

Aurecon's Business Series

Zero Marginal Cost Economics

**How zero marginal cost economics
will revolutionise the built world**

Digital Futures Publication
2020 Edition

aurecon

*Bringing ideas
to life*

About Aurecon Digital Futures

Mass digitisation is influencing all aspects of our lives; in the workplace, our homes and across the built and natural environments. A double-edged sword, digital technology has created significant new opportunity, new markets and new value, while at the same time, hastening the obsolescence of other products and services and their respective providers. In the same way, it impacts those not able to embrace the change required or comprehend the implications.

Aurecon's Digital Futures has a single focus, to look ahead at these changes and to harness advancements on behalf of our clients and partners.

This report is one in a series of publications from Aurecon's Digital Futures, each exploring key areas being reshaped by advances in digital technologies such as business and economics, the changing nature of work and the impacts of new technology.

This is a people, process, and technology approach that considers these areas simultaneously to understand the dynamics between them if we are to effectively adapt and thrive in this fast changing environment.

The reports are designed to be read together to provide a holistic view of how digital technologies are changing the world around us, and how we and our organisations need to adapt.

At Aurecon, we are looking for others who share our enthusiasm, see the value of digital innovation and strategy and who would like to benefit from our focus on the future and our learnings. If you have an interesting, difficult or unprecedented issue, let's talk about working together on an innovative solution.



Dr Andrew Maher
Chief Digital Officer



Stewart Bird
Digital Futures Leader



Foreword

Zero marginal cost economics and the impact of COVID-19

In late 2019, the world first became aware of a new coronavirus outbreak (COVID-19). Many at the time would not appreciate this outbreak would so quickly become a global pandemic, the breadth and scale of which has fundamentally disrupted life as we knew it and, with it, global economies and the way nations interact.

This edition of the Digital Futures Business Series was largely conceived prior to large-scale impacts of the COVID-19 pandemic emerging. Despite developments in the last few months, we feel that this paper's content remains highly relevant.

COVID-19 has necessitated governments across the world to close their borders to each other and to enforce social distancing measures, a result of which organisations have been compelled to adopt or rapidly scale up their digital ways of working. Staying at home has meant that home has become a place of work, a meeting place, a place from which to entertain and be entertained, a place from which to shop, eat 'out', exercise, consult the doctor and learn, virtually of course, and the only way that can happen is to think creatively and embrace digitisation.

The organisations that had already adapted their business models to take advantage of zero marginal cost economics prior to the pandemic are likely to be better placed in the current situation. Many of these organisations will already be using digital platforms and tools to deliver their services, and need fewer people and fewer physical assets in the process.

Organisations that are adapting because of the pandemic are having to do so quickly. Many will be questioning the value of their physical assets, rethinking the roles of their people, and rapidly digitising their products and services - elements of their businesses that contribute to high marginal costs.

While many traditional businesses are having to close their doors, many platform organisations such as Netflix or Amazon are seeing such a spike in demand that they are struggling to fulfil it. In many ways, the pandemic is quickening a pre-existing evolution in business.

As organisations adopt and experiment with new business models and new ways of working, zero marginal cost economics will be front of mind. This paper offers some insight into how zero marginal cost is finding renewed importance, articulates how it may impact some industries and highlights how organisations could adapt.



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01

Welcome to the first edition of Aurecon's Business Series

How zero marginal cost economics will revolutionise the built world.

Our selection of publications is aimed at unpacking the fundamental business and economic concepts underlying the advance in digital technology.

This first edition of the Business Series has been designed to present you with a fresh view of a term you may already be familiar with: **zero marginal cost**.

As a manager and a leader, you already know we are living in a time of enormous economic and business change. Industries and markets across the world are no longer static: they are dynamic and at times unpredictable, and generate complex operating environments for organisations.

Looking at industries such as entertainment and retail, we see they have changed dramatically over the past decades.

New winners (eg Spotify) and losers (eg CD retailers) have emerged. These shifts have been spurred on by advances in technologies, primarily digital technologies.

For many organisations, the response to this kind of disruption is operational in nature. Companies often choose to concentrate on doing what they currently do but just better, faster and more efficiently.¹ However, such an approach fails to properly take into account the economic aspects of disruption. Economic implications are commonly underestimated, overlooked or not thoroughly understood in our industries.

In order to survive and thrive going forwards, it is critical for every organisation – regardless of industry – to turn its attention towards the economic implications of technological disruption and ensure that fundamentals are understood by senior leadership. One of the most critical of such concepts to understand is zero marginal cost economics.

Zero marginal cost has gained renewed importance thanks to the advent and rapid advance of new technologies. Already, impacts on the nature of competition and how organisations and their business models are designed are being felt.

To date, the built world has been somewhat immune to the levels of disruption experienced elsewhere. This is partly due to the physical nature of the assets we design, construct and operate.

However, the barriers between the digital and physical worlds are now blurred because of technological advances like the Internet of Things (IoT) and Artificial Intelligence (AI). Zero marginal cost economics is likely to have a substantial impact on how the built world is designed, constructed and managed in future.

We will introduce the modern concept of zero marginal cost economics and explain how it is challenging traditional economic and business fundamentals, and discuss what that might mean for the designers, builders and operators of the built world. That's you.

02

A fresh look at zero marginal cost economics

You are probably already familiar with the term zero marginal cost: it is an economic fundamental.

