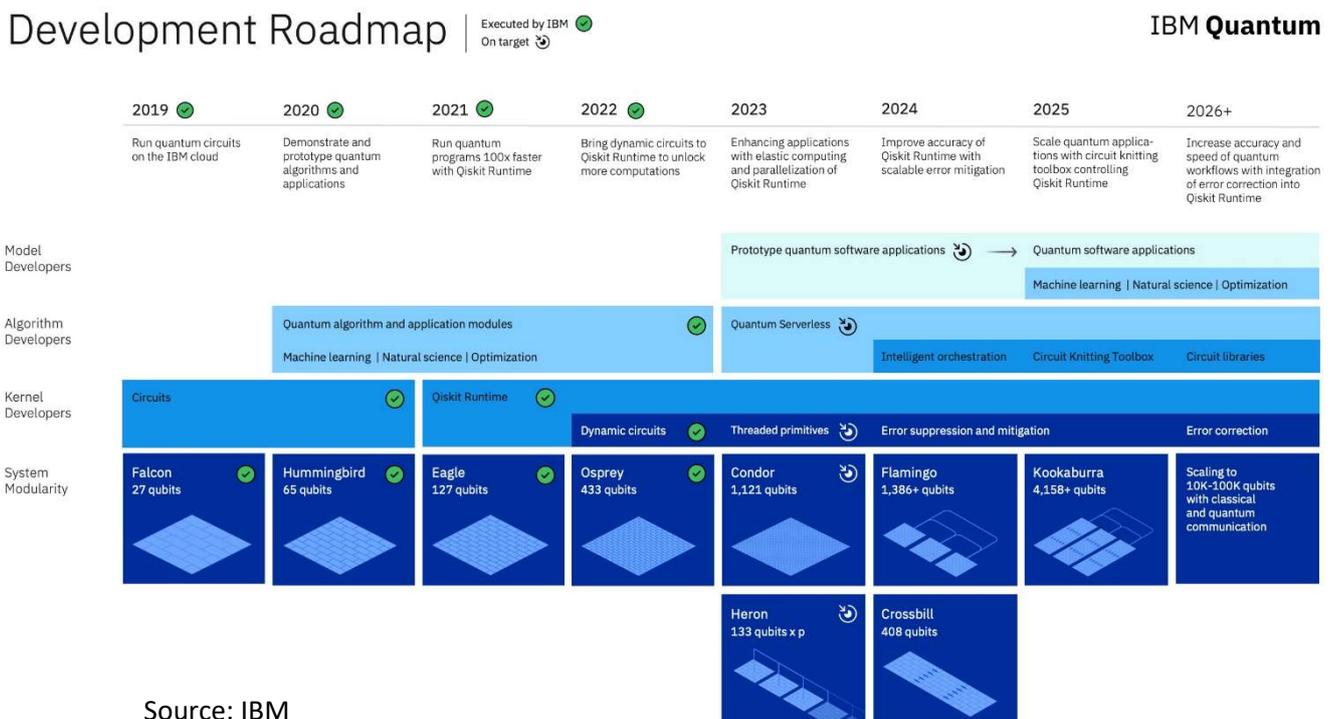
The Intelligent Era

The orders of magnitude speed of these machines is likely to be 100's, 1,000's or at the very extreme lab created environment run by Google in 2019, 158,000,000 times faster. In any event, it will run systems and process data radically faster than has ever been achieved. This is just as well, as we will be creating orders of magnitude more data from the IoT and IoNT environment alone. At the same time, our ability to analyse this data is leading to a time when we can realistically expect to be able to predict many forecastable events and head off any potentially negative consequences. This will certainly have a huge impact on the property and casualty, life and motor insurance markets. On a more positive note, we will also be able to take advantage of predicted events before they occur.

I asked ChatGPT what the potential implications of Quantum Computing are, and it replied:

"Quantum computing has several implications that could significantly impact various industries and scientific fields. Here are some of them:

Faster computation: Quantum computers can perform certain calculations much faster than classical computers, especially for problems that involve large datasets or complex algorithms. This means that quantum computers could revolutionize fields like cryptography, data analysis, and artificial intelligence.

Improved simulation: Quantum computers can simulate the behavior of quantum systems, which is difficult to achieve with classical computers. This means that quantum computing could help scientists to better understand complex phenomena, such as the behavior of molecules or the properties of materials.

Better optimization: Quantum computing can optimize complex systems with a large number of variables, such as supply chains or financial portfolios. This could lead to more efficient resource allocation, improved logistics, and better financial planning.

New encryption methods: Quantum computing could potentially break many of the encryption methods used today, which rely on the fact that classical computers cannot factor large numbers efficiently. This means that new encryption methods would need to be developed that are resistant to quantum attacks.

Energy-efficient computing: Quantum computing has the potential to be more energy-efficient than classical computing, especially for certain types of problems. This could lead to significant reductions in energy consumption and greenhouse gas emissions.

Ethical considerations: Quantum computing could have significant implications for privacy, security, and surveillance. As quantum computers become more powerful, they could potentially be used to break into secure systems and compromise sensitive information. Additionally, there are ethical considerations around the potential development of quantum artificial intelligence and the implications of its impact on society.

Overall, quantum computing has the potential to transform many industries and scientific fields. However, there are also significant challenges that must be addressed, including the

development of new hardware and software, the need for new encryption methods, and ethical considerations around its potential impact on society."

Again, it would be hard to argue that these observations are wide of the mark and provides us with some interesting potential implications that could affect your business. Quantum is in the roll-out stage, albeit it is mostly unfamiliar to us when it is made available via cloud services, obviating the need for us to understand how to operate it. We'll just use it and so will new entrants to our market and our competitors.

Quantum could be available as a call-off internet-based service in just two or three years. It will take us that long to rethink our service offerings to our clients to make the most of this when it arrives. Start-ups who are tracking this technology could already be developing their competitive offerings based on Quantum with no legacy process or technology to hold them back. Who are they and how will they likely impact you?

Quantum Internet

The Quantum Internet is already being discussed. In July 2020 the US Department of Energy (DoE) published the first blueprint of its kind, laying out a step-by-step strategy to make the quantum internet dream come true.[xix]

But what is the Quantum Internet?

The quantum internet is a network that will let quantum devices exchange information within an environment that harnesses the strange laws of quantum mechanics. In theory, this would lend the quantum internet new capabilities that are impossible to achieve with today's online applications.

The quantum internet, in simple terms, will involve sending qubits across a network of multiple quantum devices that are physically separated. Crucially, all of this would happen thanks to the unusual properties that are unique to quantum states.

Central to quantum communication is the fact that qubits, which harness the fundamental laws of quantum mechanics, behave very differently to classical bits.

I asked ChatGPT how the quantum internet benefits organizations. This is the response:

The development of a quantum internet would bring several benefits to organizations that are interested in harnessing the power of quantum computing. Here are some potential benefits:

Enhanced security: The quantum internet is expected to provide much stronger security than classical encryption methods. Quantum cryptography, for instance, uses the laws of quantum mechanics to protect data, making it virtually unhackable. This could be particularly valuable for organizations that deal with sensitive information, such as financial institutions, government agencies, and healthcare providers.

Faster communication: The quantum internet could facilitate faster and more efficient communication between organizations. Quantum entanglement, a phenomenon where two particles become intrinsically linked, could enable near-instantaneous communication between two points in space, regardless of their distance. This could be useful for high-frequency trading, scientific research, and other applications where speed is critical.

Improved data processing: Quantum computing has the potential to solve complex problems that classical computers cannot, such as simulations of large molecules or optimization problems. By accessing quantum computers through the quantum internet, organizations could accelerate research and development in a variety of fields, including pharmaceuticals, energy, and logistics.

New business opportunities: The quantum internet could create entirely new business opportunities in areas such as quantum key distribution, quantum sensors, and quantum cryptography. Organizations that are at the forefront of these developments could gain a competitive advantage in their respective industries.

Overall, the quantum internet has the potential to revolutionize the way organizations communicate, process data, and conduct business. While it is still in the early stages of development, many companies and governments are investing in quantum technology research and development, recognizing the potential benefits that it could bring.

It is not likely that we will be engaging with these capabilities on our Teams and Zoom calls any time soon but understanding the implications of this capability is vital when you are building out the strategy for your business and for your IT architecture.

If the arrival of ChatGPT surprised many, then Quantum Internet has the capacity to completely catch-us off guard. Once it become viable and pervasive it will be in great demand due to the characteristics it provides. How will you use it in your organisation and for what particular purpose?

5G/6G and satellite communications

Fast land based and cellular communications have changed everything in the last five years and 6G will multiply this. It will be lightning-fast, reliable, with low latency and even displace traditional hard-wired broadband. It is expected to be 10 times faster than 5G, and maybe even 20 times or up to 100 times faster if we believe the results coming from 6G development labs and it's coming soon. South Korea expects the first 6G pilots by 2026 and for it to rolled-out in 2028.[xx]

5G brought us new models of engagement, as it collaborated with geolocation and IoT devices. Looking ahead we will be connecting devices inside us measuring our wellness and on every surface from buildings to aircraft, from ocean floors to the stratosphere.

What will 6G do?

6G will be collaborating with even more capable IoT devices and thousands of low-orbit and very-low-orbit satellites delivering a truly connected and quantified world with no more estimating the condition of anything - we will know – as we will be measuring it, including how well we feel and our emotions (IoB). Where new models will emerge founded on fast reliable data exchange and Edge Computing.

It will be the successor to 5G and will be significantly faster. For example, In January 2022, Purple Mountain Laboratories of China claimed a world record of 206.25 gigabits per second in the terahertz frequency band, the basis of 6G. Last year speeds of 1 terabyte of data in 1 second were achieved.

6G networks will be even more diverse than predecessors and support applications beyond current mobile use such as:

•   Virtual and Augmented Reality (VR/AR).
•   Ubiquitous instant communications.
•   Pervasive intelligence.
•   The Internet of Things (IoT).

Mobile network operators will likely adopt flexible decentralized business models for 6G.

It will enable Intelligent automated management boosted by:

- Mobile edge computing.
  - IoT
  - IoN
  - IoB
- Artificial intelligence (AI).
- More responsive cognitive and Affective AI.
- Blockchain technologies.
- Fast secure distributed information management.

Global Futures
& Foresight

Of course, today there are no accepted standards for 6G, nonetheless South Korea expects to roll-out 6G in just five years.

Human-centric mobile communications will still be the most important application of 6G thus, high security, secrecy and privacy will be key features.

Today we are deploying 5G, which cell phone companies began deploying in 2019, that replaced slower 4G networks at 100 megabits, which in turn replaced 3G at 14 mbits.

5G networks are predicted to have more than 1.7 billion subscribers and account for 25% of the worldwide mobile technology market by 2025 and cover 40% of the Earth.

5G download speeds, hit up to 10 gigabits per second (Gbit/s) and has higher bandwidth and can connect more diverse devices and is delivering new and exciting uses.

For example, consumers - Claro at Allianz Parque Hall, in Sao Paulo, the first 5G-ready event venue, powered the first holographic performance in real time over a 5G network in Brazil, where musician Lucas Lima performed on the 'Led Zeppelin In Concert' show.

Manufacturers, Worcester Bosch launched the UK's first 5G factory using a 5G private network and mobile edge computing infrastructure and reduced manufacturing costs by 2%. Through a combination of 5G technology, the factory was able to optimise machine performance and increase output.

It is expected that these cellular networks will increasingly be used as general internet service providers (ISPs) for laptops and desktop computers, competing with existing ISPs using cable internet. New applications will emerge in internet-of-things (IoT) and machine-to-machine areas.

6G is just around the corner, it will be a disruptive technology and will enable other technologies to become increasingly connected and impactful.


