Our Digital Futures
The Digital Horizon

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Bringing ideas to life

Our Digital Futures

Helping others make sense of the 'now' and be **future ready** is important to us at Aurecon. So important that we set out on one of our most intensive market research undertakings yet – with the ultimate aim of helping our clients understand the actions they can take to navigate the digital landscape of the future.

Our Digital Futures uncovers what 'digital' means to our clients, their organisations and physical assets, revealing the major barriers and challenges in the constantly evolving digital space. To be released over three waves as **The Digital Landscape**, The Digital Horizon and Your Digital Strategy, the results of Our Digital Futures research provide key insights into the issues – and opportunities – that digitisation creates.

In this second instalment of Our Digital Futures – The Digital Horizon – we focus on the architecture, engineering and construction sector, **which is often regarded as a laggard in the uptake of innovation**. The insights shared will help our clients recognise what they can be doing now, in order to thrive in the future.

Thriving in the future requires focus now

"The future impact and potential of 'digital' is undeniably immense, but to create sustainable and productive businesses which are competitive in the long-term, organisations must build their capacity to thrive now. It's vital to focus on the ripple, not just the rock, have a clear view of where actions will end up, embrace relevant innovations and take a human-centred approach to decision making."

Dr Andrew Maher,
Group Managing Principal, Eminence,
Digital & Innovation,
Aurecon

The fourth industrial revolution promises unprecedented change for many industries, including the architecture, engineering and construction sector and the industries it supports. This new industrial revolution is characterised by digital platforms and systems and their overlay and integration with physical assets.

Until recently the built world and the industries catering to it have been somewhat immune to the ongoing disruption caused by new digital technologies. However, with advances in technology (particularly the pervasiveness of data-related technologies), the architecture, engineering and construction industry is poised to experience change on a broad scale.

This presents both a risk for existing organisations, as well as significant opportunity for those prepared to

evolve. Digitalisation is reshaping cities, transforming business models and integrating physical assets with their digital counterparts.

New opportunities are being unlocked for people and organisations as technologies continue to evolve and shape the workforce of the future. 'Digital' is moving from a disruptive force to an enabler of integration, with the potential to create a better, more sustainable and productive world.

As we move towards this digital future, even more important than knowing what the **current landscape** looks like, is understanding what the years ahead may hold. The Digital Horizon shares a glimpse of what may come – how the energy, transport and property industries might look and operate, what the workforce of the future may be, where organisations should focus and what it means to properly prepare now.

The Digital Horizon insights

Aurecon's Our Digital Futures research with clients, industry experts and futurists highlighted key findings about the characteristics organisations will need to thrive in a rapidly changing technological and economic landscape.

The research showed widespread agreement that the impact of digital technologies and trends will change organisations and markets considerably. Those likely to thrive into the future will have properly prepared themselves by anticipating change and building their capacity in the following critical areas.

Systematically anticipating change

Whilst many organisations still employ a 'wait and see' strategy or invest in innovation initiatives based on guesswork, organisations that systematically identify and understand signals, trends and other indicators of change, and develop plans for how to respond with informed investment will have an edge. A **recent study** of European firms found that over a seven year period, those with foresight capabilities and processes increased their profitability by 16% and their market capitalisation by 75%. 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.

Through the use of futures research, organisations can develop the methodologies to turn signals and trends into plausible scenarios, use these to inform how digital technologies may reshape markets and invest pre-emptively to capitalise on these shifts.

Understanding the business and economic implications of technology

Organisations that move beyond viewing 'digital' simply through a technology lens to understand the fundamental business implications sitting behind it will be best placed to successfully evolve into the future.

This understanding of the business and economic implications of digital technology is fundamental for organisations to assess how their value chain is evolving, where new profit pools are emerging and how to effectively adapt their business model to suit these new paradigms.

Planning the future workforce

Aurecon's research showed that the majority of organisations view upskilling their people as critical for future success.

Depth interviews indicated that the exponential rate of change has led to the rapid depreciation in the value of current skills and knowledge in the workforce, as new technologies, tools and ways of working continue to emerge and evolve. This continual rate of change is emphasising the need for continuous learning and requiring organisations to give their employees more opportunities by automating repetitive tasks and redeploying people to higher value activities.

Embracing new technologies

The need to embrace new technologies was evident from the research. Organisations that can effectively adopt new technologies to enhance their products, services and customer experience, as well as drive internal efficiencies, will be well positioned.
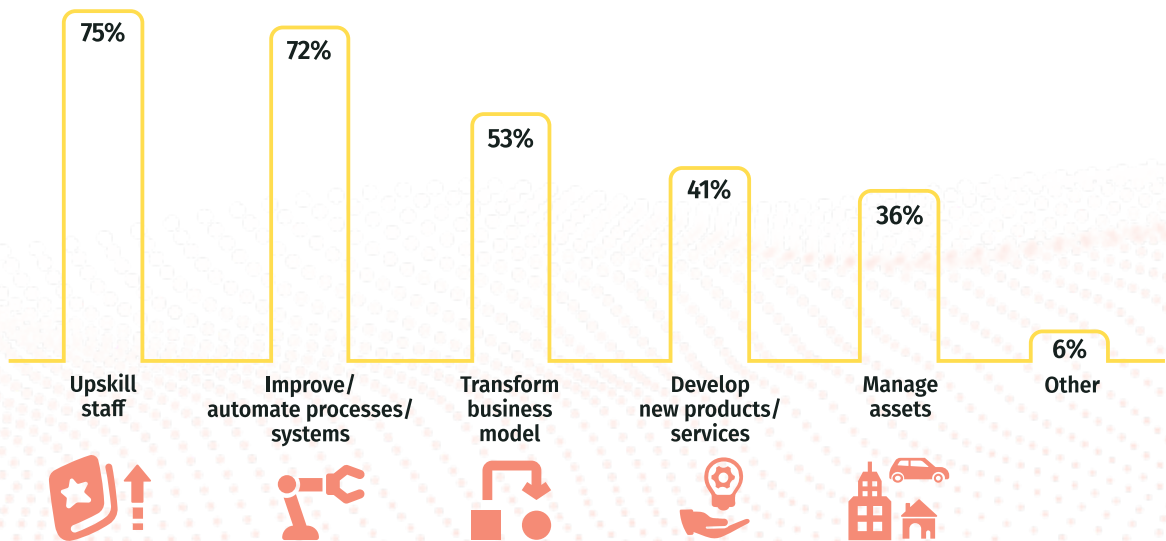
As we navigate the digital horizon, technologies relating to data capture and analysis will be critical for creating new value through enhancing products and services and supporting customer insights. Technologies that drive automation will be critical for the bottom line.