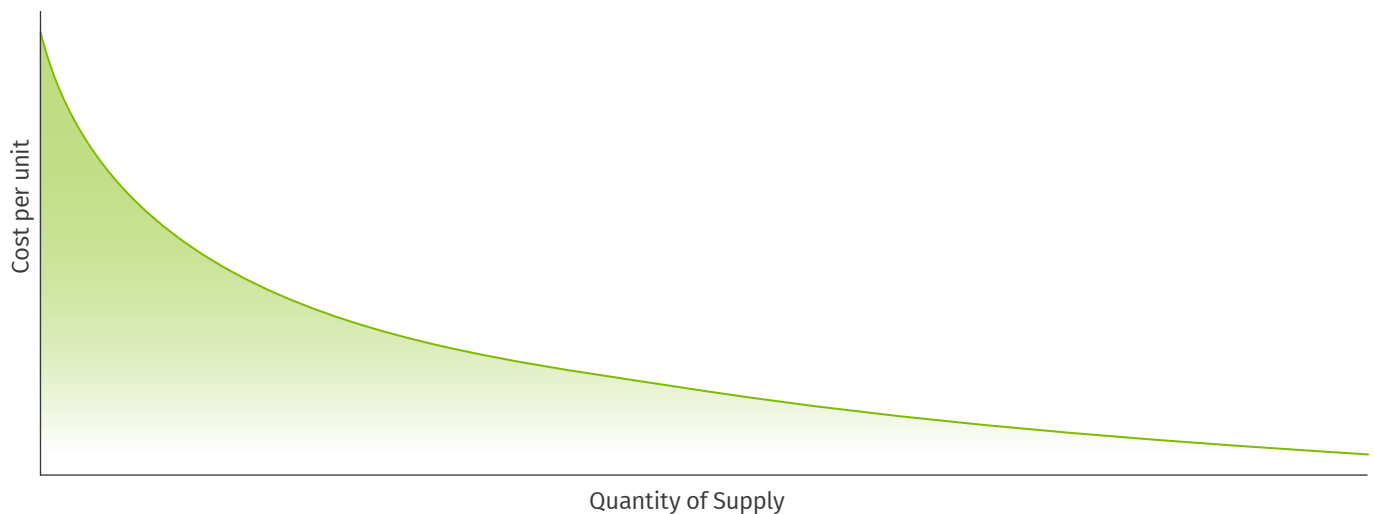


Figure 1. Zero marginal cost refers to when the cost to produce each additional unit of a good or service approaches zero.

Aiming for zero marginal cost drives efficiency, such as encouraging the refactoring of inputs and costs. These business goals have been universally adopted and are considered to be key in remaining competitive.

Traditionally, an organisation's growth was restricted by significant marginal costs. Products such as new cars, or CDs, that were typically physical in nature and required raw materials, with costs of distribution contributing further to marginal cost.

While more intangible in nature, traditional services firms also experienced substantial marginal costs. Trading in knowledge, experience and intellectual property were inextricably linked to humans, and firms' revenues were always linked to their largest cost-base: **people**.

In the past, marginal costs inhibited the speed of growth. According to this model, an optimal market occurred when marginal price equalled marginal cost.

But change was coming. Even in 2001, mainstream economists like Larry Summers and Bradford DeLong worried about declining marginal costs, given that "the most basic condition for economic efficiency is that price equal marginal cost." They concluded then that "the right way to think about this complex set of issues is not clear... we do not yet know what the right replacement paradigm will be."²



We live and work in an entirely new era, a time of exponential possibilities.

It is a time of disruption in technology and computing power, and in business growth potential (Figure 2).

The disruptive impacts of the digital revolution have radically altered how we think about marginal cost. Now, zero marginal cost appears within reach.

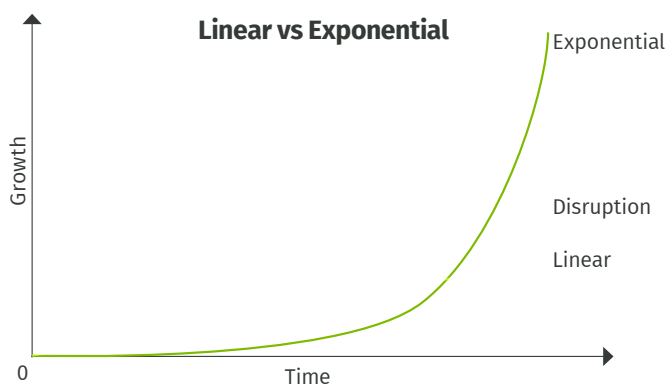


Figure 2. High marginal costs can limit an organisations' growth potential, while organisations with near zero marginal cost are more likely to achieve exponential growth

As a term, zero marginal cost was really thrown back into the spotlight in 2014 largely due to the economist Jeremy Rifkin, author of the book *Zero Marginal Cost Society: The Internet of Things* (Palgrave Macmillan, 2014).

“

In a digitally connected society, the marginal costs of an increasing number of goods and services would fall to near zero. This would force a fundamental change in prevailing business models: from markets to networks, from ownership to access, from workers to 'prosumers', from sellers and buyers to providers and users, and from consumerism to sustainability – and the second industrial revolution's economies of scale would no longer apply.”

Jeremy Rifkin

Author of *Zero Marginal Cost Society*

The first high profile example of this phenomenon was observed in the music industry. Napster's music file sharing application was among the earliest digital platforms illustrating how new technologies can transform economic realities. No longer did you have to purchase a physical album for \$30, a sum which paid the artist, the record label, the marketing firms, the manufacturers of the CD and its case, the logistics companies and the retailer.

Instead, with Napster you could access the digital music file for just the cost of an internet connection. Consumption of music became easier at close to no cost.

These early models were illegal, but they unleashed a revolution nonetheless. The digitisation of products and services, and the development of digital distribution channels have transformed businesses and entire markets.

As we will present in detail across the following sections, new business models have upended industries that previously looked safe because of their reliance on physical assets.



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03

Zero marginal cost is disrupting and reshaping value chains

Every organisation is a string of components forming a vertical value chain, with the objective of creating value for an end customer.

Traditionally, organisations have tended to be vertically integrated because this has been the most effective and efficient way to mobilise a large number of resources to create value.

Companies are founded on sustainable competitive advantage, and continually strive to improve efficiency and standardisation to lower transaction costs for chosen components. In theory, those organisations that can most effectively economise activities across their value chain lead the market.

But zero marginal cost economics is challenging this premise.

In striving to reduce costs of some components of the value chain to near zero, there is a price to pay. Eventually a point is reached at which the transaction costs drop to a level where there is very little to economise on.

When there is less to economise on, there is diminished need for an organisation to exist and the value chain risks breaking up.

Philip Evans (Boston Consulting Group Fellow) argues the rules of the game for entire industries are upended when certain components in the value chain approach zero marginal cost. Minimising marginal costs breaks up what binds a value chain, and allows for new competitive advantages and new value chains to form. This is especially true if the component being commoditised has been protecting the industry from outside competition.

This same idea was raised in Professor Clayton Christensen's theory of disruption. He argues that an industry is ripe for disruption when its core technology is stretchable. Here, core technology refers to a component in the value chain essential to the nature, protection or capitalisation of the industry, and stretchable describes its ability to be copied or replicated.

The trend of disintermediation exemplifies this. As the name suggests, disintermediation is the removal of intermediaries from value chains. Examples include travel agents, sales agents, logistics operators, retailers and more.

Disintermediation has occurred rapidly and on a grand scale. Technological advances have allowed organisations to bypass certain components in the value chain and undertake the activities themselves.