Micro Satellites

More than 2,500 active satellites now orbit the Earth. Satellite communication includes geostationary low-Earth-orbit (LEO) and medium-Earth-orbit (MEO) satellites. If current plans come to pass, it's possible that about 50,000 active satellites will orbit overhead by the end of the decade. Even if these most ambitious plans do not happen, the satellites will be manufactured and launched on an unprecedented scale.[xxi]

In fact, at the CIOnet conference in February 2023, at the Institute of Directors (IoD), it was said that there are likely to be closer to 100,000 satellites in low and very low earth (VLEO) orbit by the end of the decade![xxii]

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Use Cases include Earth observation and science, space science and the environment, IoT, communications, security, defence, positioning and navigation all of which have attracted strong business use cases for small satellites across commercial, civil, government, and military applications.[xxiii]
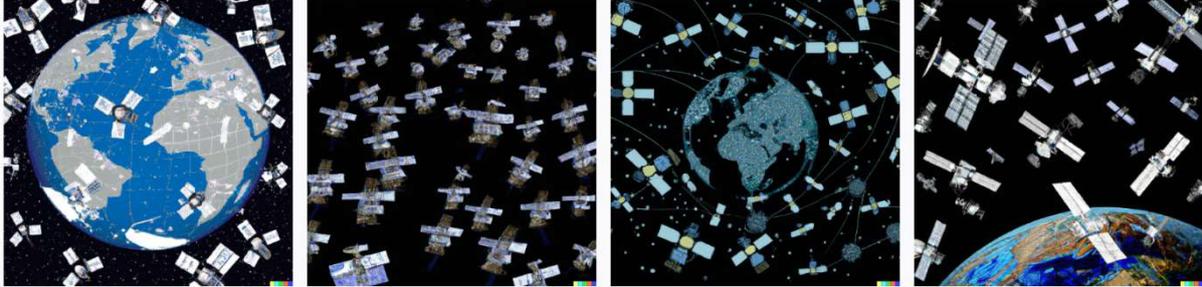
4 images created by the AI DALL-E responding to the 'chat': 'Create a graphic of hundreds of satellites around Earth'

What will you do with 6G and the abundance of connectivity it enables, that you can't do today?

Will it help new entrants eat away at your value or can you employ it to great advantage and deliver real value for your customers?

When you plan your next innovation or change consider what this capability will do for you.

Whatever the case, it's coming, and it will be here before you know it.

Data

Data is generated through our use of a wide range of technologies. It is not a separate technology in itself but as the 'Big Data' era espoused, it is the 'Oil of the digital economy', or as we are increasingly understanding, the 'life-blood' - of the Intelligent Era. The volume of data is growing at an extraordinary rate. According to John Rydning, research vice president IDC, "The Global DataSphere is expected to more than double in size from 2022 to 2026. [xxiv] The Global DataSphere is a measure of how much new data is created, captured, replicated, and consumed each year.

The research firm IDC, announced that the amount of data created and replicated during the pandemic had grown at an unusually high pace during 2020 due to the pandemic and a "dramatic increase in the number of people working, learning, and entertaining themselves from home." A total of 64.2ZB (zettabytes) of data was created or replicated in 2020. To put that in perspective: only two years earlier, in 2018, the 'Data Age 2025' research reported that the global datasphere had reached 33 zettabytes. The creation of more data due to the pandemic, didn't end with the health crisis. Many people across the globe started using digital tools (mainly Software-as-a-Service (SaaS) cloud applications) and channels for purposes such as banking, videoconferencing, and entertainment and will continue to do so.

The volume of data will multiply to around 175 zettabytes by 2025 and will unlock unique user experiences and a new world of business opportunities. Until now, data recorded and interpreted the world but that is changing. Data will define relationship between things, people, places and will be an active participant in that relationship. Once, data was static and simply recorded the relationship now it has the potential to be dynamic and enable hyper personalisation.

At the same time, the nature of data will become more important to everyday life. The notion that 20 percent of data would become critical and 10 percent hyper-critical by 2025 was first posited by IDC back in 2017. We can see that through all the changes that technology has brought that the resulting data is achieving this goal now and particularly where Edge computing is deployed. This is where data is used at the point it is captured. The value of data at the Edge is forecast to multiply 10-fold by 2030. [xxv]

This leads us to the view that the world will become increasingly hyper personalised. An age where we will become less tolerant of generic and mass-produced products and services and expect suppliers to adapt their propositions to us and our circumstances. On the one hand this is an exciting prospect, bringing increasingly relevant propositions to meet our needs. On the other hand, it will take an act of will for established providers to adopt this approach. As Deming one said, "You don't need to change – your survival is not mandatory".

Data Age 2025 described five key trends that will intensify the role of data in changing our world:

The evolution of data from back office to life critical. Once siloed, remote, inaccessible, and mostly underutilised, data has become essential to our society and our individual lives.

Embedded systems and as discussed, the Internet of Things (IoT).

As standalone analogue devices give way to connected digital devices, the latter will generate vast amounts of data that will, in turn, allow us the chance to refine and improve our systems and processes in previously unimagined ways. Big Data and metadata (data about data) will eventually touch nearly every aspect of our lives — with profound consequences.

Mobile and real-time data.

Increasingly, data will need to be instantly available whenever and wherever anyone needs it. Industries around the world are undergoing "digital transformation" motivated by this need. By 2025, more than a quarter of data created in the global datasphere will be real time in nature, and real-time IoT data will make up more than 95 percent of this.

Cognitive/artificial intelligence (AI) systems that change the landscape.

The flood of data enables a new set of technologies such as machine learning, natural language processing, and artificial intelligence — collectively known as cognitive systems — to turn data analysis from an uncommon and retrospective practice into a proactive driver of strategic decision and action. Cognitive systems can greatly step up the frequency, flexibility, and immediacy of data analysis across a range of industries, circumstances, and applications. IDC estimates that the amount of the global datasphere subject to data analysis will grow by a factor of 50 to 5.2ZB in 2025; the amount of analysed data that is "touched" by cognitive systems will grow by a factor of 100 to 1.4ZB in 2025!

Security as a critical foundation.

All this data from new sources opens new vulnerabilities to private and sensitive information. There is a significant gap between the amount of data being produced today that requires security and the amount of data that is being secured, and this gap will widen — a reality of our data-driven world. By 2025, almost 90 percent of all data created in the global datasphere will require some level of security, but less than half will be secured.

As data grows in amount, variety, and importance, business leaders must focus their attention on the data that matters the most. Not all data is equally important to businesses or consumers. The enterprises that thrive during this data transformation will be those that can identify and take advantage of the critical subset of data that will drive meaningful positive impact for user experience, solving complex problems, and creating new economies of scale. Business leaders should focus on identifying and servicing that unique, critical slice of data to realise the vast potential it holds.[xxvi]

Blockchain

A great deal has been written about the Blockchain and its potential. Of course, today its potential is already being realised with most banks and insurers are already quite advanced in its roll-out, seeing it change the management, access and security of data.

The Blockchain has a huge advantage over traditional forms of data storage in that today it cannot be hacked. However, the real advantage is that it enables the dis-intermediation of many of our processes and supply chains, removing the intermediate layer between us and our market or suppliers. There has been a long-term trend in changing supply chains, to shorten them and for manufacturers and providers to go direct to consumers, removing intermediaries who offer limited value.
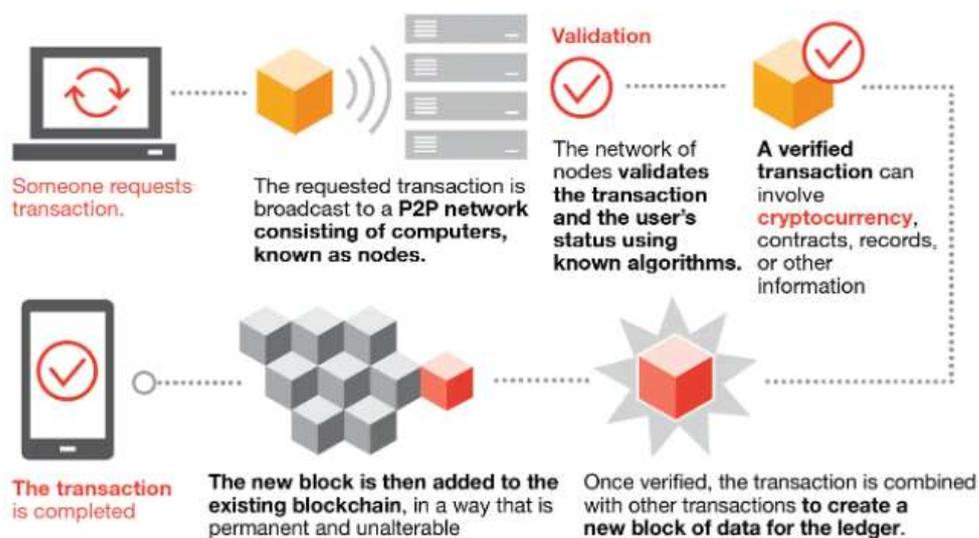
Image Source: PWC "Making Sense of Bitcoin, Cryptocurrency and Blockchain"[xxvii]

Blockchain facilitates this trend and unless an intermediary has a compelling value proposition it is likely to find itself bypassed. The good news is that it should allow increased automation of a great many processes, securely, faster and at a lower cost than traditional methods. Imagine being able to go through all the stages of buying a property in 5 minutes. Why not? Of course, it presupposes that all the necessary information is available digitally. If a property's ownership, design, construction and maintenance etc. had been digitally tracked from design then theoretically it should tell the buyer everything they need to know about it and the seller would also know the buyer's ability to complete the purchase.

Blockchain is more than the housing for cryptocurrencies and Non-Fungible Tokens (NFT's) but a transformative and enabling technology in the Intelligent Era. It is already and will have, a significant Impact on a great many sectors. We've assembled some of the opportunities where utilising Blockchain to organise data and data management could be significant:

- Legal (contracts, engagement and Identity)
- Accounting (auditing and fraud prevention).
- Aerospace (location of parts and chain-of-custody).
- Energy (smart metering & decentralised energy grid).
- Healthcare (medical devices & health info interoperability).
- Finance (remittance and currency exchange).
- Insurance (Policies, claims, p2p and micro insurance, fraud detection)
- Real-estate (deeds transfer & speed buying/selling).
- Education (manage assessments, credentials, transcripts).

International best-selling author Bernard Marr has compiled a list of current use cases from which I've selected a few. The full list is in Appendix 2. [xxviii] This gives an impression of the diversity of its uses:

Entertainment

KickCity - Platform for event organizers that enables them to pay only for what they get, and rewards community members by sharing those events.

Guts - A transparent ticketing ecosystem that uses blockchain technology to eliminate ticket fraud and the secondary ticket market.

Social Engagement

Matchpool - "Matchmakers" are rewarded for making successful matches whether it's dating, freelancing, using Uber or Airbnb.

Retail

Loyyal - Using smart contract technology, this loyalty and rewards platform creates more customized programs that allow for multi-branded rewards.

Exotic Cars

Bitcar - Fractionalized ownership of collector cars made possible by a BitCar token.

Supply chains and logistics

IBM Blockchain - Knowing the status and condition of every product on your supply chain from raw materials to distribution is critical. Blockchain for supply chains allows transparency with a shared record of ownership and location of parts and products in real time.

De Beers - De Beers mines, trades and markets more than 30% of the world's supply of diamonds. The company plans to use a blockchain ledger for tracing diamonds from the mine to the customer purchase. This transparency will help the industry and anybody who

wishes to verify, confirm diamonds are free from conflict. Fura Gems also plans to use blockchain in its supply process of emeralds, rubies and other precious stones.

Insurance

Proof of insurance - Nationwide insurance company is currently testing a blockchain solution to provide proof-of-insurance information called RiskBlock. Ultimately, when this tool is fully deployed it will help law enforcement, insured and insurers verify insurance coverage in real time and accelerate claims processing.

Healthcare

Nano Vision - Looking to catapult medical innovation away from traditional data silos and incompatible records systems, Nano Vision combines the power of blockchain with AI to gather molecular-level data on Nano Tokens. AI then sifts through the data to find trends and analyse connections that will lead to medical breakthroughs.

Real Estate

Ubiquity - This Software-as-a-Service (Saas) blockchain platform offers a simpler user experience to securely record property information to ensure a clean record of ownership.

Charity

Utopi - A lack of transparency has plagued charitable giving, but Utopi hopes to improve transparency in non-profits. When donors give using the Utopi platform they can see exactly how every penny is spent.

Financial Services

Securrency - This is a trading platform for cryptocurrencies and any kind of asset including traditionally illiquid assets to be exchanged through Securrency tokens. This allows cryptos to be traded outside of their dedicated exchanges.