A deliberate and cohesive digital strategy

As highlighted in **The Digital Landscape**, a central and cohesive digital strategy with a balanced focus on internal activities and external market engagement is crucial for future success.

Organisations that are able to develop a strategy which connects people, processes, systems and assets are likely to be best positioned to realise the full potential that digital ways of working can bring.

Focus required for organisations to thrive
(next two to five years)

Upskill staff	75%
Improve/automate processes/systems	72%
Transform business model	53%
Develop new products/services	41%
Manage assets	36%
Other	6%

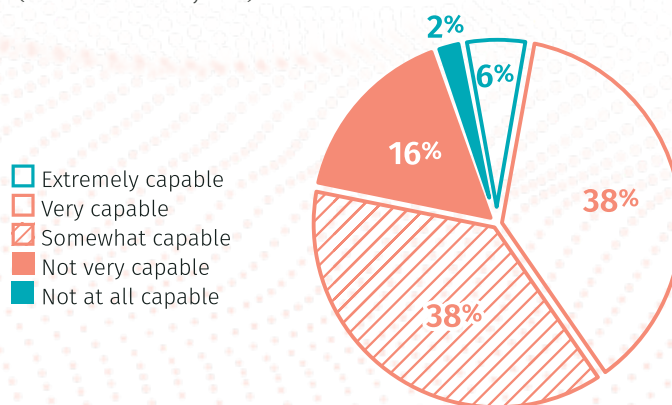# The design, construction and management of physical assets needs to catch up

Digital technology is increasing the rate of change and creating more complex business environments. According to Aurecon's research, most agree 'digital' will continue to cause meaningful changes for both their organisation and sector, and that the impact of digital change will only strengthen with time.

The clear consensus that digital has caused moderate change now, will cause considerable change in two to five years and significant change beyond 11 years, indicates that although disruption is present in many industries, the true effects have not yet rippled into every sector. This is particularly true for the part of the economy that designs, constructs and manages physical assets.

While some survey respondents believe their organisations are very capable of thriving in the digital landscape, more than one in two respondents believe their organisation is, at best, only somewhat capable of thriving.

As this sector has been slower to embrace digital technologies, there is a unique opportunity for organisations to learn from and leverage transformations occurring elsewhere and use that knowledge to anticipate outcomes and ensure digital investment reaps maximum value into the future.

"We're entering a 'post-digital' era. The major conceptual disruptions that the digital era has brought have already largely occurred. Now the focus shifts towards seeing how these disruptions can be integrated and introduced into our everyday practice. This is where we will see an even greater impact and change than we have experienced to date, and organisations need to be ready for that."

Associate Prof Dr Kristof Crolla,
Architect, Hong Kong

How organisations see their capacity to thrive in a digital economy
(next two to five years)

- Extremely capable
- Very capable
- Somewhat capable
- Not very capable
- Not at all capable

2%
6%
16%
38%
38%

Our Digital Futures shares actionable insights to help our clients address their most pressing questions

- What will my industry look like in a digital economy?
- Is my business model fit for a digital economy?
- Do I have the right asset base to compete?
- What does my organisation's workforce of the future look like?
- Does our current workforce need to upskill?
- How can I better anticipate change, not simply respond?
- How can I stay up to date on emerging technologies?
- How do we create a culture of innovation, creativity and collaboration?
- How can I identify the critical digital skills needed for our organisation to thrive in the future?
- What learning and development experiences are needed to extend the skill set of our people?
- Where do we start in building integrated networks of data?
- How can we incorporate automation into our business processes and offerings?
- How can I digitise and commercialise our intellectual property?
- How do we scale our innovations beyond experiments?

What does your future look like?

Unearth opportunities and stay ahead of the curve by exploring what you can do now to shape your future.

- Employ futures research to examine trends, emerging issues and weak signals, and develop strategies to respond to potential future operating environments, including:

  - **Identify and understand the range of trends, emerging issues and weak signals that could impact your business using a Horizon Scan.** Through identifying and unpacking signals of change in the external operating environment, we can understand potential future environments.

  - **Demystify the long term using Horizon Mapping.** Understand the long, medium and short-term impacts of change to generate innovations, make sense of trends and identify uncertainty.

  - **Explore the complexity and non-linear change with Systems Mapping.** Apply systems thinking and deep knowledge on ecosystems to explore the interaction between trends to examine broader patterns and rates of change.

- **Identify and assess the technologies that will impact your businesses with Technology Mapping.** Use a systematic approach to categorise and assess the evolution of technologies to diagnose risk, applications and readiness for implementation.

- **Develop a clear understanding of the range of your future with Scenarios.** Help prepare for the future and reckon with uncertainty by developing a better understanding of the range of plausible future operating environments.

- **Identify and unpack the impacts and implications of change through Implications Analysis.** Identify and understand the implications of future operating environments and develop strategies and tactics to respond.

- **Stress test your strategies and action plans against potential futures.** Test the resilience and robustness of your strategies against the different ways future environments may evolve, shift or diverge.

- Extract greater value from physical assets by adopting fit for purpose asset strategies that are connected to strategic and operational imperatives, using forecasting, prediction and financial analysis.

- Create a digital profile of existing and real-time asset behaviour to translate data into knowledge.

- Embrace data and analytics to make smart and strategic decisions.

How organisations can prepare

So, you don't feel prepared? Here are the four key areas, identified by our research, that organisations can address to build their capacity for thriving into the future:

1. Apply futures research to determine digital investments

Our survey data revealed that investment in digital is a high or critical priority for two in three respondents, which suggests both an appetite and the means for developing digital solutions in the coming years.