For example, website service providers such as Squarespace and Shopify allow people to undertake many of the value chain activities that retailers traditionally used to provide, such as reaching consumers, displaying products and facilitating sales. These activities are now all undertaken by individuals prepared to pay a low monthly fee for a simple e-commerce website.³

From vertical to horizontal



Figure 3. Many value chains are shifting from vertical to horizontal in shape.

Fragmented value chains also give customers greater choice. In past decades, customers were not able to pick out value components when they made a purchase. They simply selected a supplier that provided the best average value across the entire value chain.

For example, when a customer booked a hotel room they paid a fee that might have included breakfast, access to the gym and pool, use of business facilities and more. These services would have been included in the room price, regardless of whether the customer wanted to use them or not, and their options would be to simply select from similar composite offerings.

Increasingly, in accommodation and many other industries, digital technologies and zero marginal costs allow customers to purchase value components from a variety of suppliers, a trend known as unbundling.

Organisations and entrepreneurs unbundled goods and services to offer them individually. Airbnb unbundled hotel and resort offerings, Spotify and iTunes unbundled music delivery, Google and online platforms unbundled newspapers, AWS unbundled IT infrastructure and Netflix unbundled cable TV.

Value chains have also changed shape in recent years from vertical to horizontal and centralised to distributed.

Some examples are listed below:

- **Wikipedia has broken up the vertically integrated encyclopedia business into a horizontal value chain of contributors**
- **Uber has broken up the vertically integrated taxi business into a horizontal value chain of driver-partners**
- **Low cost renewable technologies are breaking up the vertically integrated energy industry into a horizontal value chain of micro producers**

Many other industries are on the same trajectory, as they begin to realise the value and opportunity to achieve lateral scale by using digital technologies. The new horizontal and disaggregated value chains do not suit the traditional business models of vertically integrated organisations.

Instead, such arrangements necessitate entirely new business models, along with the redistribution and redefinition of what is meant by 'value' in many industries.

04

Changing consumption patterns has forced business model innovation

Traditional business models have typically been one dimensional, where an organisation produces one unit and sells it once to a consumer.

These have come to be known as **linear business models**, partly due to the significant marginal costs that hinder their growth potential.

Over the last few decades, many organisations have sprung up or adapted themselves to take advantage of zero marginal cost economics and the horizontal value chains they perpetuate.

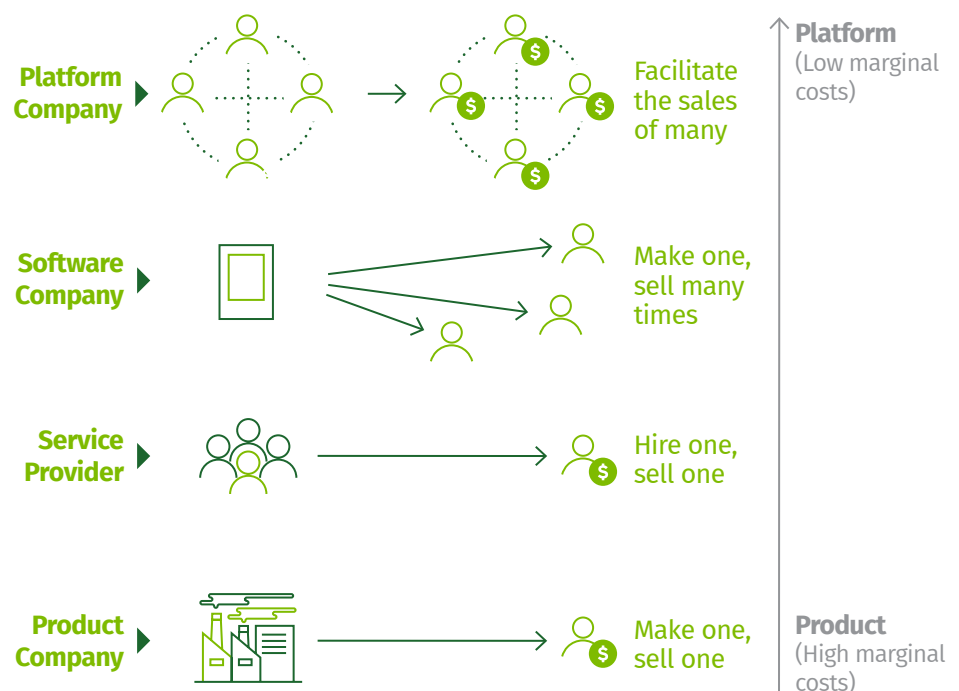
With increasing digitisation of products and services, they can now be produced, replicated and sold again and again at near zero-marginal cost (see Table 1).

Through innovation, organisations have created new business models to compete successfully in this new economic paradigm.

Many of these new models are designed so that organisations can build something once and extract value from it more than once. This maximises the value an organisation can capture from the product and reduces marginal costs over time. Such capability began with software – because of the ease by which it can be replicated – but has more recently been applied to physical products too.

Table 1. Spectrum of businesses from product to platform models.

Source: Modern Monopolies - Alex Moazed & Nicholas L Johnson





Take GoGet for example, a car share service provider that fits somewhere between personal ownership and rental. GoGet provides customers with access to shared cars for an annual fee plus a per kilometre fee. Rather than selling the car once, their pay for access services allows them to provide the car to each additional customer at near zero marginal cost.

These business models are very good at removing many of the 'pain points', or value-eroding steps, customers experience with more traditional business models. In traditional car ownership, pain points include unutilised car time, registration costs, servicing and the need to own a garage for parking. GoGet removes all of these.

New business models have fundamentally changed the nature of consumption. Now we talk not about ownership, but of access. Consumers now favour unlimited access to a range of services such as car-riding services, streaming services and subscriptions, as opposed to owning the physical products themselves.

In new business models, products become services and services connect organisations to their customers more effectively. Rather than selling 1 000 different products, organisations can sell access to one product and sell it 1 000 times instead.

In turn, this provides the organisation with far better insights into their customers. Instead of one touchpoint with one customer every time a product is sold, the organisation can have repeated communications with many customers over a longer period of time.

Here are some examples of digital business models you may be familiar with:

- Free model
- Freemium model
- Subscription-based model
- On-demand model
- Platform model
- Peer-to-peer, two-sided marketplace
- E-commerce model
- Ad-supported model
- Hidden revenue generation model

Emergence of new business models through digitisation of products and services.