Ripple - Ripple aims to be a global payment solution provider by connecting banks, payment providers, corporations and digital asset exchanges to allow instant, on-demand settlement globally.

There are so many blockchain innovations that could have been included. Many of these are potentially disruptive and it will be interesting to watch how many survive this early phase. Previously over hyped technologies, such as the internet, shows that it could well collapse. The dot.com bust came about through new providers trying to advertise themselves to fame and many ran out of money in the process. Blockchain is quite different in that it is primarily addressing existing problems and is supported by industry players. Blockchain has come of age and will transform our ability to trust organisations again, as the provenance and transparency of their dealing will be on show to those who are entitled to see it.

Analytics

It's one thing to have a vast amount of data but it is quite another to turn it into actionable information and intelligence providing actionable insights. We have data that is captured, analysed and executable in one location that we categorise as Edge computing today. Sensors such as movement switches and cameras often have an immediate use. We also have information that is gathered, concentrated, and refined and frequently combined with other data forms and data from other sources. This is where traditional central database management has been at play and of course, today, much of that tales place across the internet in massive Cloud data centres. I asked ChatGPT "what are the different forms of data analytics?"

There are several forms of data analytics, including:

1. *Descriptive analytics: Summarizing and describing data to understand patterns and trends.*
2. *Diagnostic analytics: Investigating specific events or situations to understand why they occurred.*
3. *Predictive analytics: Using historical data to make predictions about future events or trends.*
4. *Prescriptive analytics: Recommending actions or decisions based on data analysis.*
5. *Cognitive analytics: Using artificial intelligence and machine learning to analyse and understand data.*
6. *Big data analytics: Processing and analysing large sets of data.*
7. *Real-time analytics: Analysing data as it is generated, in real-time.*
8. *Text analytics: Analysing unstructured text data, such as social media posts, to understand sentiment and opinions.*
9. *Visual analytics: Using visual representations of data to aid in analysis and understanding.*

It generated a good description of the various forms of analysis which I've expanded here. We began the analytical journey many years ago with 'Business Intelligence' which was relatively simple and allowed us to interrogate, mostly in-house collected, data using straightforward questioning and received simple answers. Beyond that, we then got into increasingly sophisticated and insight generating forms of analytics. Simplistically:

- Descriptive Analytics tells us what happened and was helpful to us in understanding how the various moving parts of our business operate and our interactions with our stakeholders.
- Diagnostic Analytics starts to tell us why it happened. What were the drivers that resulted in the change we observe. This approach allowed us to adjust the contributory factors that impact the issue we are addressing. It is frequently used in marketing, sales, resource, or supplier management or in the manufacturing process.

- Predictive Analytics, enables us to interrogate the information, as above, and identifies patterns and potential outcomes for a forward-looking view. This is pretty much where we are with most forms of analysis in use in business today and starts to use fundamental forms of AI. Machine Learning is well able to make forward predictions of learned behaviours of most models. If we capture the right data, we should be able to perform this without too great a difficulty.
- Prescriptive Analytics is the ability to understand what we must do to make the preferred outcome happen and make a series of recommended actions to achieve it. If it is within our control of course.
- Autonomous analytics is the application of machine learning (ML) to enhance and make human judgements. This gives businesses many opportunities to improve their decision making and predictive abilities as the data becomes more complicated. ML is the key to autonomous analytics ability to use self-learning algorithms that get better with more data. These algorithms modify themselves as more data comes along with more evaluated actions.
- Cognitive analytics uses more sophisticated AI methods - cognitive and behavioural AI as well as ML and as a result we should be able to be more deterministic than ever before. Data Scientists are a key component to operate effective cognitive analytics and they are in great demand. Everyone wants them from our health services, bankers and insurers to manufacturers and the Army.

I wrote the above section before I interrogated ChatGPT. Its response was excellent but lacked a so what, but maybe I needed to ask a different question!

So, I asked: "How will cognitive analytics help my business?"

Cognitive analytics can help your business in a number of ways:

- *Improved decision making: By using artificial intelligence and machine learning, cognitive analytics can help identify patterns and insights in data that may not be apparent to humans. This can lead to more informed and accurate decision making.*
- *Predictive modelling: Cognitive analytics can be used to make predictions about future events or trends based on historical data. This can help businesses anticipate future demand and make adjustments accordingly.*
- *Automation: Cognitive analytics can be used to automate repetitive or time-consuming tasks, such as data entry and analysis. This can free up employees to focus on more important tasks, increasing efficiency and productivity.*
- *Personalization: Cognitive analytics can be used to analyse customer data and provide personalized recommendations and experiences. This can help increase customer loyalty and satisfaction.*
- *Fraud detection: Cognitive analytics can be used to detect fraudulent activity by identifying patterns and anomalies in data. This can help businesses protect themselves from financial losses.*

- *Natural Language Processing: NLP can help to extract insights from unstructured text data, such as customer feedback and social media posts, which can be used to improve customer service, product development, and marketing strategies.*

Overall, cognitive analytics can help your business by providing insights, automating tasks, and helping to make more accurate predictions.

The good news is that this is all data based and analysed using tools so it should be repeatable. This will take out a lot of the 'hunch' in marketing, selling, buying, resource management, for example, in the future. Or will the human element still need to be part of those processes? In fact, it is the human creativity and ability to see 'outside the box', connect information that, on the face of it, looks irrelevant, that will often create highly rewarding insights. I can't imagine that this will be automated very soon.

Consider the Meerkat marketing campaign. It has been incredibly successful, generating marketing industry awards, new business for the platform and a range of toys and models and a place in the affection of insurance and energy searching consumers. Would AI have seen the opportunity to substitute '*Market*' for '*Meerkat*' in the marketing of a 'Search the Market' platform offer?

The world will become increasingly knowable, through many sources including the various forms of IoT, satellites and drones and the massive amounts of data they produce will be available and analysed, by various forms of analytics and AI and processed at the speed of Quantum computing. Of course, the big question is and remains, the accuracy of the data we are using, which is a current flaw in the process and will need to be addressed urgently before we can realise the full potential of data analysis.

The remaining forms of analysis that ChatGPT generated are self-explanatory. The ability to extract value and insight from unstructured text, voice and visual data will be a key requirement to operate in our increasingly social, individualistic, and personalised world. Imagine being able to extract meaningful information from a multi-player virtual reality environment, interpreting our every move, utterance, expression or inflection and how we interact.

This is all going to require access to the right forms and sources of data and the means to analyse it to generate actionable insights in what you need to do now and what you could or should be doing in the future. Understanding the capabilities of these analytical tools and the outputs that they can generate is going to be one of the key skills of leaders, in fact it is already.

Extended Reality

It's easy to see how the virtual concept of the metaverse has materialised. Over time, human-to-human interaction has moved from in-person to the telephone, then video conferencing and now to potentially synthetic business meetings. It's a progression that makes sense in hindsight and should empower us to see how this capability will develop in the future.

Extended Reality (XR) is made-up of three components. Augmented Reality (AR), Mixed Reality (MR) and Virtual Reality (VR). These various categories of virtuality create new and different experiences from one another. Virtual Reality is a completely immersive 3D experience, where you are separated from the world around you. Augmented Reality is pretty much as is described and overlays a 3D experience with the real-world. Finally, Mixed Reality is like the AR experience, blending elements of the real world and digital world but this time with interaction between the digital and real-world objects, changing the digital world. I'm sure you know this and a great deal more, but I thought that it might be helpful to position these varying forms of virtuality.
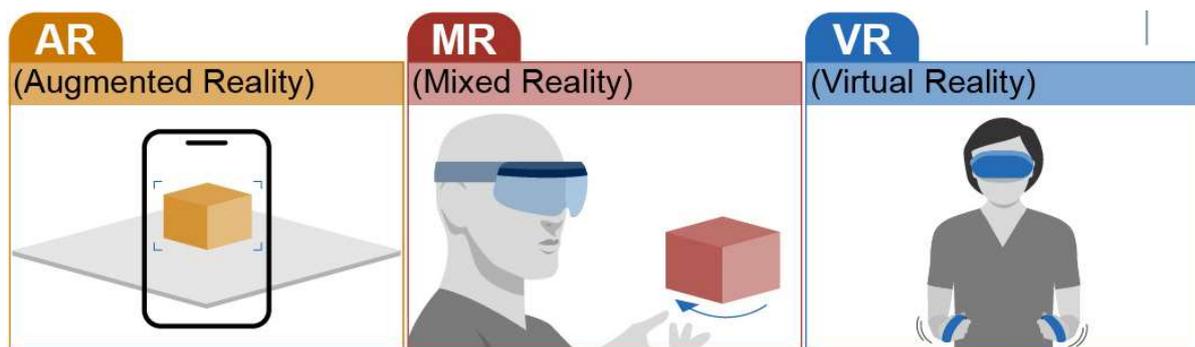
Image source: US Government Accountability Office

According to research by ReportLinker the global metaverse market is forecast to grow by US$1,152.35bn between 2022-2027, accelerating at a compound annual growth rate (CAGR) of 40.06% during this period. That's generating revenues of over *US$1 trillion*.[xxix]

I suppose the important question to ask is: why is this included in a paper on the Intelligent Era? To answer that, I would say that data, processing speed and communication capabilities of XR provide the enabling environment that will deliver a viable, relevant experience in the Intelligent Era, making it truly valuable. Not quite at the level of 'The Matrix' but delivering the ability to truly augment and enrich our lives, not replace life itself.

So, what do those XR components deliver?

Virtual Reality

Virtual Reality (VR) has been a long time in incubation, not unlike so many emerging technologies. It's not so much that the idea is new rather the implementation and the technical ability and the infrastructure are now available and offered at the right price with the necessary back-up. In this case, it is very much the bandwidth of the connections across the internet, the processing of the graphics and the content accessible from within VR that will make the difference.

By way of example, I recall in 1980 entering Professor Stone's lab at Salford University in the UK, donning a headset and pair of gloves and entering a virtual supermarket. In those times they had to hard-code the 'supermarket' which was hosted on a Prime computer. Everything inside the virtual word was 'soft' I could move anything anywhere, fly around the space and even go down the drains and that was 40 years ago. So, what happened.

What happened, was that the technology got better, the speed of processing got faster, it became more affordable, easier to use, content is proliferating, and virtuality got a kick-start through us needing to mee online during the Pandemic. Not enough to make it an 'overnight' success but we're nearly there. There are so many areas of our lives that can be enhanced by quality offerings in VR it is unbelievable that we are seeing it develop so slowly. We can identify its disruptive and empowering capability in a great many sectors including: education, travel, entertainment, film, gaming, concerts and events, manufacturing, architecture, design, construction, advertising and health, to name just a few areas where transformative propositions are being deployed.

Image credit: Bermix studio on Unsplash

Imagine if university or school students could choose their favourite way to learn online, with their favourite character as teacher and tester. Imagine if I wanted to play games, or travel in space, or be an historic figure to learn a lesson, VR enables this. Humans will remain a vital part of the education process; how many times have we heard successful people tell us that a specific teacher or lecturers inspired them. The human still plays a pivotal role in understanding the student, tutoring, testing understanding and in a great

Image credit: Samsung

many other ways, but they cannot always be the best teacher for a specific topic on a specific day. VR can do this.

How do I know – because YouTube is already sharing a 2D experience of this and we love it. Today, an average of 2,500 new videos are uploaded to YouTube every minute, amounting to 183 hours of video content. What more will a 3D immersive experience offer once we see just a fraction of this content being uploaded.

There's a list of ways VR can be deployed in education in the appendices.[xxx]

As one VR salesman once told me at a conference, the difficulty in selling 3D is you must experience it to truly understand its potential and our advertising channels are all 2D. At a workshop I invited business leaders to try a VR headset. The first person put the headset on and looked straight ahead, I had to swivel their head around for them to realise they weren't looking at a jungle setting, they were *in a jungle setting*. When the dinosaur stirred and its tail swished over their head, they ducked. I.e., within 2 minutes they believed they had to duck down to avoid injury, they acted as if it were real. In turn, each of the others did precisely the same.