However, depth interviews with business leaders and futurists around the world indicate that this voracious appetite often leads to investing based on hunches rather than statistical data, potentially limiting the effectiveness of the investment. This insight reaffirms the increasing importance of organisations to look externally and develop systematic and deliberate ways to monitor the ever-shifting digital environment, anticipate change and prepare themselves for the future.

Futures research tools such as horizon scanning and scenario planning allow organisations to assess how digital technologies and trends will impact industries helping them to inform, define, execute and persist with strategic initiatives to proactively respond, rather than simply react.

As we head into the future, many industries serviced by the architecture, engineering and construction sector will transform.

Those who stay up to date on emerging trends and new technologies can turn disruption into opportunity by knowing what is being developed, what is available, when to use it and how, when it will likely reach maturity, how it will likely impact their industry and how they can respond commercially.

"Governments have traditionally invested in physical infrastructure which have driven social and economic growth, but they should also consider what digital public infrastructure should be invested in that will enable new technologies and trends, and will power our economy into the future: such as connectivity to enable everyone to be online; integration where systems work together better; identity so we can take advantage of connectivity and integration; and security to ensure safety."

Jithma Beneragama,
Director of Digital,
Victorian Department of
Premier and Cabinet

Digital investment priority

14%	Critical
48%	High
25%	Medium
13%	Low
	Nil

0%
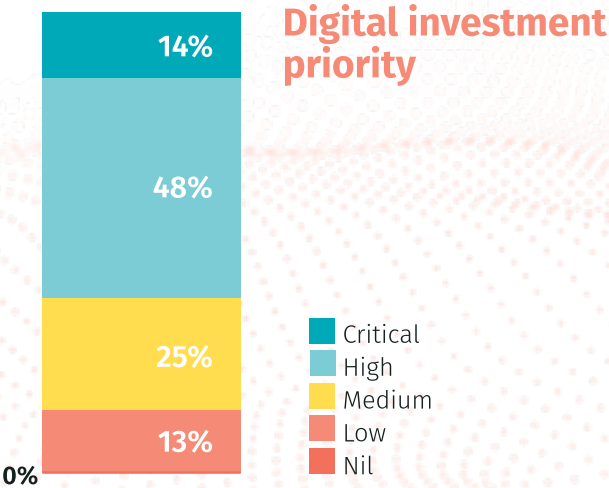
2. Embrace and embed critical technologies

Greater disruption is inevitable as new technologies connect the physical and digital worlds at a pace and scale never witnessed before. Looking ahead, our research shows that data-driven tech trends, such as big data, data analytics and cloud computing are thought to be the most critical technologies for the architecture, engineering and construction sector over the next five years. While these technologies have been applied in discrete areas of the architecture engineering and construction industry, it is the ability to integrate previously siloed activities or data that is causing a fundamental shift.

Data is widely seen as the fundamental business asset and is improving business operations (internally and externally). It is also the enabler of other technologies such as artificial intelligence, machine learning, blockchain, energy tech and autonomous transport – which according to Aurecon's research, are currently considered by survey respondents to be less important over the next five years compared to other technologies.

Survey respondents' lack of attention is risky given these technologies promise to radically reshape entire industries by connecting the digital and physical built environments in completely different ways.
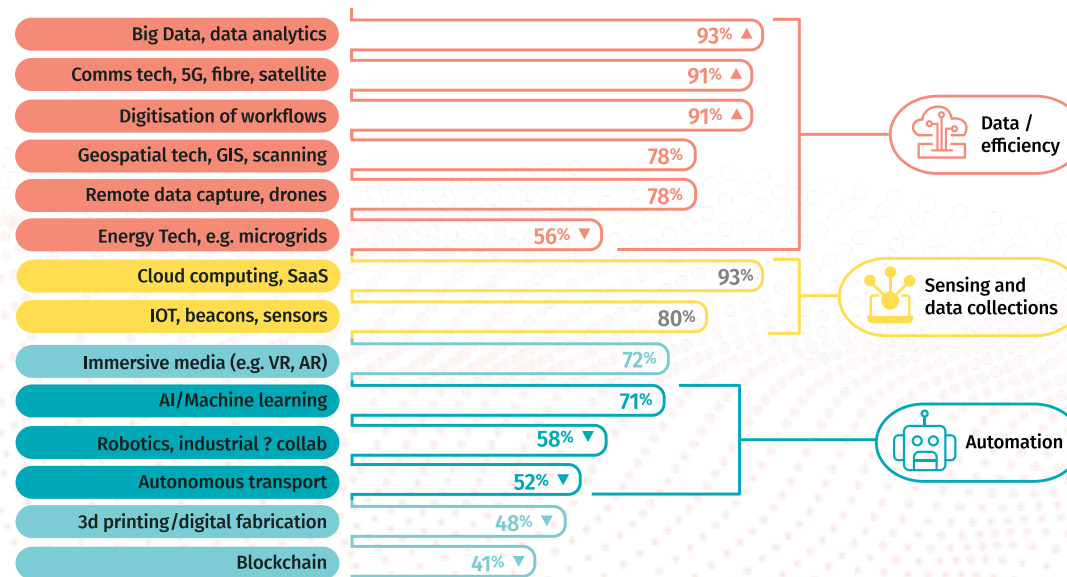
They will bring new challenges for business models of industry incumbents, transform value chains within these industries and force organisations to rethink the value they create. To be part of this future, organisational leaders need to properly understand the impact of these technologies and prepare their businesses now to pre-empt this change.

No matter what the technology, or when it becomes relevant, the message from our depth interviews is clear: organisations must strike a balance between technological implementation that is operational and technology that enables more effective integration with other parts of the industry. Those with an operational only focus risk investing significant time and money into initiatives which may diminish in value or become obsolete as the economic underpinnings of their industry continue to shift.