A platform is a business model that facilitates the exchange of value between two or more user groups, typically a consumer and a producer. Platform businesses focus on creating a means of connection, rather than a means of production and are perfectly suited for horizontal value chains⁴.

Platform business models are perhaps the purest form of a zero marginal cost business. As the facilitator of transitions between suppliers and consumers, these businesses hold no inventory. They make their revenue by taking a cut of each transaction, or through an indirect means such as advertising or data collection once they've established an audience of appropriate size. Each additional customer or sale is achieved at near zero marginal cost.

While firms like Facebook and Tencent are pure platform businesses, many other successful organisations such as Amazon and Apple are a hybrid. For example, alongside their online marketplace platform and Amazon Web Services (AWS), Amazon also provides inventory management and logistics services such as Fulfilment. To support their App Store platform, Apple sells phones and tablets and other hardware items that connect app developers with Apple product users.

These new technology or digital business models are incredibly successful. The top five technology companies in the world, Amazon, Alphabet, Facebook, Microsoft and Apple, are valued at more than USD 4 trillion (greater than the value of Germany's entire stock market).

But despite their immense size, these organisations still continue to grow at an impressive pace. For example, the share price of the five firms grew by 52% over the last 12 months (2019-2020) and their sales income grew by 17% over the last quarter⁵.

Part of the success of these technology business models is that they are able to continue to scale unencumbered by high marginal costs. At the same time the actions taken as part of their business model are continuous and reinforcing in nature, this is also known as the flywheel effect.

Firms that adopt these models put significant emphasis on creating new touch points with their customers, extracting insights from the market, and enhancing and adapting products or services on an ongoing basis in response to fresh insights.

New business models and their flywheel effects provide organisations with exponential growth opportunities.

However, many of the organisations just discussed are digital natives and they were established at the outset of the global digital revolution. It is much more complex to consider economic reformation of incumbent organisations and industries with traditional vertical value chains in response to digital disruption.

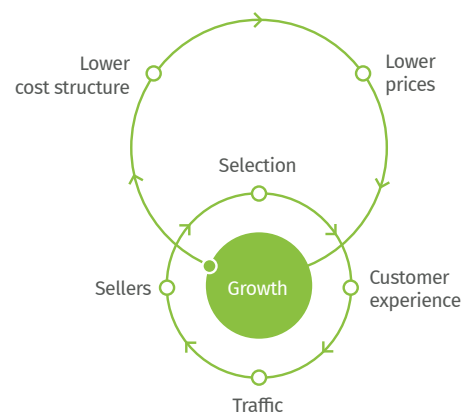
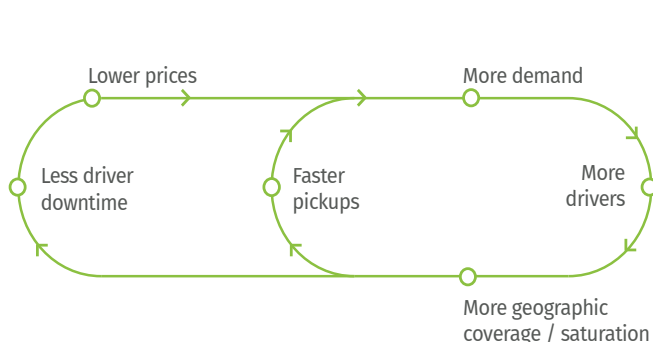


Figure 4. Amazon's flywheel on the left and Uber's flywheel on the right



05

Why the built world is becoming increasingly vulnerable to zero marginal cost economics

Businesses are adapting to the changing environment but how are these different sectors impacting us?

At this point you may still be thinking the retail, entertainment and tourism industries are a far cry from our own as designers, builders and operators of the built world.

However, new technological trends such as the Internet of Things (IoT) and Artificial Intelligence (AI) allow zero marginal cost economics to have an increasing impact on our industry too.

We are now entering what many call the Fourth Industrial Revolution, characterised by advanced digital technologies and their overlay and integration with the physical world. This paradigm will likely change some of the economic fundamentals underpinning our industries, and will require businesses to adapt.

IoT and new internets

Advances in hardware have allowed the internet to move beyond just knowledge and communications to become an internet of things, where physical objects are connected in real time. Technological advancements blur the lines between the digital and physical worlds.

While perhaps not a pure IoT example, Uber, Lyft and Didi represent the beginnings of a connected transport internet by connecting car owners with passengers via digital platforms.

Automation in transport and logistics networks will further change how we move people and goods; in controlled environments, such as logistics centres, transport and distribution are already highly automated. Just take a look inside an Amazon fulfilment centre.

We are also seeing public transport becoming increasingly autonomous, with driverless trains and buses already in play.

Although progress is somewhat slower in difficult-to-control urban environments, it is possible that we will see autonomous trucks, cars and UAVs at scale, significantly bringing down the marginal cost of getting from A to B. This is the beginning of what many call the transport and logistics internet.

The energy internet by comparison, is more advanced. For some time, we have seen advances in power generation technologies that allow individuals to become energy producers (or prosumers), sparking decentralisation of the energy industry. Battery technology, microgrids and peer-to-peer trading will further bring the marginal cost of energy production down towards zero.



These new internets will continue to emerge across a number of industries such as the Internet of Food and the Internet of Clothing, which were proclaimed by Haier at the 2019 Drucker Forum,⁶ as a way to connect consumers, prosumers and organisations. Consequently, many traditional value chains will become decentralised.

AI and its impact on intellectual property

AI is also driving businesses closer to zero marginal cost. Technological advances are not simply automating manual tasks, they are also impacting many intellectual pursuits.

Advancements in data science and programming are moving us beyond basic mechanisation and communication to the extent that complex processes and knowledge are being coded into software to automate sophisticated cognitive tasks.

This has happened at such a pace that tasks once thought to be too complex for a computer to ever do successfully, for instance, driving a car on urban roads, or understanding and communicating in natural language, are already being digitised and are available to average consumers. We have seen this with Tesla's autopilot and Apple's virtual assistant Siri.⁷

The advanced programming approaches allow knowledge-based organisations, particularly professional services firms, to code important intellectual property (IP) into software and use it again and again at close to zero marginal cost.

In the legal profession, tasks traditionally undertaken by lawyers are increasingly being digitised and productised using techniques such as natural language processing and text mining.

Likewise, the financial services sector has been shifting to algorithmic trading techniques for a number of years, replacing the human knowledge and intuition that was once the sole means of assessing trades.