When you work out how to deploy VR in your organisation it will be a game changer. Meta might be seeking to own the branding of the immersive VR experience, calling it the Metaverse but it's not all about communication or gaming, it's far more important. How will you use it in your world?

Augmented reality

Augmented reality (AR) is a technology that allows the superimposition of digital elements into the real-world around us. In AR you can see a composite view of physical or real-world

elements and digital elements. However, there is no interaction between the digital elements and the physical world elements. This was notably delivered by Google via their 'Google Glass' spectacles. It was a brilliant concept. Its market price point was high for a consumer product, which delayed pick-up and it received push-back in California because of the onboard camera. A new term emerged as wearers were called 'Glassholes' – not good for its brand image and take-up by new users.

The concept of AR is brilliant and once the delivery is sorted out it will enhance our understanding of the environment around us. In 2000 we created a film where we showed data being loaded to spectacles.[xxxi] In the same film, we showed an interactive contact lens showing images augmenting someone's life. Will this be the way we go? In any event, its time to think how your staff, workers and customers can benefit from you delivering services via AR.
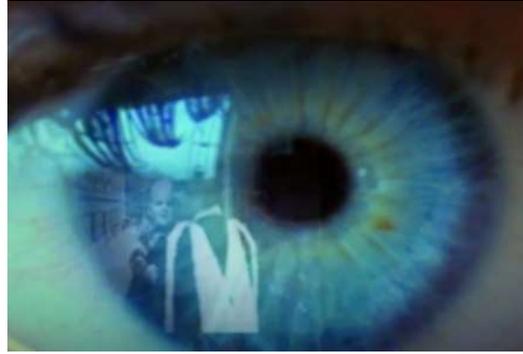
Mixed Reality

Mixed reality (MR) allows not only the superposition of digital elements into the real-world but also their interaction. The user can see and interact with both the digital elements and the physical ones. MR experiences get input from the environment and will change the digital components accordingly.

However, the nature of industrial applications requires employees to deal with physical situations when troubleshooting or engaging with complex issues. Mixed reality is the perfect blend of digital content in the physical space and can transform how information is viewed, processed and utilised by frontline workers. Rather than abstracting from the real world, it's all about making enhancements to the physical objects in front of us.

Image credit: My name is Yanick on Unsplash

To conclude, these various forms of virtuality are set to take-off dramatically during the Intelligent Era and are set to empower and amplify our human capabilities. At the same time, it will create fantastic 'liveable' experiences that will bring great joy to our lives and allow us to connect with anything and anybody, anywhere, in a realistic way.

In a final story – years ago I was asked to help a room full of financial services senior executives see the potential value of virtual reality. To be honest, I wasn't really getting

anywhere, that old premise of seeing is believing kicked in and they couldn't see it. A very helpful delegate relayed a story that brough light on this subject and it went like this:

He said, "my sister lives in Canada and I live in the UK. We telephoned one another and that was OK, then we were able to text one another and that somehow felt more immediate and spontaneous, more real. Now, he said, we go for walks together in VR" – creating a shared experience, a sense of connection. Then everyone there understood. It was all a bit nascent then but imagine when this takes off with consumer acceptance and ubiquity being the norm, what would you offer and how would you go about doing it? Indeed, how would you engage with all your stakeholders using MR?

Would you do anything new or the same things you've always done in a different way?

Holograms

We are all aware of the many uses that holograms have been put to in the entertainment space but where else will it have a big impact in the coming years?

Holograms could soon become the next wave of communications, connecting people with spatially designed virtual objects to add depth, realism, and emotional impact to face-to-face communications.

Image credit: ABBA Voyage

XR today[xxxii] tells us that over the last few years, technology has advanced significantly by reconnecting how people communicate. Phone calls became video calls, particularly through the COVID-19 pandemic, and allowed millions of people to 'meet' and do business despite national lockdowns.

Several new companies have begun exploring immersive avatar development and photorealistic holograms for future communications platforms, using bleeding-edge real-time 3D engines. Such technologies were conceptualised in science fiction but are now

becoming a (virtual) reality.Mixed Reality and Holograms are Already Emerging. In the immersive world, some of the leading drivers of content are employing holographic images and digital twins. These spaces can recreate whole facilities, cities, and environments for real-time monitoring, measuring, and collaboration.
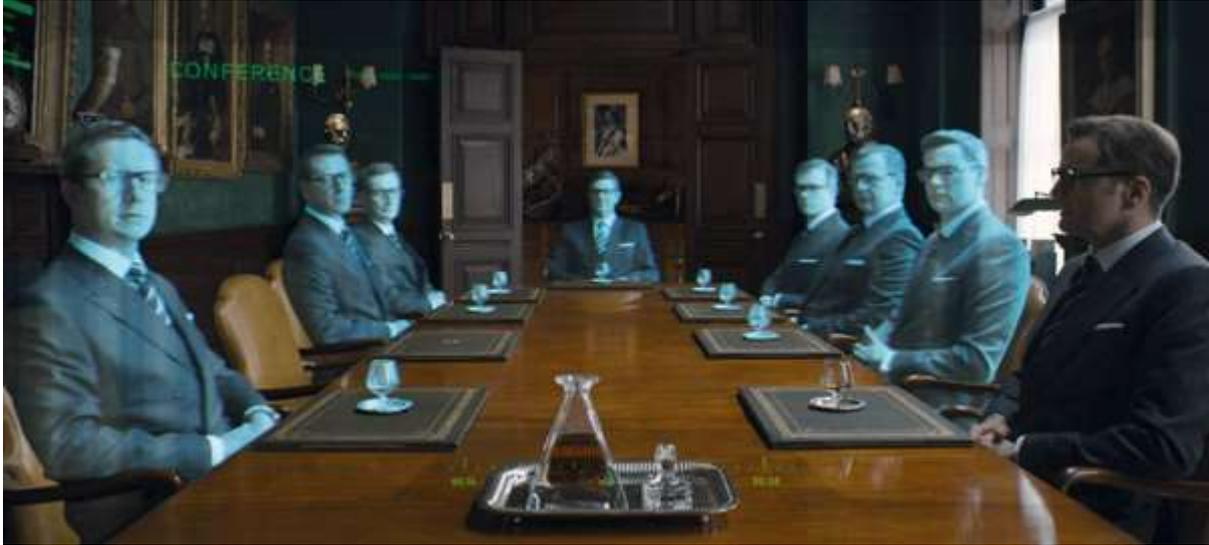

Image credit: Jellyfish Pictures

Most companies exploring holographic content use them with augmented and mixed reality (AR/MR). Firms such as Magic Leap, Microsoft, Meta Platforms, Varjo, Matterport, and Siemens have showcased solutions for remote collaboration and built virtual control centres for smart factories.

Enterprises have become more intrigued with collaborative virtual experiences as they provide greater interactivity with colleagues and tackle the "zoom fatigue" many faced during the pandemic.

Current Use Cases for Holographic Content

For holograms to gain traction, they require a lot of complementary emerging technologies. Tools such as AI, low latency 5G/6G, cloud and edge computing, and advanced computing all contribute to a solid, convincing experience.

Sensors are also essential for allowing people to interact with creative content. They track body and facial movements for realistic avatars and eye gaze to measure attention on specific digital content.

For example, Cisco Systems developed their Webex Hologram hybrid work solution to
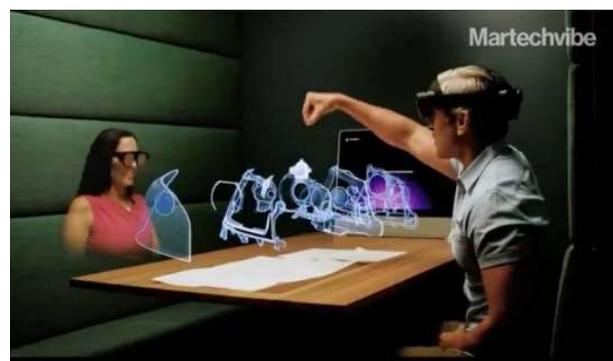
Image credit: Cisco

deliver AR holograms for business meetings, allowing attendees to access realistic, interactive virtual models.

Campfire is also building holographic technologies for computer-aided design (CAD) programmes. This will provide photorealistic 3D models for engineers directly to their smart glasses to collaboratively evaluate the latest products, designs, and schematics.

Some companies are exploring future hardware designs for hosting holographic content. Stanford and NVIDIA have launched research and development (R&D) efforts to design holographic glasses to replace VR headsets. While still a concept, smart glasses may become the future of immersive experiences.

Companies like Newtonlab Space have also used real-time 3D holographic content featuring Marvel superheroes to promote advertisements for companies. This has significantly increased interactions and engagement with potential customers, sparking further interest in the technology.

The Future of Communications

The COVID-19 pandemic of 2020 pushed the industry to innovate ways to advance face-to-face interactions more than ever. With the help of emerging technologies and a vision for the future, enterprises slowly trialled and rolled out new solutions to expand adoption of new XR devices.

Within the next decade, holographic content will prove invaluable to many enterprises and consumers, as they experiment with digital twins, design, and even beauty and entertainment and a whole host of other applications. These immersive mediums will become the artform of the next generation, even a new normal in communication.

Is the capability presented by holographic technology of use in your organisation – if it is in what way?

Additive Manufacturing (3D and 4D printing)

Additive manufacturing (AM), also known as 3D printing, is a process in which a digital model is used to create a physical object by adding successive layers of material. The material used can be plastic, metal, or a variety of other materials, and the process can be used to create a wide range of products, from simple prototypes to complex end-use parts. Additive manufacturing has the potential to revolutionize manufacturing by allowing for faster, cheaper, and more flexible production of products. According to ChatGPT.

AM has been used for over 30 years, particularly at the prototyping stage of developing physical products. It came into its own as China took on the manufacturing role for the world when designers where in countries many thousands of miles away. That process still goes on, but the big change has been the emergence of fully functional end-user products. In some cases, the ability to create products using this technique has created superior products than those created traditionally. Today, end-user products are used to replace human components, particularly bone mass, create clothes, formula-one engines, aircraft parts, houses, apartment blocks and commercial buildings. There appears to be no limit.

As we get better and faster at producing products using this method the opportunity to create hyper-personised solutions to exactly fit our needs becomes attractive. Not only can they be personalised, but we can have a role in the design of those products, through voice and text activated AI we will be able to design our desired object, visualise it through Virtual Reality and the AI engine will check its veracity prior to production. Mass produced products in some areas will be a thing of the past.

I asked DALL-E to "draw me a 3d view of a two-floor house with large windows" and this is what it generated in about 10 seconds:

Created by DALL-E in response to: "draw me a 3d view of a two-floor house with large windows".

We could explore and modify these designs in VR and have that output checked in AI and produced on a concrete Additive Manufacturing machine such a this:

Image credit: COBOD

Image credit: ICON

This type of AM machine built this small 800 square foot home in the United States in 24 hours and for under $4,000 and it is stronger than a traditional home built with block of brick. Since then, we've 'printed' larger houses, apartment blocks and multi-floor commercial buildings of over 6,900 square feet (640 square metres).

Image credit: The 640 sq.m. Apis Cor 3D construction company of Boston, Dubai Municipality admin building

3D bioprinting is the use of additive manufacturing techniques that combine cells, compounds, and biomaterials to create bioengineered tissues and structures. Unlike traditional 3D printing, bioprinting uses something called bioink, a mixture of organic and inorganic materials, to make models.[xxxiii]

One final point which illustrates how important AM will be is shown in the findings of the IEEE annual study conducted in 2019. The study found that most parents (U.S.: 52%; U.K.: 60%; Brazil: 75%; India: 92%; China: 94%) would be very comfortable allowing a properly tested and fully functional 3D printed heart to be implanted in their child, if needed in the future. Many parents surveyed went further, expressing that they would be "extremely" comfortable allowing a 3D printed heart to be implanted in their child (India: 58%; China: 50%; Brazil: 42%). [xxxiv]

Image credit: ETH Zurich

4D Printing

4D printing is the process through which a 3D printed object transforms into another structure through the influence of external energy input such as temperature, light or other environmental stimuli. 3D Printing is about repeating a 2D structure, layer by layer, from the bottom to the top, until a 3D object is created. 4D Printing is referred to as 3D printing transforming over time. Thus, a fourth dimension is added: time.