Importance of technologies to businesses over the next five years
(answers include somewhat important + very important)

Technology	Value
Big Data, data analytics	93% ▲
Comms tech, 5G, fibre, satellite	91% ▲
Digitisation of workflows	91% ▲
Geospatial tech, GIS, scanning	78%
Remote data capture, drones	78%
Energy Tech, e.g. microgrids	56% ▼
Cloud computing, SaaS	93%
IOT, beacons, sensors	80%
Immersive media (e.g. VR, AR)	72%
AI/Machine learning	71%
Robotics, industrial ? collab	58% ▼
Autonomous transport	52% ▼
3d printing/digital fabrication	48% ▼
Blockchain	41% ▼

Data / efficiency

Sensing and data collections

Automation

3. Upskill to prepare your workforce of the future

According to our global research, to realise meaningful change and advance over the next two to five years, many organisations believe upskilling staff and improving and automating systems and processes will create positive shifts to enable success long-term. This insight demonstrates an understanding that refreshing knowledge and skills is critical for the longevity of organisations, and that work undertaken by humans that involves repetition is a significant risk.

Despite conventional concern about job loss associated with automation, depth interviews suggest those leading the way in the future will not be automating purely from a productivity perspective, but rather to free up people to engage in continuous learning opportunities and enable investment of saved resources in other ventures. This will become even more important as organisations create new intellectual property.

Our research also indicated that upskilling staff and building integrated networks of data and systems will be essential in order to prosper in the next two to five years and beyond. People from STEM (science, technology, engineering and mathematics) fields who have deep technical capabilities, business and digital literacy plus human cognitive, relational and social perceptiveness skills will be increasingly important in a technology-dominated future.

4. Transform business models to stay competitive

Technological advances are creating new economic paradigms which are challenging the business models and physical assets of traditional industry players. Aurecon's research revealed there is an acute awareness that digital technologies and trends will be influential in repositioning organisations and reshaping value chains for many years to come.

Digital technologies and their integration with the physical environment are introducing new business and economic concepts that have never been on the radar. Concepts such as zero-marginal cost economics are now challenging traditional markets like never before.
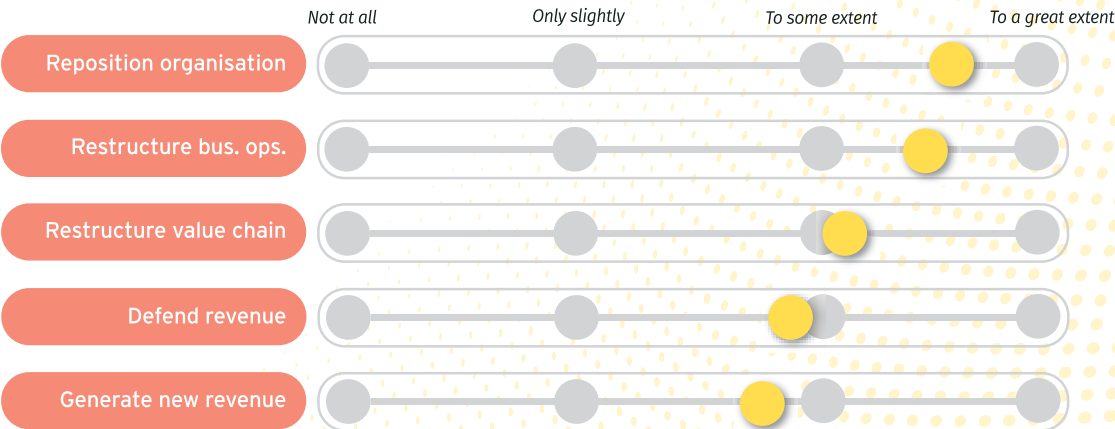
The traditional definitions and categorisations of industries and organisations will likely continue to blur as value chains weaken, reshuffle and reform, and organisations shape their unique future vision to create value for customers. In many cases, this may involve continuously re-adjusting their business model and reimagining the physical assets that support it.

Organisations that can understand the implications of these economic shifts and adapt their business models accordingly will be best placed to thrive in future.

"It is not the strongest of the species that survives, nor the most intelligent; it is the one most adaptable to change."

Charles Darwin,
British naturalist

'Digital' driving core business outcomes

	Not at all	Only slightly	To some extent	To a great extent
Reposition organisation				●
Restructure bus. ops.			●	
Restructure value chain			●	
Defend revenue			●	
Generate new revenue			●	

What futures do we need to prepare for?

Preparing your business and workforce is essential to thrive into the future digital landscape, but what might those futures look like? We interviewed clients from across industries, futurists, and foresight teams, to discover some fresh, bold, insights into the futures that organisations should be preparing for.

"In the future, data has been understood and embraced and used as a building block to connect sectors and prop up the shared economy. Businesses are sharing information with each other, private sector shares information with cities and consumers also share information. Data also makes possible the direct interface between information ecology – the direct connection between humans and the physical world around them."

Stephen Yarwood,
Futurist, Australia

"The future is always as complicated as the present. It doesn't get simpler. Unless we reimagine, we won't get better. I might imagine a future where the digital environment gets faster and more efficient and becomes an enabler, a backdrop, and frees people up. It might be a world where people use and think about information differently...we have moved from long document format thinking, to clusters of data, links between data and different access points for how we get information."

Kristin Alford,
Futurist, Australia

"Digital has changed how people interact with their environment, with shops, transport systems, and the infrastructure around them. Digital trends are going from product to an intelligent connected ecosystem which connects sectors together, so people and businesses can access everything easily, efficiently, accurately and rapidly."

Mohammad Ali Baradaran,
Futurist, Iran

"5G and IoT will be the core connectivity layer that will enable us to build on artificial intelligence and machine learning. The evolution of the network will impact a gamut of industries – from transport in the form of drones, autonomous vehicles and smart city systems, to manufacturing 2.0 with crowd robotics. Imagine a (near) future where one machine can be trained in a manufacturing facility, learn, and train all the other machines doing the same task across the world. IoT will form the backbone of smart urban infrastructure and massive data collection and insights. With the right orchestration and analytics platforms, it will continue to impact and evolve the way we work."

Yvonne Lim,
Futurist, Singapore

"We have seen a number of waves and types of technological disruption, which have impacted different sectors in different ways. Robotics automation, AI, big data and then the mixed reality universe of major reality and virtual reality...spawning new economies like the sharing economy, the on-demand economy and the GIG economy."