These technologies are allowing organisations to separate their revenue from their largest cost-base, their staff. Such capability means that organisations are experiencing a shift from traditional linear business models to exponential models.⁸

AI will increasingly allow more work currently undertaken by people to be digitised, productised and commercialised at near zero marginal cost.

06

Zero marginal cost will impact diverse industries in different ways

Zero marginal cost will undoubtedly impact many industries and challenge some of their economic underpinnings.

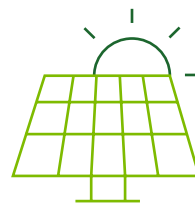
However, the impact will not be uniform in speed and scale in all business environments.

Some industries are already experiencing significant change (eg energy and education industries), while others are only starting to see the effects (eg transport, property, architecture, engineering). As zero marginal cost impacts industries at different rates, some are being completely transformed. For others the full impacts are yet to be felt, but now is the time to anticipate change and prepare.

Incumbent organisations can expect new opportunities, but also risks. At best, the potential exists for businesses to achieve exponential growth; at worst, organisations will be left with stranded assets and defunct business models.

Above all, it is critical that business leaders in every industry understand the concepts behind zero marginal cost economics, comprehend its potential implications and start preparing their organisations for potential futures.

How might things play out in different industries?



Energy industry

The energy internet is already taking shape in many countries. With the cost of renewable energy technologies falling significantly in the last few years, many smaller players have been able to make the shift from consumer to prosumer, generating their own energy at near zero marginal cost and feeding excess back into the grid.

Countries such as Australia are at a point of transition to renewables and zero marginal cost energy.

“

We're getting more and more zero or marginal-cost generation from the wind and the sun.”

Victoria Energy Policy Centre Director Bruce Mountain

This is proving a challenge for vertically-integrated energy industry incumbents, as the centralised value chains of the past become increasingly distributed. The economic foundations that were once extremely lucrative for such companies are being eroded.

According to a recent article by the Australian Broadcasting Corporation (ABC), so much solar power is storming into the national grid in the middle of the day that states – including South Australia – are now experiencing periods of negative prices for power.⁹



As Dr Hugh Saddler from the Australian National University's School of Public Policy explains, "What that means is the generators that are going through that period actually have to pay to generate electricity, which is not great for the economics of a coal-fired power station."¹⁰

Australian Energy Market Operator CEO Audrey Zibelman has also noted the impact of renewable energy on the economics of coal. "Unless we get the markets right - and we continue to see the emergence of rooftop solar as well as variable renewable energy - we'll see even earlier coal retirements than anticipated because the economics of plants won't be viable," she said.

The impact of zero marginal cost energy production is forcing incumbent organisations to learn how to take advantage of zero marginal cost economics. As a result, new horizontal value chains are emerging. This involves considering new business models with a fresh mix of physical and digital assets that allow prosumers to generate, store, use and trade energy.

Many organisations, particularly retailers, are turning their attention towards becoming service providers to both households and commercial customers. For example, retailers such as Powershop are investing in digital platforms and data analytics to better support households and businesses in buying and selling energy.

Power2U, a Swedish start up, is helping building owners not only become efficient power users but also power generators. Power2U uses cloud-based software to assess the energy usage of buildings and identify opportunities for improved efficiency. By optimising the energy peaks of each building's assets (solar panels, batteries, etc), Power2U is then able to create a flexible power grid, where the energy assets of one building are able to store and exchange electricity with the energy assets of other buildings. As a result, each property can become a prosumer in the local grid and sell excess energy back to the main grid, creating additional revenue streams for the owners.

While the scale of change in the energy industry is challenging for existing market players, these changes present significant opportunities for building and land owners in other industries. For example, Aurecon is helping South Australian (SA) Water achieve its goal of a zero cost energy future, neutralising one of its largest operating expenses.¹¹

Zero marginal cost economics is enabling more of us to become a prosumer, save on current energy costs and generate new revenue streams.



Transport and logistics industries

Although less mature than the energy internet, the beginnings of a transport and logistics internet are clear.

Ride-sharing services such as Uber, Grab, Ola and DiDi are connecting passengers with 'driver partners' in cities across the world. The zero marginal cost economics of these platform business models have allowed rapid scaling. This phenomenon caught the centralised and vertically integrated taxi industries off guard.

Many of these organisations are also connecting restaurants to people, and delivering food to homes. As a result, delivery services have become unbundled from restaurants. Even further, now the act of cooking is starting to become unbundled from restaurant brands as new 'dark kitchens' emerge.¹²

Car-sharing organisations like GoGet are converting on the access over ownership trend, and contributing to declining car ownership among the younger generations. This creates challenges for car manufacturers in how they sustain their business in the coming years and decades.

Debate is still ongoing regarding the impact of zero marginal cost business models on traditional public transport modes. Some believe the services take commuters away from public transport, while selected studies show that firms such as Uber might actually be helping public transport numbers by providing last mile solutions (eg catch the bus and then order a car to reach your home).¹³

Private car manufacturers may decide to transition their businesses towards providing access to their fleet – taking advantage of zero marginal cost economics – and will therefore be in direct competition with public transport. In addition, electrification of these vehicles coupled with zero marginal cost renewable sources may trigger a decline in the appeal of public transport as a sustainable and socially responsible mode of transport.

Many transport authorities around the world are now looking at mobility as a service (MaaS) platforms as a way to adapt to these changes, engage with the wider transport eco-system and allow themselves to take advantage of zero marginal cost economics. A recent example of this is Vy's (a Norwegian transport group) appointment of Australian firm SkedGo to build their MaaS platform.¹⁴

Although these trends are already reshaping the urban landscape, it is the rise of autonomous vehicles that could really revolutionise many aspects of the built world.

Autonomous buses, trains and cars are already transporting people around defined areas, and driving the cost of travel further towards zero. For example, Sydney Metro launched its driverless train last year.¹⁵

It's still unclear whether people will choose ownership or just access company-owned or public autonomous vehicles.



Property industry

The coming years will likely bring disruption in the property industry, as our need for property and how we use it changes over time.

Relevant here are significant changes in retail practices, thanks to zero marginal cost economics. With advances in technology, the marginal cost of marketing and selling products and services to the public is near zero. Platforms such as Alibaba, eBay and Amazon allow producers and suppliers to reach vast audiences without the need to engage with brick and mortar retail. Further, e-commerce website providers like Shopify and Squarespace offer the means for businesses to create their own websites and facilitate their own sales.