Changing size

The most obvious advantage of 4D printing is that through computational folding, objects larger than printers can be printed as only one part. Since the 4D printed objects can change shape, objects that are too large to fit a printer can be compressed for 3D printing into their secondary form and unwrap to complete their final assembly as the image shows below. Be aware that 3D printers are already creating boats over 15 metres long and 10 metres wide.
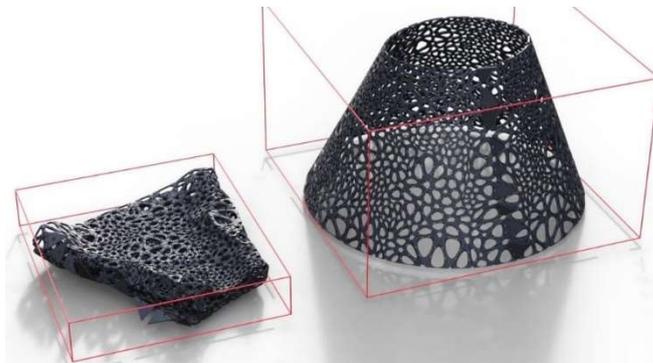
Image credit: Sculpteo

Self-repair piping system

One potential application of 4D Printing in the real world would be pipes in a plumbing system that dynamically change their diameter in response to the flow rate and water demand. Pipes that could possibly heal themselves automatically if they crack or break.

Self-assembly furniture

Since 3D printing furniture is limited by the size of the printer, 4D printing could allow the printing of a flat board that will curl up into a chair by just adding water or light to it.

Medical

Another application of 4D printing in the medical field could be the design and production of stents. Programmed stents would travel through the human body, and when they reach their destination, they would open.


Image credit: Self-folding protein from the MIT Self-Assembly Lab

Fashion

4D printing could also change the face of fashion. The MIT Lab is studying potential applications of 4D technology in clothing. One of the ideas is that clothing could change accordingly to the weather or the activity. For instance, shoes could change their shape when you start running to provide you with better comfort and amortisation. [xxxv]

Changing world trade

It is tricky to define the exact potential of AM, but some experts expect it to take a share of 50% of manufacturing over the next two decades. In the ING report - '3D printing, a threat to global trade' they published tentative calculations that show that, if the current growth of investment in AM continues, 50% of manufactured goods will be printed in 2060 in scenario 1, with this figure possibly being achieved as early as 2040 in scenario 2, in which investment doubles every five years.

3D/4D will likely result in the reduction of world trade by 1/4 by 2060, or 2/5 by 2040 if the faster of the scenarios comes to pass. In any event it looks like it is a perfect answer to those wanting to reshore manufacturing and to those that want to implement a more distributed manufacturing and even, highly personalised, strategy.[xxxvi]

3D printing will change the nature of trade because AM use far less labour, reducing the need to import intermediate and final goods from low-wage countries, can be faster, better, personalised, more available and environmentally friendly and cheaper than traditional manufacturing methods.

This technology will further revolutionise the creation of products, prosthetics, construction and manufacturing. Co-designed, co-created, hyper-personalised adaptive. What's not to like!

If you have any need or reliance on physical objects or the physical environment, you will want to be consider the impact of AM on you, your market and your customers.

Skills and Job Roles

Throughout this paper I have been highlighting the changing landscape for gainful employment because of the impact of the Intelligent Era. The types of skills and job roles are set to change, and I've highlighted some of them here.

Skills for the future

McKinsey Global Institute's research report, highlighted the top three skill sets workers will need in order to secure the best careers for the future. The most in-demand skills are:

Higher cognitive - These include advanced literacy and writing, critical thinking, and quantitative analysis and statistical skills. Doctors, accountants, research analysts, and writers use these.

Social and emotional - These include advanced communication, empathy, to be adaptable, and the ability to learn continuously. Business development, programming, and counselling require these skills. These jobs are also amongst the best careers for the next ten years.

Technological - This includes everything from basic to advanced IT skills, data analysis, and engineering. These future skills are likely to be the most highly paid.

They further illustrated the skills across 13 groups and 4 categories that we will need to thrive in the intelligent Era.

Cognitive

Critical thinking
- Structured problem solving
- Logical reasoning
- Understanding biases
- Seeking relevant information

Planning and ways of working
- Work-plan development
- Time management and prioritization
- Agile thinking

Communication
- Storytelling and public speaking
- Asking the right questions
- Synthesizing messages
- Active listening

Mental flexibility
- Creativity and imagination
- Translating knowledge to different contexts
- Adopting a different perspective
- Adaptability
- Ability to learn

Interpersonal

Mobilizing systems
- Role modeling
- Win–win negotiations
- Crafting an inspiring vision
- Organizational awareness

Developing relationships
- Empathy
- Inspiring trust
- Humility
- Sociability

Teamwork effectiveness
- Fostering inclusiveness
- Motivating different personalities
- Resolving conflicts
- Collaboration
- Coaching
- Empowering

The Intelligent Era

Source chart from McKinsey and Company "Distinct elements of talent."

Ross Dawson, The Australian Futurist and AI educator, developed the chart below to identify the defining lines between AI and Human capability:[xxxvii]
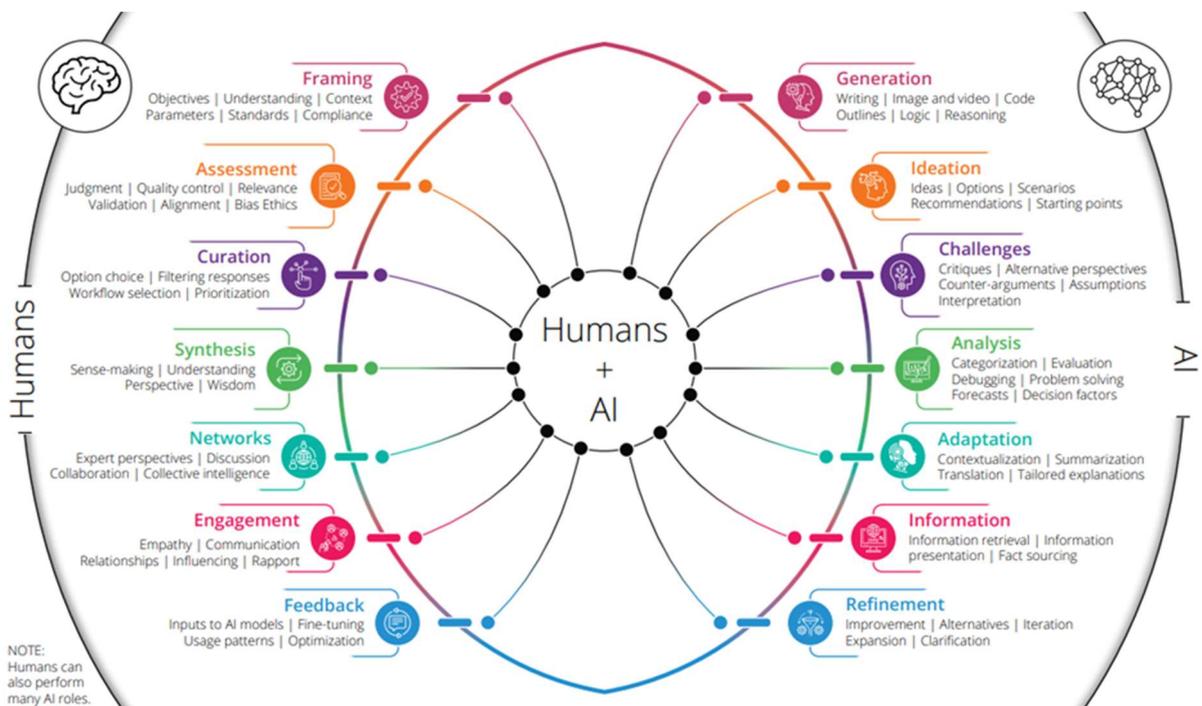
Tasks and job roles will be impacted by the take-up of new technologies, some of which are listed here, from the 2020 report on the future of jobs from the World Economic Forum:[xxxviii]

Roles reducing in demand:

1 Data Entry Clerks
2 Administrative and Executive Secretaries
3 Accounting, Bookkeeping and Payroll Clerks
4 Accountants and Auditors
5 Assembly and Factory Workers
6 Business Services and Administration Managers
7 Client Information and Customer Service Workers
8 General and Operations Managers
9 Mechanics and Machinery Repairers
10 Material-Recording and Stock-Keeping Clerks
11 Financial Analysts
12 Postal Service Clerks
13 Sales Rep., Wholesale and Manufacturing, Tech and Scientific Products
14 Relationship Managers
15 Bank Tellers and Related Clerks
16 Door-To-Door Sales, News and Street Vendors
17 Electronics and Telecoms Installers and Repairers
18 Human Resources Specialists
19 Training and Development Specialists
20 Construction Laborers

Roles increasingly in demand:

1 Data Analysts and Scientists
2 AI and Machine Learning Specialists
3 Big Data Specialists
4 Digital Marketing and Strategy Specialists
5 Process Automation Specialists
6 Business Development Professionals
7 Digital Transformation Specialists
8 Information Security Analysts
9 Software and Applications Developers
10 Internet of Things Specialists
11 Project Managers
12 Business Services and Administration Managers
13 Database and Network Professionals
14 Robotics Engineers
15 Strategic Advisors
16 Management and Organization Analysts
17 FinTech Engineers
18 Mechanics and Machinery Repairers
19 Organizational Development Specialists
20 Risk Management Specialists

I asked ChatGPT what the implications of AI on work would be and this is its answer:

"The implications of artificial intelligence (AI) on work are far-reaching and complex. Some potential impacts include:

- *Automation of jobs: AI systems can be trained to perform tasks that were previously done by humans, such as data entry, customer service, and decision-making. This could lead to job displacement and unemployment.*
- *Increase in productivity: AI systems can work around the clock and make fewer mistakes than humans, which could lead to increased efficiency and economic growth.*
- *Creation of new jobs: As AI technology advances, new jobs will be created to develop, maintain, and work alongside these systems.*
- *Changes to the nature of work: As AI takes over certain tasks, workers may be required to perform different or more complex roles that are complementary to the capabilities of AI.*
- *Changes to the structure of organizations: AI systems can be used to make decisions, coordinate work, and monitor performance, which could lead to changes in how organizations are structured and managed.*

Overall, the effects of AI on work are likely to be both positive and negative, and will depend on how the technology is implemented, as well as on how society responds to the challenges it creates."

That's a pretty good result, generating convincingly human-like text.

The promise of generative AI is that it can boost the productivity of workers, if not replace job roles by automating tasks in a great many industries. In the same way machines augmented and replaced manual labour, AI will augment brainpower in the cognitive revolution, and it is likely to have a big impact on areas as diverse as the automation of customer services, scientific research, marketing, health and digital assistants.

Top Future Jobs in 2030

Analysing the major technological and business trends today, Cognizant and ZDNet propose the best jobs/careers to emerge over the next 10 years will include:

- Virtual Store Sherpa- will focus on customer satisfaction through virtually advising customers using the knowledge of the product line.
- Personal Data Broker- will ensure consumers receive revenue from their data. The broker will establish prices and execute trades.
- Personal Memory Curator- will consult with patients and stakeholders to generate specifications for virtual reality experiences.
- Augmented Reality Journey Builder- will collaborate with talented engineers and technical artists to develop vital elements for clients.

- Highway Controller- will monitor automated road and air space management systems to ensure no errors occur.
- Body part maker- will create living body parts for athletes and soldiers.
- Nano-medic- will transform healthcare.
- GM or recombinant farmer- will transform farming and livestock.
- Elderly wellness consultant- will cater to the physical and mental needs of the elderly.
- Memory augmentation surgeon- will boost patients' memory when it hits capacity.
- 'New science' ethicist- will ford the river of progress.
- Space pilots, tour guides, and architects- will allow pilots, tour guides, and architects to live in lunar outposts.