Dion Chang,
Futurist, South Africa

"Digital has enabled us to re-platform our methods of communicating, storing and transacting from the physical into the digital realm. It has created connectivity, access to knowledge and given us the capacity to mobilise resources, people, assets. Those companies surviving into the future will have moved fast, operated in an ecosystem rather than behind forts and walls, they are the agile ones, that are open to new ways of working. They are porous, multifaceted and continuously deploy innovation, are willing to test and trial (Amazon, Google, Maersk) and have open mindsets to make things happen."

Pete Williams,
Futurist, Australia

Micro-scenarios

There is no one single future. Multiple versions and divergent paths exist and technology is a key driver of change. The technologies we have today and emerging technologies over the next horizon are challenging the fundamental underpinnings of many industries – let's take a look at what's possible.

Future Energy

Portraying the future will always be challenging given the infinite ways the future could evolve. However, based on current market trends, technological advances and insights from industry experts and futurists, the following is a micro-scenario on how the energy market and its associated technologies, assets and business models could evolve.

At all levels the energy sector is undergoing rapid and major transformation. Digitalisation is simultaneously a driver and an enabler of this energy transformation.

Technological advances in generation, storage, management and trading are fundamentally changing the asset base. The last decade has seen significant shifts in energy technologies, from the rapid deployment of large-scale wind and solar, the widespread adoption of rooftop solar and the emerging use of large and small-scale batteries to firm up supply, through to the emerging hydrogen economy. From a technology perspective alone the energy sector faces many divergent futures. Meanwhile consumer choices and global momentum to decarbonise are only multiplying the complexity that distribution networks face in weighing investment decisions.

Where the historical electricity grid was based on moving electricity predictably from large, centralised, far-flung generators to thousands of remote end consumers, the new grid model is almost entirely decentralised and more fluid. Now, there are many more sources and sinks of energy, at all scales – consumers are now able to generate, store and share their own power, and both localised microgrids and distributed virtual power plants are commonplace.

Already this is creating mini self-sufficient communities, with only weak reliance, if any, on the traditional grid. The rise of the prosumer changes the economic paradigm and challenges the business models and operating models of physical assets of traditional industry players. Where before consumers could be treated as customers, now the prosumer must be considered as a potential business partner.

From silent to smart assets

As coal and **natural gas became a thing of the past**, some assets were decommissioned, whereas others were reused and repurposed in different ways. As external pressures (**such as bans on new residential natural gas connections**) brought closer a reality where assets would be stranded, organisations that explored all viable options were able to maintain value from their assets and thrive.

Poles, wires, transformers, switchyards and substations still exist, but are now underpinned by an 'invisible' twist. Layers of data capture, dissemination and monetisation have been added to allow better use of existing infrastructure and assets – similar in principle to Uber and traffic routing apps, where the cars and roads remain the same, but an enabling platform now exists over the top to better match supply and demand and increase utilisation of the infrastructure. Ageing infrastructure has been upgraded to become 'smart'. Assets now have more intelligent and flexible control systems which have broadened their operating range and decreased operating margins.

From describing the past to simulating the future

As the availability and ubiquity of data in the energy system has increased, asset owners have moved from exploring historic patterns to simulating the future. In a system as dynamic as the energy sector, which must adjust to consumer demand caused by weather and climatic patterns across all timescales, big data and **machine learning have been applied** to understand and respond to mismatches between supply and demand. Applying digital techniques such as advanced analytics and forecasting have helped the system to become more resilient and markets become more efficient.

New technologies, equipment and pieces of kit are now commonplace – advanced inverter tech, static var compensators, renewable energy zones, electrolysers, virtual power plants and synchronous condensers are now all part of the everyday energy lexicon.

How business models have changed

The transformation of the grid has opened doors for business models to evolve and new players to enter the sector. Other organisations have become asset-less, adopting a trading position between demand and supply, taking advantage of improved access to information, improving modelling and forecasting, and taking advantage of zero marginal cost economics of renewable energy.

A key evolution in business models has been the recasting of platforms upon which energy trading occurs. More and more, electricity is under the control and ownership of neighbourhoods, households, or anyone with personally owned infrastructure to store energy, push it back into the grid, convert to other forms (for example heat, or hydrogen) or share amongst themselves. Prosumers have become increasingly savvy in the way they consume and buy power, with the ability to sell excess energy to a neighbour or use their data to negotiate a deal with a retailer when buying their next major appliance – which could very well be an electric vehicle.

Digital technologies have led to greater price transparency and more efficient markets, as more granular, real-time information and analytics have enabled consumers to take a more active role in managing whether, when and how they consume electricity and other forms of energy, which has in turn reduced the need to over-build or 'gold plate' energy networks.

New entrants without large capital investments in the system have moved into the market, such as Tesla, Google and Amazon – players with existing tech, payment platforms, connections and the trust of consumers.

Who has survived and how?

Those creating wealth in this energy future have evolved their business models to optimise value chains and accommodate tech as it emerged. The generators that have survived took advantage of emerging markets and technologies to better manage their assets, unlocking new revenue streams (ancillary services, ramping, load following), reducing costs through digitally-enabled asset optimisation, and repowering, upgrading or hybridising (e.g. with renewables or storage) where appropriate to capture technology opportunities.

The transmission and distribution utilities that have survived the turbulence made early, strategic steps to maintain and increase their relevance in a disrupted market. They explored how to extract value from alternative delivery models for new assets such as unregulated services and renewable energy zones, from better enabling new generation or load (such as hydrogen or battery electric vehicles), and from taking a stake in demand management, orchestration of distributed energy resources and energy management and trading platforms.

Energy retailers that have thrived are those either unencumbered by stranded asset risks from legacy assets, or with enough market power through scale and vertical integration to stave off threats from more agile, new entrant competitors. Retail electricity pricing models have changed dramatically, with a wide range of providers and tariff options available to suit every taste, including bundling of value-added products and services. Retailers no longer make money from selling kilowatt-hours of energy – their profits come from enabling energy transactions, which may be peer-to-peer with neighbours, or with a shared community battery, or from selling a battery electric vehicle...along with the charger, lifetime electricity and financing that comes with it.