Together, changes like these have created disintermediation of physical retail shops and impacted property values as footfall declines.¹⁶

Now that physical retail shop fronts are no longer the sole (and perhaps not even the most important) interface for organisations to engage with customers, property owners are having to find new strategies to attract customers to actually visit. Many organisations are turning to visitor experience as a drawcard. For example, Scentre Group recently announced it would offer more services as part of its experience-based Westfield Living Centres.¹⁷

Living Centres is a new term that reflects the desire of consumers who want to visit a shopping complex for more than merely the retail experience but for health, beauty, food and entertainment.¹⁸ This shift in focus will undoubtedly have implications for retail property design, operation and maintenance in the years to come.

However, it is not just retail that is moving towards facilitating a better visitor or tenant experience: the trend is also seen in commercial property.

As zero marginal cost economics perpetuates increasingly horizontal and decentralised value chains, the nature of work and employment is changing. Fragmentation allows individuals to move away from careers at vertically integrated organisations. Instead, people are designing and facilitating their own careers and work opportunities.

This new level of flexibility is changing how we view office space. Property owners are increasingly having to look beyond solely providing space in return for rental yields. Instead, they're providing services and infrastructure in the form of digital applications, data services and IoT infrastructure for organisations to attract people towards the workplace, and facilitate more intangible aspects of work such as creativity, collaboration and social inclusion. The impact of COVID-19 has further underscored these existing trends and placed greater urgency on property owners to innovate.

Zero marginal cost transport may also have an impact on the property sector. Property owners already use transportation as a significant commercial lever. Parking fees constitute a significant revenue source for many, and others use value capture techniques and the development of transport hubs to offset the cost of property development. Advances in autonomous modes of transport could force some of these income pathways to dry up for property owners.



For example, some suggest that parking revenue may erode as shared or pay for access autonomous vehicles become commonplace¹⁹. As with Uber in future passengers may be dropped off at property locations, allowing the autonomous vehicle to leave and fulfil another trip with another passenger. In this scenario, large areas currently reserved for parking will not be required, eliminating parking fees as a revenue source.

The flip side is that then an opportunity opens up to reapply parking spaces for other revenue generating activities.²⁰

Unmanned aerial vehicles (UAVs) are also an emerging mode in the transport internet. Indeed, UAVs designed for parcel delivery are already being pilot-tested by Google's Wing project in Canberra.

Aviation giants like Boeing and Airbus are backing start-ups around the world to develop passenger drones. Uber has also announced it wants to start passenger drone services in cities such as Melbourne in 2023.²¹

While many believe the technology is not mature enough yet, such moves are prompting property owners to consider the implications of drone transport. Westfield shopping centres have already begun talks to ensure they are central hubs for services such as Uber Air.²²

As these technologies become more feasible, cities will need to plan drone corridors where UAVs are allowed to safely fly. If UAVs will be moving people and products, property owners may need to consider whether their land acquisitions fall within these future corridors.

Good positioning of owned land will provide opportunities to develop new transport hubs, and facilitate other pathways for value capture.²³

Many owners and operators of residential property are already experiencing the effects of zero marginal cost economics and the access economy. A growing number of apartments are being used as Airbnbs, rented out to people for short-term stays. This trend is seeing some buildings become quasi-hotels rather than strict residential blocks.

Some landlords are restricting tenants from listing their properties on sites such as Airbnb, while others are capitalising on the trend by controlling and facilitating services such as cleaning, concierge, and safe key services.

The property sector is increasingly feeling the flow on effects of trends linked with zero marginal cost. Property sector leaders are being forced to innovate on their centuries old business model of receiving rental yields in return for space.



Health industry

Although COVID-19 has gone some way to speed up the adoption of newer practices (eg telehealth), newer technologies (eg wearables) offer healthcare providers the opportunity to move further beyond this model, and start to take advantage of zero marginal cost economics. While the complexities and risks this sector deals with may limit the speed of change, significant opportunities are increasingly emerging for innovators in this space.

A recent Harvard Business Review article reported on two hospitals in southeast England and their pilot trials of wearable devices, data analytics and artificial intelligence to treat outpatients.²⁴ Patients discharged from the hospitals were fitted with a Wi-Fi enabled armband that remotely monitored vital signs such as respiratory rate, oxygen levels, pulse, blood pressure, and body temperature.

The health benefits appear promising, with hospital readmission rates down, and emergency room visits reduced. Economic benefits have also been recorded. The need for costly home visits has dropped by 22%. Longer term, adherence to treatment plans have increased to 96%, compared to the industry average of 50%.

This is just one example showing how digital technologies can change the way healthcare is delivered.

Traditionally, treating patients requires physical space for beds, and doctors and nurses in attendance. Home visits require qualified people to travel to patients to monitor their progress. Such modes of health management involve a significant marginal cost to treat each additional patient.

New technologies offer healthcare providers the opportunity to move beyond this traditional model and start to take advantage of zero marginal cost economics. New, decentralised approaches will most likely require fresh thinking about the business models of hospitals and healthcare facilities. One option is to charge for prevention-related health services on an ongoing, zero marginal cost basis, rather than bill for treatment. In the long run, this may necessitate new approaches in designing healthcare infrastructure.

Mercy Hospital in the USA has outlined a bedless hospital as one of their goals, and has established a Virtual Care Centre that focuses on remote monitoring and predictive analytics.²⁵

More cutting-edge technologies such as 3D printing and robotics are also driving medical activities further towards zero marginal cost. For example, the first successful robotic supermicrosurgery using a dedicated robot has recently taken place (to treat breast cancer-related lymphedema).²⁶

As these technologies and their applications mature, the economic underpinnings of the healthcare system will continue to shift, and so too will the business models of the organisations that work within it.



Education industry

The education industry had to adapt quickly to new technologies. Since the beginnings of the internet, and particularly since the launch of YouTube in 2005, education has existed in a space where any user can create and upload content and distribute it to potentially millions of people for free. Access to information and knowledge online has fundamentally changed how people access education and learning materials.

Education providers have adapted relatively successfully to this zero marginal cost economy, with just about every education provider digitising their learning content and offering access to it via massive open online courses (MOOCs).