Alternatively, this list compiled by Bruce Anderson, content marketer, editor and writer, is a view of some of the more intriguing jobs of the future and included in whole in the appendix.: [xxxix]

- Organ creator - create organs and body parts from stem cells and by additive manufacturing methods.
- Augmented-reality journey builder - will allow customers to experience virtually anything they wish.
- Metaverse planner - will augment reality and the new in demand roles.
- Biofilm installer - slime and pond scum are also a remarkable tool for sewage treatment, oil spill clean-up, and generating power.
- Earthquake forecaster - machine learning and seismology means governments might be hiring forecasters soon.
- Makeshift structure engineer - 3D printing to construct temporary buildings for those in need after natural disasters or armed.
- Algorithm bias auditor - Given the increasing statutory scrutiny on data," says the WEF, "it's a near certainty that when it comes to how they're built…"
- Rewilder - turn a concrete jungle into a green belt. Rewilders will focus on undoing the blight of two centuries of industrial revolution.
- Human-machine teaming manager - will identify tasks, processes, systems, and experiences that can be upgraded by newly available technologies and imagine new approaches, skills, interactions, and constructs.
- Digital currency advisor - specialise in crypto currencies and show people how to manage their wealth by using the right balance of systems."
- Drone traffic optimiser - will need to oversee their flight paths so they don't begin to wreak complete havoc. In the United States, NASA and the FAA are working on this.
- Autonomous car mechanic – They won't repair themselves and they will combine an old-fashioned love of tinkering with a cutting-edge understanding of technology.

- Smart home design manager - will boom as homes are built — or retrofitted — with dedicated home office spaces, replete with routers in the right place, soundproofing, separate voice-driven entrances."
- Agile supply chain worker - will constantly scout out new sources for materials and components and connect company supply lines on the fly to keep costs low and turnaround fast,"
- Rubbish/trash engineer - will be charged with coming up with clever methods to upcycle trash on a large scale, and manufacturers of everything from toys to clothes to furniture.

Whatever list you look at you will see a great many new roles, new skills, attitudes and literacies that will be required as we progress into the Intelligent Era. It is always difficult to imagine what doesn't yet exist but hopefully these lists of potential new job roles comfort you, that, as existing tasks and roles decline in demand, new ones will arise. The trick is to be ready for both events and have an attitude and a process that facilitates and encourages this for you and your organisation.

How are you identifying roles that will be impacted by elements from the Intelligent Era? Are you preparing your workforce for this change? Has your leadership team a clear understanding of the likely degree of change? What are the dangers to you and your organisation posed by the need for this skill and role change? What advantages can you take from empowering your teams with this knowledge? How will you successfully compete for talent?

Next steps

1.   Stay informed.
2.   Identify the issues the Intelligent Era (IE) will bring to your organisation?
3.   How might IE change the market you serve?
4.   What new entrants are poised to enter your market due to the IE?
5.   Identify what your competitors are doing to adjust to the IE?
6.   What will your customers want?
7.   What will your workforce expect?
8.   How will you hire scarce IE skilled talent?
9.   What impact will it have on your training?
10. What new partners might you need?
11. What opportunities does IE present you with?
12. Create a communication plan to address emerging IE issues.
13. Create a culture of forward curiosity.
14. Create a responsibility to stay on top of the implications of IE.
15. Undertake regular 'Horizon Scans' to be on top of this change.
16. Create Scenario Plans of the impact of IE on your organisation.
17. User Future Wheels to determine unintended consequences of change.

I'm sure that you can think of a whole load more relevant questions for your organisation to respond to in order to be prepared for the Intelligent Era.

What tools and skills will you develop to examine this fast-moving future?

Scenario Planning   Horizon Scanning   3 Horizon   DELPHI Method   Futures Wheel

Who should read this, or part of this, next?

About the author

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David is recognised as a leading strategic futurist who combines the experience gained from a 40-year IT, marketing and business career with strategic visioning to help organisations better prepare for the future. His career has spanned European and US IT corporations. He is a much sought after keynote speaker and is the author of many works on embracing change and the drivers of change. Before establishing Global Futures and Foresight, an independent futures research firm, he created and ran the Unisys supported 'Global Future Forum'. Prior to this he was head of strategic marketing for their $2bn global financial services business.

David and his organisation have been engaged by some of the largest and most prestigious firms from around the world including:

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Appendix 1

Generative AI

The best way to get the most up-to-date list of AI tools is to ask ChatGPT or an equivalent AI tool.

This list has been prepared by GitLab.[xl]

This list provides an overview of popular generative AI models, apps, and services, providing insights into its capabilities and how it is being used in various industries.
Contributions are welcome. Add links through pull requests or create an issue to start a discussion.

Contents
- Recommended reading
- Text
- Code
- Image
- Video
- Audio
- Other
- More lists

Recommended reading
- Generative AI: A Creative New World - A comprehensive examination of the generative AI industry, offering a historical perspective and in-depth analysis of the industry ecosystem. By Sonya Huang, Pat Grady and GPT-3, September 19, 2022.
- A Coming-Out Party for Generative A.I., Silicon Valley's New Craze - Article about the rise of generative AI, particularly the success of the Stable Diffusion image generator, and the associated controversies. New York Times, October 21, 2022.
- AI's New Creative Streak Sparks a Silicon Valley Gold Rush - Article about the growing hype and investment in generative AI startups, with various industries exploring its potential applications. Wired, October 27, 2022.
- How Large Language Models Will Transform Science, Society, and AI - Article summarizing the capabilities and limitations of the GPT-3 model, and its potential impact on society. By Alex Tamkin and Deep Ganguli, February 5, 2021.

Milestones
- Bing Search - Microsoft announces a new version of its search engine Bing, powered by GPT-4. Microsoft blog, February 7, 2023.
- ChatGPT - Announcement of ChatGPT, a conversational model trained to answer follow-up questions, admit mistakes, challenge incorrect premises, and reject inappropriate requests. OpenAI blog, November 30, 2022.
- Stable Diffusion Public Release - Announcement of the public release of Stable Diffusion, an AI-based image generation model trained on a broad internet scrape and licensed under a Creative ML OpenRAIL-M license. Stable Diffusion blog, 22 August, 2022.

Global Futures
& Foresight

- [DALL·E 2](#) - Announcement of the release of DALL·E 2, an advanced image generation system with improved resolution, expanded image creation capabilities, and various safety mitigations. OpenAI blog, April 6, 2022.
- [OpenAI API](#) - Announcement of the OpenAI API for text-to-text general-purpose AI models based on GPT-3. OpenAI blog, June 11, 2020.

Text

Models

- [GPT-3](#) - OpenAI's API provides access to GPT-3, which performs a wide variety of natural language tasks, and Codex, which translates natural language to code.
- [Gopher](#) - Gopher by DeepMind is a 280 billion parameter language model.
- [OPT](#) - Open Pretrained Transformers (OPT) by Facebook is a suite of decoder-only pre-trained transformers. [Announcement](#). [OPT-175B text generation](#) hosted by Alpa.
- [Bloom](#) - BLOOM by Hugging Face is a model similar to GPT-3 that has been trained on 46 different languages and 13 programming languages.
- [ChatGPT](#) - ChatGPT by OpenAI is a large language model that interacts in a conversational way.

Search engines

- [Perplexity AI](#) - AI powered search tools.
- [Metaphor](#) - Language model powered search.
- [Phind](#) - AI-based search engine.

Services

- [Compose AI](#) - Compose AI is a free Chrome extension that cuts your writing time by 40% with AI-powered autocompletion.
- [Rytr](#) - Rytr is an AI writing assistant that helps you create high-quality content.
- [wordtune](#) - Personal writing assistant.
- [OthersideAI](#) - AI-powered writing assistant.
- [Moonbeam](#) - Better blogs in a fraction of the time.
- [copy.ai](#) - Write better marketing copy and content with AI.
- [Jasper](#) - Create content faster with artificial intelligence.
- [Anyword](#) - Anyword's AI writing assistant generates effective copy for anyone.
- [Cogram](#) - Cogram takes automatic notes in virtual meetings and identifies action items.
- [Contenda](#) - Create the content your audience wants, from content you've already made.
- [Hypotenuse AI](#) - Turn a few keywords into original, insightful articles, product descriptions and social media copy with AI copywriting.
- [co:here](#) - Cohere provides access to advanced Large Language Models and NLP tools.
- [Lavender](#) - Lavender email assistant helps you get more replies in less time.
- [Lex](#) - A word processor with artificial intelligence baked in, so you can write faster.
- [Jenni](#) - Jenni is the ultimate writing assistant that saves you hours of ideation and writing time.
- [LAIKA](#) - LAIKA trains an artificial intelligence on your own writing to create a personalised creative partner-in-crime.
- [Mem](#) - Mem is the world's first AI-powered workspace that's personalized to you. Amplify your creativity, automate the mundane, and stay organized automatically.

- [QuillBot](#) - AI-powered paraphrasing tool.
- [Postwise](#) - Write tweets, schedule posts and grow your following using AI.
- [EmailTriager](#) - Use AI to automatically draft email replies in the background.
- [Copysmith](#) - AI content creation solution for Enterprise & eCommerce.
- [Character.AI](#) - Character.AI lets you create Characters and chat to them.
- [Sybill](#) - Sybill generates summaries of sales calls, including next steps, pain points and areas of interest, by combining transcript and emotion-based insights.
- [Taskade](#) - Outline tasks, notes, generated structured lists and mind maps with Taskade AI.
- [GPT for Sheets and Docs](#) - ChatGPT extension for Google Sheets and Google Docs.

Academia

- [Elicit](#) - Elicit uses language models to help you automate research workflows, like parts of literature review.
- [genei](#) - Summarise academic articles in seconds and save 80% on your research times.
- [Explainpaper](#) - A better way to read academic papers. Upload a paper, highlight confusing text, get an explanation.
- [Galactica](#) - A large language model for science. Can summarize academic literature, solve math problems, generate Wiki articles, write scientific code, annotate molecules and proteins, and more. [Model API](#).
- [GPTZero](#) - A tailored solution for educators to responsibly adopt AI-technologies in schools.
- [Consensus](#) - Consensus is a search engine that uses AI to find answers in scientific research.

Code

- [GitHub Copilot](#) - GitHub Copilot uses the OpenAI Codex to suggest code and entire functions in real-time, right from your editor.
- [Ghostwriter](#) - An AI-powered pair programmer by replit.
- [tabnine](#) - Code faster with whole-line & full-function code completions.
- [Stenography](#) - Automatic code documentation.
- [Mintlify](#) - AI powered documentation writer.
- [Debuild](#) - AI-powered low-code tool for web apps.
- [AI2sql](#) - With AI2sql, engineers and non-engineers can easily write efficient, error-free SQL queries without knowing SQL.
- [Pygma](#) - Turn Figma designs into high-quality code.
- [Kite](#) - Kite adds AI powered code completions to your code editor, giving developers superpowers.
- [MutableAI](#) - AI Accelerated Software Development.
- [OpenAI Cookbook](#) - Examples and guides for using the OpenAI API.

Image

Models

- [DALL·E 2](#) - DALL·E 2 by OpenAI is a new AI system that can create realistic images and art from a description in natural language.
- [Stable Diffusion](#) - Stable Diffusion by Stability AI is a state of the art text-to-image model that generates images from text.
- [Midjourney](#) - Midjourney is an independent research lab exploring new mediums of thought and expanding the imaginative powers of the human species.

- [Imagen](#) - Imagen by Google is a text-to-image diffusion model with an unprecedented degree of photorealism and a deep level of language understanding.
- [Make-A-Scene](#) - Make-A-Scene by Meta is a multimodal generative AI method puts creative control in the hands of people who use it by allowing them to describe and illustrate their vision through both text descriptions and freeform sketches.