The large energy users that have thrived were able to adapt their usage patterns and energy procurement strategy to take advantage of the flood of cheap but intermittent renewable energy sloshing around the grid. With better real-time access to live price signals for the cost of grid energy, large users have put smart money behind managing their demand and storing energy as electricity, heat, hydrogen or other forms to realise big savings in energy costs and create new revenue streams.

Digital skills for future energy

The ability to combine a digital response with first principles and deep technical knowledge of older technologies and systems has been vital for the energy sector. The future of energy infrastructure is one of addition, more data, more systems, more complexity. As these shifts took place, the skills the energy industry needed involved managing the network as an integrated system and making sense of large volumes of data related to those decisions.

Future transport

Portraying the future will always be challenging given the infinite ways the future could evolve. However, based on current market trends, technological advances and insights from industry experts and futurists, the following is a micro-scenario on how the transport market and its associated technologies, assets and business models could evolve.

Transport is not driven by redesigning the system for transport technologies, but instead to accommodate changing needs across society. It is no longer about using a personal vehicle to get from A to B but leveraging a network where first and last mile connections are seamlessly integrated into the public transport system. Putting lifestyles and users at the centre of transport decisions, this optimised and integrated transport network allows for seamless mobility.

A desire for a zero-carbon future has seen the rise of electric vehicles, and hydrogen fuel cell vehicles in the logistics sector, which are quieter and better for the environment than the fossil fuel cars of old. Transport has experienced its fair share of technology hype from driverless cars and electric scooters to drone delivery and aerial taxis.

With a sharing economy and Mobility as a Service (MaaS) in full swing, users, operators and owners have multiple options across all modes, allowing everyone to make personal decisions on how they engage with transport options. Overall this has reduced the footprint of roads in an urban environment. Streetscapes now prioritise active transport and city streets are more pedestrian and cycle friendly. Traffic lights have been removed, intersections are increasingly redundant, and many roads have been transformed into water storage facilities and gardens. The shift from buying personal vehicles to pay-as-you-go vehicle sharing has seen parking lots become houses, hotels and schools, and kerbsides now generate revenue via fees for ride-share pick-ups and drop-offs.

Driverless car technology struggles to interact with the unpredictability of the urban environment. A key shift in the transport system has been to move away from the technology requirements driving the system and thinking of technology as an enabler to place communities at the centre of decision making and planning. Digital technologies have become a tool to understand the users and change our understanding of how and for whom we design transport networks.

From stagnant to dynamic assets

Intelligent transport networks are impacting all transport assets, from roads to tracks, and runways to ports. Assets are changing, most notably with the integration of layers of automation technologies, data, and analytics. Owners and operators are shifting to monitoring their entire network in real-time, predicting failures before they occur, and automating specific functions to ensure optimal operation.

This shift to a dynamic system that can anticipate user needs and self-organise is the key enabler to unlock seamless mobility. Heavy rail is still the backbone of the public transport system, remaining the most efficient way to move mass volumes of people. However, first and last mile connections have been made more effective, enabled by tech connecting different modes and offering greater choice. After 100 years of stagnation, the industry has embraced opportunities available for investment in the operation and control of transport systems.

Thanks to automation, sensing and connectivity, trains now talk to each other (and other systems and modes of transport), run to schedule more accurately, and have increased capacity. Stations have been altered to create more space for more people and faster passenger throughput or to connect with other modes. This dynamic network then enables efficiencies in other sectors. Logistics are more efficient – trucks are never empty and are better connected to warehouses and distribution centres which share real-time data and cooperate in one network.

From technology driven to technology enabled

The flow of data and information is critical, allowing all parts of the network to communicate and provide seamless mobility for users. A train tells a bus it's running late; the bus waits, knowing how many passengers will be boarding; it monitors the temperature outside and turns up the air conditioning to prepare for the heavy load. Meanwhile the traffic monitoring system tells a road user their usual route is congested and that they face a $100 charge to travel on that road. In the same interaction the user is offered free access to alternative public transport nearby. This reduces congestion on the road network and allows the bus to make up the time it spent waiting for the late train.

In this transport future, tech is the enabler to create better outcomes. It allows us to look at the whole network and create an ecosystem where users, operators and owners are informed and can make better decisions. Data, AI, machine learning and automation have given us a better understanding of human behaviour, playing a critical role in how cities have been planned for liveability and growth.

How business models have changed

Cities and governments have created new revenue streams, from surcharges on congested roads, to pricing of kerbside access.

As many facets of the vehicle supply chain have changed or disappeared, organisations have also adapted in order to remain competitive. Petrol stations have evolved to become retail destinations with electronic vehicle charging and hydrogen refuelling for shared vehicles. Car brands have transitioned from manufacturer and seller, to Mobility as a Service providers.

In the public transport sector, mega-agencies have become more prominent, with once disparate organisations (i.e. tram owners, bus owners) merging to form one integrated and connected entity which handles every aspect of planning and operation across the public transport network. This 'one voice' is driving efficiencies, faster response times, and better outcomes for passengers and communities.

Who has survived and how?

Organisations thriving and creating new value in this transport future have understood their role in delivering outcomes which help people connect with the places they want to work, live and play; and have delivered outcomes to make cities and towns function more effectively.

They understand what data they have and how it connects with the broader network. They respond to and engage with new technologies but always put humans at the centre of decisions by understanding what users want and how their needs are changing.

They have evolved business models in line with relevant trends and emerging technology and have upskilled their workforce to ensure their long-term survival into the transport future.

Digital skills for future transport

As transport specialist skills evolve to bring data and analytics into the process of designing transport networks, some traditional roles have transitioned or disappeared. New skills are required to think about service delivery and design fully connected, digitally enabled infrastructure and systems that also address the needs of the community.

Future property

Portraying the future will always be challenging given there are many potential futures that may emerge. However, based on current market trends, technological advances and insights from industry experts and futurists, the following is one micro-scenario for how the property market and its associated technologies, assets and business models could have evolved.

Population growth and urbanisation has created a need for more residential, commercial, social and public buildings within communities. A focus on green cityscapes and healthy living spaces has broadened to encompass the development of sustainable buildings that are ethically produced and environmentally sound, enhancing the user experience.