When students are able to learn remotely, and universities and education providers shift their business models to charge for zero marginal cost content, the question then turns to the role of campuses. Studies show students are now spending less time on campus, and feeling less socially satisfied with their peers when they have the option to study remotely.²⁷ The trend could be further amplified due to the outbreak of COVID-19.²⁸

Reflecting the change, many universities are rethinking the role of their physical campus infrastructure and developing them into 'Living Labs'. Living Labs are defined as user-centred, open-innovation eco-systems. Many universities create such systems to allow their campus infrastructure to provide unique opportunities for students, researchers and the community.²⁹

For example, Murdoch University in Perth has revealed plans to create a Living Lab of renewable technologies, allowing researchers to experiment hands-on with emerging technologies from energy generation to peer-to-peer trading using blockchain.³⁰

As more and more learning content is delivered online at zero marginal cost, the role of universities and other education providers will continue to evolve. Many will continue to find new and innovative ways to utilise their physical assets and repurpose traditional classroom and lecture hall space.



Manufacturing industry

Manufacturing has not yet felt the full effects of zero marginal cost economics. However, emerging technologies such as 3D printing and other digital fabrication techniques will have an impact.

The first 'low-cost' Stratasys 3D printer entered the market in 2002 priced at about USD 30 000; today's entry-level 3D printers start at just AUD 350. The technology is growing exponentially, and quickly becoming a viable means of production for a diverse range of products.

Product components in cars, airplanes, human prostheses, and even replacement parts for the International Space Station (produced in zero gravity orbit) are now being 3D printed.³¹

These new fabrication technologies have the potential to significantly challenge the vertically integrated value chains of traditional manufacturing.

Much of the manufacturing industry offers value through economies of scale and specialisation. Factories and manufacturing plants are typically designed for repetition at scale, which ensures they can remain cost competitive by recouping initial investment overhead costs.

However, the designs that feed new fabrication technologies are digital, and can be distributed to users around the world at zero marginal cost. Online platforms such as Thingiverse are already activating a large prosumer network that uploads and shares designs, offering anything from figurines to spare machine parts. This allows designers of products to achieve lateral scale.

As 3D printing technologies mature and scale, and as raw materials improve and become cheaper,³² the manufacturing industry may become increasingly

decentralised. Manufacturing activities may fall victim to disintermediation, with designers able to provide access to their designs direct to customers who can then print the components locally.

In addition, online distribution could trigger disintermediation in organisations that support the supply chain and logistics of the manufacturing industry.

New fabrication technologies may affect manufacturers beyond purely basic consumer products too. Food production is a good example, with many start-ups vying for space in this emerging area of manufacturing. Organisations are in the process of commercialising 'lab-grown' foods such as beef and prawns.³³

Overall, major economic change is probably a little way off in the manufacturing industry.

"You're not going to be sitting in your home, printing out exactly what you want to repair your car any time soon, but major manufacturing companies are really adopting this technology," says Jennifer Lewis, a materials scientist at Harvard University in Cambridge, Massachusetts.³⁴

As new technologies mature, it is plausible that manufacturing could become increasingly decentralised. Many businesses will evolve to take advantage of zero marginal cost economics, and challenge the well-entrenched foundations it currently operates on.

Some businesses are already moving forwards: software design company Autodesk has invested in its belief that the future lies with makers, acquiring MIT spin-off Instructables in 2011 to engage in the growing maker community.³⁵



Professional services, including architecture and engineering

Zero marginal cost economics will have an impact on how the built world is designed and managed. This shift will open up opportunities for professional services firms to assist in the redesign and rethinking of our physical assets, but also create new and challenging operating environments.

Advancements in data science and programming allow us to move beyond basic mechanisation and communication, and begin to code complex processes and knowledge into software. More broadly speaking, digital technologies allow intellectual property (IP) to be codified, copied and distributed in totally new ways, and at scale.

Traditionally, professional services firms would commercialise their IP by deploying their people to projects, and charging based on the number of hours those people worked or by the value they created for the client.

These traditional models assume IP is inextricably linked to people, the largest cost base for most organisations. By this model, large contracts won by a company meant the cost base needed to further increase through hiring more people, or asking existing staff to work more hours. It resulted in growth only ever being linear.³⁶

Now, artificial intelligence (AI) based technologies enable the digitisation of a new level of IP in the form of mathematical models, self-learning algorithms, and neural networks. Such technologies allow sophisticated IP to be uncoupled from people, and then digitised, productised and sold at zero marginal cost, upending the traditional business models of many professional service firms.

The productisation of IP necessitates a business model that differs from the traditional models employed by professional services firms. Market leading consulting firms like McKinsey have already realised this. For instance, the McKinsey Solutions package provides software-based toolkits that embed the company's expertise within a client's organisation. It is an approach that 'productises' McKinsey IP, and pushes the company into a new model of asset-based consulting.

For architects and engineers, the growing maturity and adoption of computational design practices are driving the marginal cost of design towards zero. Clearly, these computational strategies offer significant improvements for design processes, for example through allowing designers to deal with increased complexity, to improve accuracy and to hasten speed of delivery. However, as engineers and architects develop these tools and embed more and more IP into them, the way in which their work is commercialised will need to shift over time.

Evolution of Professional Services Value Chain

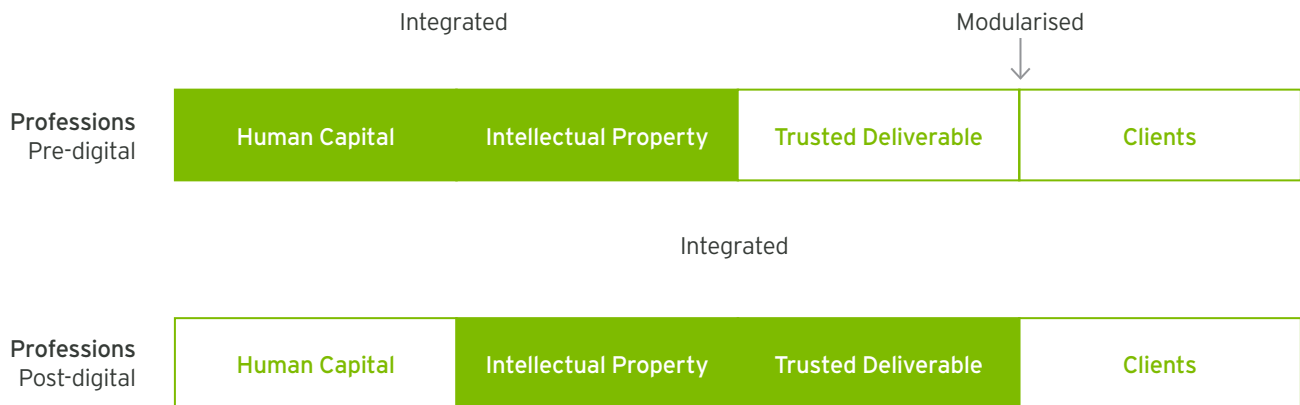
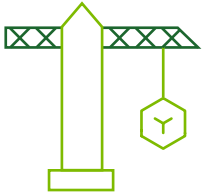


Figure 5. Intellectual Property is increasingly being uncoupled from people and 'baked' into deliverables. Source: Chasing Digital, Anthony Stevens.