Services

- [Craiyon](#) - Craiyon, formerly DALL-E mini, is an AI model that can draw images from any text prompt.
- [DreamStudio](#) - DreamStudio is an easy-to-use interface for creating images using the Stable Diffusion image generation model.
- [Artbreeder](#) - Artbreeder is new type of creative tool that empowers users creativity by making it easier to collaborate and explore.
- [GauGAN2](#) - GauGAN2 is a robust tool for creating photorealistic art using a combination of words and drawings since it integrates segmentation mapping, inpainting, and text-to-image production in a single model.
- [Magic Eraser](#) - Remove unwanted things from images in seconds.
- [Imagine by Magic Studio](#) - A tool by Magic Studio that let's you express yourself by just describing what's on your mind.
- [Alpaca](#) - Stable Diffusion Photoshop plugin.
- [Patience.ai](#) - Patience.ai is an app for creating images with Stable Diffusion, a cutting edge AI developed by Stability.AI.
- [GenShare](#) - Generate art in seconds for free. Own and share what you create. A multimedia generative studio, democratizing design and creativity.
- [Playground AI](#) - Playground AI is a free-to-use online AI image creator. Use it to create art, social media posts, presentations, posters, videos, logos and more.
- [Pixelz AI Art Generator](#) - Pixelz AI Art Generator enables you to create incredible art from text. Stable Diffusion, CLIP Guided Diffusion & PXL·E realistic algorithms available.
- [modyfi](#) - The image editor you've always wanted. AI-powered creative tools in your browser. Real-time collaboration.
- [Ponzu](#) - Ponzu is your free AI logo generator. Build your brand with creatively designed logos in seconds, using only your imagination.
- [PhotoRoom](#) - Create product and portrait pictures using only your phone. Remove background, change background and showcase products.
- [Avatar AI](#) - Create your own AI-generated avatars.
- [ClipDrop](#) - Create professional visuals without a photo studio.
- [Lensa](#) - An all-in-one image editing app that includes the generation of personalized avatars using Stable Diffusion.

The Intelligent Era

Image libraries

- [Lexica](#) - Stable Diffusion search engine.
- [Libraire](#) - The largest library of AI-generated images.
- [KREA](#) - Explore millions of AI generated images and create collections of prompts. Featuring Stable Diffusion generations.
- [OpenArt](#) - Search 10M+ of prompts, and generate AI art via Stable Diffusion, DALL·E 2.

Model libraries

- [Civitai](#) - Community driven AI model sharing tool.
- [Stable Diffusion Models](#) - A comprehensive list of Stable Diffusion checkpoints on rentry.org.

Stable Diffusion resources

- [Stable Horde](#) - A crowdsourced distributed cluster of Stable Diffusion workers.
- [DiffusionDB](#) - A list of all public apps, developer tools, guides and plugins for Stable Diffusion. [Airtable version](#).
- [PublicPrompts](#) - A collection of free prompts for Stable Diffusion.
- [Stableboost](#) - Stableboost is a Stable Diffusion WebUI that lets you quickly generate a lot of images so you can find the perfect ones.
- [Hugging Face Diffusion Models Course](#) - Python materials for the online course on diffusion models by [@huggingface](#).

Video

- [RunwayML](#) - Magical AI tools, realtime collaboration, precision editing, and more. Your next-generation content creation suite.
- [Synthesia](#) - Create videos from plain text in minutes.
- [Rephrase AI](#) - Rephrase's technology enables hyper-personalized video creation at scale that drive engagement and business efficiencies.
- [Hour One](#) - Turn text into video, featuring virtual presenters, automatically.

Audio

Speech

- [Resemble AI](#) - AI Voice Generator and Voice Cloning for Text to Speech.
- [WellSaid](#) - Convert text to voice in real time.
- [Play.ht](#) - AI Voice Generator. Generate realistic Text to Speech voice over online with AI. Convert text to audio.
- [Coqui](#) - Generative AI for Voice.
- [podcast.ai](#) - A podcast that is entirely generated by artificial intelligence, powered by Play.ht text-to-voice AI.

Music

- [Harmonai](#) - We are a community-driven organization releasing open-source generative audio tools to make music production more accessible and fun for everyone.
- [Mubert](#) - A royalty-free music ecosystem for content creators, brands and developers.
- [MusicLM](#) - A model by Google Research for generating high-fidelity music from text descriptions.

Other

- [Diagram](#) - Magical new ways to design products.

- [PromptBase](#) - A marketplace for buying and selling quality prompts for DALL·E, GPT-3, Midjourney, Stable Diffusion.
- [This Image Does Not Exist](#) - Test your ability to tell if an image is human or computer generated.
- [Have I Been Trained?](#) - Check if your image has been used to train popular AI art models.
- [AI Dungeon](#) - A text-based adventure-story game you direct (and star in) while the AI brings it to life.
- [Clickable](#) - Generate ads in seconds with AI. Beautiful, brand-consistent, and highly converting ads for all marketing channels.
- [Scale Spellbook](#) - Build, compare, and deploy large language model apps with Scale Spellbook.
- [Scenario AI](#) - AI-generated gaming assets.
- [Brandmark](#) - AI-based logo design tool.
- [Teleprompter](#) - An on-device AI for your meetings that listens to you and makes charismatic quote suggestions.

More lists

- [Tools and Resources for AI Art](#) - A large list of Google Colab notebooks for generative AI, by [@pharmapsychotic](#).
- [The Generative AI Application Landscape](#) - An infographic that maps the generative AI ecosystem, by [Sonya Huang](#) of Sequioa Capital.
- [Startups - @builtwithgenai](#) - An Airtable list by [@builtwithgenai](#).
- [The Generative AI Index](#) - An Airtable list by [Scale Venture Partners](#).
- [Generative AI for Games](#) - A market map of companies working on Generative AI for games, by [a16z](#).
- [Generative Deep Art](#) - A curated list of generative deep learning tools, works, models, etc. for artistic uses, by [@filipecalegario](#).
- [GPT-3 Demo](#) - Showcase with GPT-3 examples, demos, apps, showcase, and NLP use-cases.
- [The Generative AI Landscape](#) - A Collection of Awesome Generative AI Applications.
- [Prompt Engineering Guide](#) - Guide and resources for prompt engineering.

Lists on ChatGPT

- [Awesome ChatGPT](#) - A curated list of awesome tools, demos, docs for ChatGPT and GPT-3, by [@jordn](#).
- [Awesome ChatGPT Prompts](#) - A collection of prompt examples to be used with the ChatGPT model.
- [FlowGPT](#) - Amplify your workflow with best prompts.

Appendix 2

International best-selling author Bernard Marr compiled a list of current user cases which I've quoted from here. This gives some impression on the variety of uses Blockchain can be applied to: [xli]

Entertainment

KickCity—Platform for event organizers that enables them to pay only for what they get, and rewards community members by sharing those events.

B2Expand—Based on the Ethereum blockchain they create cross-gaming video games. Their first video game "Beyond the Void" got into Ubisoft's startup program and they're the first gaming company on Steam with a crypto economy.

Spotify—When Spotify acquired blockchain startup Mediachain Labs it was to help develop solutions via a decentralized database to better connect artists and licensing agreements with the tracks on Spotify's service.

Guts—A transparent ticketing ecosystem that uses blockchain technology to eliminate ticket fraud and the secondary ticket market.

Social Engagement

Matchpool—"Matchmakers" are rewarded for making successful matches whether it's dating to freelancing to Uber and Airbnb.

Retail

Warranteer—A blockchain application that allows consumers to easily access info regarding the products they purchased and get service in the case of product malfunction.

Blockpoint—Simplifies the creation of payment systems and allows mobile wallet, loyalty program, gift cards and other point-of-sale functionality.

Loyyal—Powered by blockchain and smart contract technology, this loyalty and rewards platform creates more customized programs that even allow for multi-branded rewards.

Exotic Cars

Bitcar—Fractionalized ownership of collector cars made possible by a BitCar token.

Supply chains and logistics

IBM Blockchain—Knowing the status and condition of every product on your supply chain from raw materials to distribution is critical. Blockchain for supply chains allows transparency with a shared record of ownership and location of parts and products in real time.

Food industry—The food industry's complex network from farmers to grocers makes tracking down food-borne illnesses challenging. Blockchain can improve the transparency and efficiency of finding out what food might be contaminated and where throughout the supply chain.

Provenance—Consumers are increasingly demanding transparency regarding the products they purchase and consume to ensure the sourcing of materials and production of products adheres to their individual values. Provenance uses blockchain to provide chain-of-custody and certification of supply chains.

Blockverify—With a claim to "introduce transparency to supply chains," Blockverify focuses on anti-counterfeit solutions using blockchain to verify counterfeit products, diverted goods, stolen merchandise and fraudulent transactions.

OriginTrail—Already in use in the food industry, more applications are planned for OriginTrail, a platform that lets consumers know where their purchases came from and how they were produced.

De Beers—De Beers mines, trades and markets more than 30% of the world's supply of diamonds. The company plans to use a blockchain ledger for tracing diamonds from the mine to the customer purchase. This transparency will help the industry and anybody who wishes to verify, confirm diamonds are free from conflict. Fura Gems also plans to use blockchain in its supply process of emeralds, rubies and other precious stones.

Insurance

Accenture—With goals to boost efficiency and productivity within the insurance industry, Accenture builds blockchain solutions for its insurance clients. They translate key insurance industry processes into blockchain-ready procedures that embed trust into the system.

Proof of insurance—Nationwide insurance company is currently testing a blockchain solution to provide proof-of-insurance information called RiskBlock. Ultimately, when this tool is fully deployed it will help law enforcement, insured and insurers verify insurance coverage in real time and accelerate claims processing.

Healthcare

MedicalChain—The first healthcare company using blockchain technology to facilitate the storage and utilization of electronic health records in order to deliver a complete telemedicine experience. They are real practicing doctors in the UK healthcare structure and want to change the system from within.

MedRec—In order to give any medical provider secure access to patients' records, MedRec uses blockchain to save time, money and duplication in procedures between a variety of facilities and providers. Patients could also grand access to their anonymous medical records to be used for research.

Nano Vision—Looking to catapult medical innovation away from traditional data silos and incompatible records systems, Nano Vision combines the power of blockchain with artificial intelligence (AI) to gather molecular-level data on Nano Tokens. AI then sifts through the data to find trends and analyse connections that will lead to medical breakthroughs.

Gem—With a goal to give patients control over their medical records and genomic data by using a blockchain solution, Gem has also partnered with Centres for Disease Control and Prevention to experiment with using blockchain to monitor infectious diseases.

SimplyVital Health—This platform sits on blockchain technology that empowers providers and patients to access, share and even move their healthcare data.

Real Estate

BitProperty—Using blockchain and smart contracts, BitProperty wants to democratize opportunity and create a decentralized society by allowing anyone anywhere in the world (except the U.S. and Japan due to regulatory concerns) to invest in real estate.

Deedcoin—Rather than a typical 6% real estate commission, Deedcoin runs on 1% and hopes to be the new way for home buyers and sellers to connect with real estate agents who accept a lower commission.

Ubiquity—This Software-as-a-Service (Saas) blockchain platform offers a simpler user experience to securely record property information to ensure a clean record of ownership.

Charity

BitGive —This gloabal donation platform leverages Bitcoin and blockchain technology to provide greater transparency to donors by sharing real-time financial and project information. Save the Children, The Water Project and Medic Mobile are a few of the charities working with BitGive.

AidCoin—Since research shows 43% of people don't trust charities, AidCoin hopes to improve that trust with distributed ledgers, smart contracts and cryptocurrencies and make the non-profit sector more transparent.

Utopi—A lack of transparency has plagued charitable giving, but Utopi hopes to improve transparency in non-profits. When donors give using the Utopi platform they can see exactly how every penny is spent.

Financial Services

Bitcoin Atom —A new fork of Bitcoin that allows everyone to easily exchange cryptocurrencies without any trading fees and no exchange hacks, making Bitcoin truly decentralized again. The technology is based on atomic swaps—an invaluable tool for exchanging one cryptocurrency with another (e.g. 1000 BTC with 56500 LTC) and no need for a trusted third party. But currently, widespread adoption of atomic swaps has been prevented because they require highly technical skills; something Bitcoin Atom will solve.

Securrency—This is a trading platform for cryptocurrencies and any kind of asset including traditionally illiquid assets to be exchanged through Securrency tokens. This allows cryptos to be traded outside of their dedicated exchanges.

Ripple—Ripple aims to be a global payment solution provider by connecting banks, payment providers, corporations and digital asset exchanges to allow instant, on-demand settlement globally.

ABRA—A global app and cryptocurrency wallet that allows you to buy, invest and store 20 crytopcurriences including Bitcoin, ethereum, litecoin and more.

Aeternity—This highly scalable blockchain platform can be used for any application that requires high transactional speed including smart contracts that are created off chain and nano and micro payments.