The property sector, once considered a laggard, has now embraced digital technology at scale and through every aspect of the supply chain. There is a new air of sophistication around how buildings are designed and constructed. The supply chain is digitally connected from start to finish, and buildings now have a 'digital twin' allowing architects, contractors, engineers, owners and operators to see the end product and simulate its use before construction to optimise operation. The increased use of advanced manufacturing techniques in construction means buildings are being designed with an increasing trend towards onsite fabrication using additive manufacturing technologies.

From cookie-cutter to bespoke

Initially when buildings as products took hold, there was concern around standardisation resulting in less control, less choice for customisation and optimisation, and a lack of aesthetic originality. Whilst this may have been the case early on, the proliferation of computational design practices coupled with advanced fabrication technologies and techniques has introduced a high level of creativity and sophistication back into the design and construction process.

New technologies have also given rise to the production of new materials which are critical enablers in creating buildings 'as products' – such as mass engineered timber, and precast concrete and polymers that enable offsite, modularised construction.

The ability to rapidly generate hundreds of design options and select the best within given parameters has enabled high levels of customisation and designs that better suit different environments. New large-scale fabrication technologies, such as 3D printing, now allow these bespoke designs to be constructed efficiently and cheaply, reducing the need to standardise structural and aesthetic components of a building and enabling customers to create their own unique elements.

From disconnected to integrated

Data remains a fundamental asset in the ongoing operation of property assets. Machine learning led approaches take a wide range of datasets into consideration as buildings are continually tuned. These systems, once requiring humans, are now closed loop and self-optimising.

A disaggregated, disconnected construction process is a thing of the past. The supply chain is now digitally connected from start to finish. Designs are no longer passed down the supply chain and recreated and reworked for different purposes. Instead, architects, engineers and contractors all contribute to and build on a central source of truth – a 'digital twin'.

The supply and procurement processes for many buildings are managed and tracked using distributed ledgers. The introduction of these technologies has not only improved the management of building components and their logistics but have also provided transparency into their origin and the conditions in which they were fabricated.

From opaque to transparent

Ethics are now an important consideration in the daily lives of many and there is significant demand for ethically produced and environmentally sound buildings. Growing awareness amongst the public around privacy and surveillance has also seen ethical considerations extend to the digital systems within buildings and their surrounding spaces. Many property owners are seeking to attract people to their buildings by being transparent about what data is captured from occupants, with many buildings now designing in 'exclusion zones' where no data collection takes place.

How business models have changed

Technological advances and commoditisation have led to the emergence of new players with new business models. Large, vertically integrated manufacturing entities have emerged to offer in-house services spanning design, fabrication and construction.

Instead of generating the majority of their revenue during a two to five year building design and construction phase, many property developers have diversified and developed digital systems that allow them to provide ongoing operation and maintenance, which sees them generate significant wealth over a building's 75 year lifespan. Costs are declining and profits are escalating, with assets operating more efficiently and sustainably, and over a longer lifespan, than in the past.

Whilst digital technologies have reduced the energy consumption of buildings significantly, many property assets are now also energy producers. Renewable sources such as photovoltaics and algae facades have created a valuable source of new revenue for their owners where excess energy is traded with others within their precinct or purchased by transport providers to recharge their electric vehicles.

It is now standard practice for business models to embrace buildings which are designed for multiple purposes: residential towers are also quasi-hotels; lecture rooms are industry engagement spaces; office cubicles are tech-laden collaboration spaces.

Who has survived and how?

Organisations that invested in experimentation, diversified their service offerings, tested new business models, and integrated and embedded technology in a different way have thrived. These organisations were able to more rapidly adapt and embrace new wealth generating opportunities to future proof their business in the ever-changing world.

At the same time as upskilling staff in new capabilities, these organisations deliberately focused on external forces, which allowed them to engage with the market, actively participate in the property ecosystem, learn from their experiments and share that knowledge through the industry.

Digital skills for future property

As automation in the property sector leads to less need for skills in traditional crafts such as carpentry, bricklaying and electrical wiring, it has also simultaneously created a greater need for skills in areas such as programming, data science, visualisation, computational design and digital fabrication. Process and systems engineers have become critically important to manage more integrated design and fabrication processes.

Future workforce

Portraying the future will always be challenging given there are many potential futures that may emerge. However, based on current market trends, technological advances and insights from industry experts and futurists, the following is one micro scenario for how the future workforce could have evolved.

There is a strong emphasis on social, environmental and economic responsibility. Workplaces are reconsidering the meaning of work, critically exploring what important human work is, what good work is, where economic value should be placed, what work looks like in the context of the planet and how best to organise the workforce accordingly.

Workplace reputation is now more important than revenue. Talent is such a scarce resource that the ability to attract and retain people is influenced more than ever by how employees experience their working environment. Employees, customers, investors and stakeholders all prioritise purpose beyond profit, and social activism is common in both the public and private sectors.

People have started to rethink what work means, and what it should be. They have reassessed the links between work, craft, income, identity, self-realisation and time. As more robust data has become available around the impact of climate change on health, and the availability of labour has been impacted by a greater desire for improved quality of life, movements such as **downshifting** (four days as the new five), anti-careerism, and 'enoughness' have taken hold. People have become more satisfied with what they have, rather than continually searching for more. There has been a push back against meaningless work, and an unwillingness to accept jobs which have no positive impact on the individual or broader society and environment.

From constant connectivity to digital boundaries

With digitisation at the centre of everything, boundaries have started to appear around technology as people crave respite and the right to be forgotten. A balance between tech and humans has also played out with an augmented workforce that draws on the strengths of both humans and robots to work in a truly collaborative way.

While tech has enabled the progression of the virtual workplace – with 4D holograms sitting next to colleagues – an innate desire for humans to congregate in person has remained. As we have become smarter about building use and human-centred design, workplaces have shapeshifted and have greater interoperability than traditional office buildings.

From inertia to momentum

Successful organisations have adopted digital technologies to codify, productise and commercialise intellectual property in new ways. This has freed up people from repetitive tasks and allowed them to pursue new, more meaningful endeavours, creating valuable new intellectual property in the process. This continuous learning and innovating has allowed forward-thinking organisations to attract, retain and develop talent, enabling them to thrive.