Many start-ups and new entrants in design-related services are already taking advantage of the new ability to codify and productise IP and offer it at zero marginal cost. These organisations employ a strategy of 'decoupling' where they focus on a specific component in the value chain that is currently delivered inefficiently by incumbents and steal that value activity away.³⁷

Take ArchiStar for example, whose Property Intelligence platform can automate significant parts of the site select and configuration process, essentially decoupling these activities from architects, planners and engineers.³⁸ This practice is effectively chipping away at the traditional value chains of these organisations.

Professional services firms should ensure they maintain a watchful eye on the market around them, understand how technology is driving change and ensure business model innovation is given adequate attention.



Construction industry

Construction, at its core, will always involve the use of raw material inputs. As a result, construction will probably not be as susceptible to the broader changes zero marginal cost economics will bring to other industries.

However, as with the manufacturing industry, improvements in digital fabrication technologies may change how construction is undertaken. Some smaller, less sophisticated activities may become increasingly decentralised.

One of the technological trends is 3D printing. The sophistication of concrete and steel printing techniques is growing rapidly, and increasingly such methods are able to operate on an large scale.

3D printing technologies offer significant cost-saving potential through reduction in labour and lower requirements for materials. Research shows that construction costs could drop by 50 – 70%, and labour costs by 50-80% if adaptation occurs.³⁹

Dubai is committed to leading the world in this growing area of construction: the city has set a target for every new building being 25% 3D printed by 2030.⁴⁰ In Amsterdam, MX3D has successfully completed and installed the first 3D printed steel bridge.⁴¹

While these technologies represent significant change, large scale disruption for the construction industry is not likely in the short-term.

Henrik Lund-Nielsen is CEO of Danish 3D-printing company COBOD International, which produced Europe's first 3D-printed building in 2017. "The potential is still huge and great and everything, but we haven't learned to master it yet," he said. "We're not fully ready to compete head on with the construction industry."

07

Digital innovation must be considered in an economic context

The previous sections are designed to give you an idea of how different industries might be impacted by our changing technological and economic landscapes. But they are by no means an exhaustive list of possibilities.

The ways in which zero marginal cost economics may play out for organisations will differ greatly depending on the nature of the industry they are in, where in the value chain they sit and what business model they employ.

Data tells us organisations have low confidence about how their current business models will fare into the future (Figure 6), and that many businesses look inwards rather than outwards (Figure 7). Some organisations employ a 'wait and see' strategy or invest in innovation initiatives based on guesswork: policies that create significant risks.

McKinsey Digital Global Survey 2017

8%

of companies believe their business model will remain economically viable through digitisation.



Figure 6. A 2017 McKinsey Digital Global Survey found only 8% of organisations believed their business models would remain economically viable in a digital economy.

Client Focus



**100%
Internal focus**



41% have more of an internal focus



39% have an even division between internal and external



20% have more of an external focus



**100%
External focus**

Figure 7. A recent survey conducted by Aurecon shows the majority of clients consider their focus to be mainly internal.

Source: Our Digital Futures Market Research



To mitigate such risks, organisational leaders should ensure they have a broad, open and informed perspective when considering where to focus their innovation efforts. It is no longer enough to think about digital innovation solely in an operational context. It must also be considered in an economic context.

Businesses will have an edge over competitors when they systematically identify and understand signals, trends and other indicators of change, and develop plans for how to respond with informed investment.

A 2018 study of European firms found those with foresight increased their profitability by 16% and their market capitalisation by 75% (over seven years). Those that did not invest in systematically understanding their potential futures saw their profitability decrease by 44%, and did not record any changes in market capitalisation.⁴²

Application of futures research and strategic foresight can clearly assist organisations in developing the methodologies to turn signals and trends into plausible scenarios. These can be used to inform how digital technologies may reshape markets and to invest pre-emptively to capitalise on these shifts.

Zero marginal cost economics continues to reshape value chains, influence consumption patterns, and turn consumers into prosumers. It is becoming increasingly important for organisations to establish systems and processes to ensure they understand changing market dynamics, and have considered investments that allow them to pre-empt change and adapt quickly.



08

It is time to pay attention to zero marginal cost economics

The time to sit up and pay attention to the impact of digital technologies on the economics of your industry is now.

The built world and the industries that design, construct and operate it have been somewhat immune or shielded from the levels of disruption experienced by other industries. This is no longer the case.

The lines between the digital and physical worlds are blurred. Technological advances are exposing architecture, engineering, construction (AEC) and the industries they service to the same phenomena that has forced huge economic and business shifts in other parts of the economy.

When zero-marginal cost is real, it weakens and reshuffles value chains, it forces us to rethink how we view and commercialise intellectual property, and it necessitates critical analysis of business models.

Organisations across the built world must look beyond digital innovation as a technology, efficiency or operational innovation challenge. They must understand the fundamental economic and business shifts that reshape some of the basic assumptions around how their industries work.

In our industries, businesses can no longer be one-dimensional in how they create and capture value. They must reassess what sort of work they do, and whether they have the right physical and digital assets to compete and thrive in this new digital economy.

Now is the time for true innovation, founded on the realities of a zero marginal cost economy.



09

Where to next?

Digital Futures focuses on enabling Aurecon and our clients to be agile, allowing us to adapt to the rapid technological advancements that take place within our industries and their related fields.

We want to positively influence how organisations operate so they can deliver better value across their operations. Our goal is to create sustainable solutions that have the flexibility to enhance the digitisation of infrastructure today, tomorrow and into the future.

Every day, our attitude to innovation finds new answers to old problems, and equally creates groundbreaking outcomes for new problems presented by our ever-evolving world.

At Aurecon, we're seeking other organisations who share our enthusiasm for finding the new answers, who see the value of digital innovation and strategy, and who will benefit from our expertise.

If you feel you have an interesting, difficult or unprecedented situation, let's talk about working together on innovative solutions.



Interested in exploring how we can bring your idea to life?
Contact **Stewart Bird** to start the conversation.

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