Smart Valor—With a mission to make global investments simple, fair and accessible to everyone, Smart Valor democratizes access to global wealth and investment opportunities.

Circle—Send money via text without any fees thanks to this UK-based company.

There are so many blockchain innovations out there that it was a challenge to find what to highlight (check out a previous post of mine for more blockchain examples). Many of these are potentially disruptive and it will be interesting to watch how many of these will survive this initial hype phase. If the initial dot com boom is anything to go by, then there will be many casualties in the short term but serious disruptions in the medium and longer term. An amazing space to watch.

Source image created by DALL-E responding to the question "create an image of the intelligent era in sci-fi style".

Appendix 3

Using VR in education can improve learning by helping educators create interactive classrooms – a list produced by The Education Outlook in 2022.[xlii]

Virtual reality or VR in education is highly getting adopted by educational institutions. Virtual reality in education allows students to experience destinations from across the world without ever having to leave the classroom. Augmented reality is a technology that overlays digital information such as sounds, videos, and graphics on top of the real-world environment. AR is often confused with virtual reality (VR), a technology that creates entirely artificial environments. Using augmented reality in education can improve learning by helping educators create interactive classrooms that increase student engagement. This article features the top 10 best examples of AR and VR in education everyone should know about.

Virtual reality and augmented reality make the Red Planet appear in the windows of an ordinary school bus. Field trips are informal learning experiences that get students out into the world, exploring the world and students' interests. This way they eliminated the need for VR glasses and created a group immersive experience.

Museum Experiences with the Best Guides in the World

Virtual reality in education not only allows students to get to places like Mars but also the trips to museums, parks, historical sites, and more show students that learning (and life) that happens outside the classroom is also possible. It is one of the best examples of AR and VR in education one should apply in the classroom.

Virtual Lab Environment to Conduct STEM Classes

Having an augmented reality-based lab to ensure a safe and interactive environment for students to learn STEM subjects is certainly a great tool to possess. The students learn how to sequence the genome, what the data looks like and how the results can be used to provide a diagnosis or choose the right medication. Virtual labs or "lab simulations" offer a way to experience the experimental steps for a biological experiment on a screen.

Taking a Look Inside a Human Brain to Learn Chemistry

Virtual reality in education is an excellent tool to learn about inaccessible processes. For example, human chemistry is one of the most interesting areas to study. One example that shows how fun and effective Virtual reality and augmented reality can be to learn about humans is inMind2, a game designed to help students learn the chemistry behind human emotion.

Augmented Reality in Education: Specialized Vocation Training

Vocational training can be significantly improved through virtual reality headset use. Participants can use both augmented reality and virtual reality to place themselves in virtualized scenarios based on common problems found in any given industry. Being able to experience different scenarios specific to the student's or employee's field repeatedly for learning purposes is invaluable. It is one of the best examples of AR and VR in education.

Media and Art Creation

Relying on augmented reality to learn how to create innovative content types for public consumption is the next step forward in advertisement and PR. Using a reliable resource for essay samples in tandem with Virtual Reality can also help professionals create engaging content to augment their articles or case studies.

Soft Skills Development

While virtual reality and augmented reality cannot be a substitute for real-life experience, VR in education allow students to develop soft skills. Skills that are associated with collaboration, negotiation, servicing, and other forms of peer interaction are called soft skills that can be practiced ad infinitum via augmented reality in education.

VR in Education for People with Disabilities

Virtual reality gives users the chance to explore new worlds and try new experiences, which may be especially meaningful for people with motor disabilities. In particular, virtual reality environments can allow people with motor disabilities to virtually overcome certain physical limitations. It is one of the best examples of augmented reality and virtual reality in education.

Social Diversity and Inclusion Norms Training

Innovative strategies and successful solutions to business problems depend on cultivating vital knowledge, skills, and tools to live, learn, and lead in a diverse and dynamic business world. While it may be completely normal for some to work with people of different ethnicity, religion, or sexual orientation, others may not be so accepting.

Campus Visits

Augmented reality and virtual reality can also enable students to assess colleges they are interested in. Some schools have already begun offering their own VR campus tours. With images and videos that showcase campuses in immersive 360-degrees, students can explore prospective schools with ease regardless of their real-world location.

Appendix 4

Produced from a blog by Bruce Anderson '15 Jobs You'll Be Recruiting for in 2030' in May 2022.[xliii]

Many of the jobs that today's students will be doing in 2030 haven't been invented yet. The big question for talent acquisition teams everywhere: What will those jobs be?

It turns out that many of these jobs will spin off from technologies that are emerging today — drones, alternative energy, autonomous cars, and cryptocurrencies and blockchain developments, for starters.

We looked into our crystal ball — and around the web — and here are 15 of the most intriguing (and perhaps far-fetched) jobs you may be recruiting for in the not-so-distant future:

1. Organ creator

The New Zealand–based website Crimson Education speculates that the shortage of transplantable organs will, eventually, lead scientists to create organs and body parts from stem cells and other materials, including some that may not even exist yet. Recruiters will be searching for candidates with a background in molecular biology, tissue engineering, or biomedical engineering.

2. Augmented-reality journey builder

Starting with notions developed in Total Recall (memory implants of vacations) and Westworld (an android-staffed amusement park), AR journey builders will allow customers to experience virtually anything they wish. The AR journey builders will, according to Cognizant's 21 Jobs of the Future, "design, write, create, calibrate, gamify, build, and — most importantly — personalize the next generation of mind-blowing stories and in-the-moment vignettes" for well-heeled clients. The position will demand a film school degree as well as experience with massively multiplayer online role-playing games.

3. Metaverse planner

Ironically, some of the first jobs created by the metaverse are brick-and-mortar retail jobs — Meta opened a California store in early May to hawk VR and AR gear. Down the road, of course, the metaverse will not only augment reality, it will augment the LinkedIn list of in-demand jobs. And one of those roles will be metaverse planner. "[T]he Planner," says the blog for Honeypot, a European job platform for tech talent, "will need to drive a strategic portfolio of opportunities from proof-of-concept to pilot to deployment." Planners will need management experience and an entrepreneurial spirit. And, obviously, they'll require a metaversity education.

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4. Biofilm installer

Biofilms — collections of microbial cells attached to wet surfaces — are icky, sticky, and tricky. They are literally slime and pond scum and the source of 80% of microbial infections. But they are also a remarkable tool for sewage treatment, oil spill clean-up, and generating power. "By coating certain surfaces in the bathroom and kitchen of homes, they will become key tools for environmentally friendly buildings," says the Canadian Scholarship Trust (CST), which also sees a big role for biofilm installers in "retrofitting smart, energy-efficient buildings." It's possible that biofilm installers will fit showers with microbes that attack bathroom mildew or, more broadly, equip homes with a living organism to process the garbage.

5. Earthquake forecaster

Many of the jobs on this list would have been inconceivable even a few years ago, but the role of earthquake predictor has been a job of the future for at least 50 years. In the 1970s, many scientists said that accurate, timely earthquake prediction was just around the corner. Five decades later, that's where it remains — just around the corner. But an acceleration of machine learning applied to seismology in recent years has also accelerated hopes that businesses and governments might be hiring forecasters soon. Clearly, a background in geology and geophysics will come in handy, but so might a little abracadabra.

6. Makeshift structure engineer

The days (not so long ago) of using 3D printing to create keychains and Yoda heads have been replaced by the technology being employed to produce prosthetic hands and prototypes of jet engines. In the future, makeshift structure engineers will deploy 3D printing to construct temporary buildings for those in need after natural disasters or armed conflict (can't we manage to get rid of that by 2030?). "3D printing will be able to print the parts needed to create small housing units, similar to trailers, in several hours or days, so that they can be assembled quickly for those in need," CST says. Makeshift structure engineers will have a background in industrial design and structural engineering.

7. Algorithm bias auditor

Algorithms drive much of 21st-century life, from the musical choices put forth by Spotify to the dating options offered by Tinder. The contemporary hiring process — from which postings are teed up to job seekers to which candidates an ATS serves up to recruiters — is also powered by them. "Given the increasing statutory scrutiny on data," says the World Economic Forum, "it's a near certainty that when it comes to how they're built, verification through audits will help ensure the future workforce is also the fair workforce." Algorithm bias auditors will have a background in computer science or data analytics.

8. Rewilder

These are the radical transformers who will potentially turn a concrete jungle into a green belt. Rewilders will focus on undoing the blight of two centuries of industrial revolution, replacing aging factories and unneeded buildings, roads, and fences with forests and native species. Rewilders will likely have a background in agriculture, wildlife management, and environmental science.

9. Human-machine teaming manager

There may be no other position that puts its occupant in the middle of the future of work quite the way the role of human-machine interface manager does. "As a man-machine teaming manager," Cognizant says, "you will identify tasks, processes, systems, and experiences that can be upgraded by newly available technologies and imagine new approaches, skills, interactions, and constructs. You will define roles and responsibilities and set the rules for how machines and workers should coordinate to accomplish a task." Requirements? Recruiters will be searching for candidates with a background in experimental psychology or neuroscience paired with work in computer science, engineering, or HR.

10. Digital currency advisor

With the soaring interest in cryptocurrencies such as Bitcoin, Litecoin, and Ethereum, investors now have enormous opportunities — and potential exposure — in unregulated financial instruments. "Digital currency advisors," CST says, "specialize in these currencies and show people how to manage their wealth by using the right balance of systems." Digital currency advisors will have backgrounds in accounting, financial management, and data security — but probably not professional basketball (in this TV ad with Stephen Curry).

11. Drone traffic optimizer

Once a novelty, drones today are filming our movies and fighting our wars, policing our neighbourhoods, and delivering our packages (well, that's the plan anyway). In another decade or so, they will be everywhere. And someone will need to oversee their flight paths so they don't begin to wreak complete havoc. In the United States, NASA and the FAA are working on this issue at a national level. The drone traffic optimizers will handle at a local level.

12. Autonomous car mechanic

The coming lines of autonomous cars from companies such as Tesla, Waymo, GM, Hyundai, Cruise, Pony.ai, and Ford will drive themselves. But they won't repair themselves. And the mechanics who will care for cars will combine an old-fashioned love of tinkering with a cutting-edge understanding of technology. Mr. Goodwrench meets Watson.

13. Smart home design manager

The Home of Tomorrow was once a world's fair staple. But now that future has arrived and current homes can control their own lighting, temperature, and security. "The rise of smart home design managers," says the World Economic Forum, "will boom as homes are built — or retrofitted — with dedicated home office spaces, replete with routers in the right place, soundproofing, separate voice-driven entrances." These managers will be "home-schooled" with advanced degrees in AI, robotics, and residential architecture.

14. Agile supply chain worker

In a global and online economy, businesses will increasingly need to respond in real time to fluctuations in both supply (where can I get parts faster, cheaper, of better quality?) and demand (why the sudden interest for our product in Southeast Asia?). "[C]ompanies need people who constantly scout out new sources for materials and components and connect company supply lines on the fly to keep costs low and turnaround fast," says CST. Recruiters will look for candidates who've studied supply chain management and logistics at business school. Military veterans with experience in SCM will also be high in demand.

15. Trash engineer (aka, Garbage designer)

Humans, according to the United Nations, produce over 2 billion tons of garbage each year. And we're running out of places to stash our trash. But to those who say there's no way out of this mess, our future trash engineers say, "Rubbish!" The Thrillist weighs in: "Garbage designers . . . will be charged with coming up with clever methods to upcycle trash on a large scale, and manufacturers of everything from toys to clothes to furniture will hire them to find more efficient ways to use and reuse their by-products." A background in materials science and industrial design will be needed for those who dream of nothing less than cleaning up the world.

Final thoughts: Jobs of the future have never looked so good.

Remember George Jetson, the bumbling dad in Hanna-Barbera's space age cartoon series? George worked three hours a day, three times a week, at Spacely's Space Sprockets. His 21st-century job? Turning the Referential Universal Digital Indexer on and off (and complaining about how much work he had).

Future jobs will be much more, well, animated. We may need robot counsellors and aquaponic fish farmers, memory surgeons and virtual store sherpas, bio-waste optimizers and plant therapists.

One certain job of the future is the need for someone to recruit nimble, creative talent to fill all these roles.

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