Change has been iterative and rapid, ad hoc and over time, and the organisations that have survived are those that have successfully updated knowledge, mindset, views, skills and technology. They have balanced growth horizons, from the core opportunities of Horizon 1 to the emerging opportunities of Horizon 2, effectively keeping the lights on and experimenting with alternative ways of doing and knowing. The successful transition to Horizon 2 required doing things differently – both in mindset and in work performed. Organisations have embraced momentum, including different thinking, different organisational structures and different systems.

The most significant change has been combining foresight and futures research with workforce planning. Organisations no longer assume that they can simply project their current, increasingly human-robot augmented workforce into the future. Instead, futures research has been used to look at the drivers and patterns of change around organisations and the workforce, providing a collective understanding of potential scenarios and enabling organisations to better determine what they will need in order to thrive, and what actions they need to take to bridge the gap.

Integrated skills will define the future workforce

There has been a major shift in the way organisations think about what is needed in order to respond to uncertain futures. True innovation and results have only been achieved by those organisations that also shifted mindsets to create a workforce with a combination of technical literacy, deep business and digital literacy, human cognitive, relational and social perceptiveness skills.

Employers have moved from the notion of 'hard' or 'soft' skills to a deeper consideration of skills such as:

o   deep and unbounded curiosity

o   collaboration 2.0, with each other and in their ability to dance with robots

o   sense making and confusion endurance

o   complex ethics

o   deep cultural skills: moving from surface level cooperation and collaboration to a much deeper, genuine level

o   tech expertise and ability for detoxing (switching off) from digital

o   systems thinking and understanding

o   cross cultural intelligence, cultural fluency

o   understanding different ways of seeing the world

There has been a shift from sourcing talent from outside organisations to reskilling internally as organisations redeployed and transitioned skills to ensure their survival.

Case studies

How organisations are preparing for these futures...now.

Developing the means to systematically anticipate change and organise your organisation to respond is increasingly important for any business. The following real-world examples demonstrate how a variety of organisations are preparing themselves across the key areas identified through our research, to thrive into their future.

Apply futures research to determine digital investments

Taking a strategic, long-term, systematic approach to current and future uncertainties is a priority for the **Singapore Government** as it strives to keep the country one step ahead. Central to achieving this is the creation of strategic guidance at the highest level of government, a dedicated foresight unit – **the Centre for Strategic Futures** – and a network of advisors across government which feed into the unit. Focused on critical issues confronting policymakers today and over the next 50 years, the unit is tasked to think about future challenges and opportunities, looking for signals which indicate potential change. From increasing nationalism and populism in western politics, climate change or technologies such as artificial intelligence, its impact on jobs and the broader effect on society, this horizon scanning is critical in helping to keep the country agile and ready for the future.

Autodesk's focus on Strategic Foresight is helping the multinational software organisation to anticipate and shape the future. With a dedicated **internal strategic foresight team** they are methodically looking at the future, identifying and understanding the many fragmented indicators for what may be possible, and developing ideas around how to respond. With creative and critical thinking around challenges (such as the future of work, artificial intelligence and machine learning), Autodesk is exploring the changing nature of *design and make* processes and how their customers' work will evolve over the next decade; effectively preparing them to proactively anticipate blind-spots and better understand and identify future opportunities.

Embrace and embed critical technologies

Faced with a protracted manual process to determine maintenance requirements for over 8000km of road, the **City of Cape Town** turned to digital approaches which reduced risk, timeframes and cost. By combining digital leadership and technology including surveying, geographic information system, machine learning, aerial photography, laser scanning and **geospatial** metadata, over 101,000 road segments were digitally captured, validated and tested. Through this approach, road surface area calculations were delivered accurately, confidently and in shorter timeframes compared to a manual approach, which freed up engineers to focus on designing a well-connected city.

Embracing world leading automation on **Melbourne's West Gate Tunnel** gave the industry a glimpse into a future where 2D drawings will no longer be needed in the same capacity as in the past. With the right digital strategy, leadership, team and tools, automating design and developing a single point of truth 3D model sped up the generation of design plans, reduced communication barriers between stakeholders and improved coordination between design teams. It also replaced the need for a fleet of people to manually input data and extract thousands of individual yet highly similar construction plans, and presented new opportunities to build capacity of those people, broadening their skills into new territory and ensuring they are ready for the future, now. In future, this digital information has an opportunity to become a client critical tool which informs their asset management program and asset investment decisions well after construction is complete.

As **ID Architects in Singapore** started to embrace digital approaches, including BIM, they set out a clear position for their ultimate goals and quickly realised that many other things needed to change. The most pressing was a cultural and behavioural shift to enable designers to realise this isn't just about drafting and cannot be done in isolation. Their clear goal from day one informed strategy and enabled meaningful impact for the organisation and broader industry. As a result, now they are working from common platforms and common tools in a truly collaborative and connected environment with many staff modelling in the same way and using consistent visualisation approaches.

Upskill to prepare your workforce of the future

The **University of Western Australia** applied automation to a number of background processes which have created benefits across admissions, human resources and finance processes. With a clear strategy, a solid understanding of what needed to be done and how they were to achieve it, the goal of retaining existing staff was also possible with these new ways of working, following investment in the necessary skills matrix and a program to upskill staff, reshaping and repurposing a number of roles to re-balance the workforce.

For **Territory Generation**, maintaining reliable electrical supply is essential. Keeping pace with evolving technologies – such as battery energy storage systems – ensures they maintain a competitive operational business and have the ability to supply services in the most efficient and cost-effective ways. While automation has come with some rationalisation of jobs, it has also created a more highly skilled workforce through investment in training and upskilling and could lead to more work in the future.

Transform business models to stay competitive

The energy supply industry is undergoing transformative change, and **Powerlink Queensland's network vision** is strategically preparing the organisation to thrive through this transition, and for decades into the future. Underpinning the vision is the exploration of a range of possible future scenarios for the next 30 years which have enabled Powerlink to understand the services that current and future customers will value, and how the network and business will have to adjust and develop. This systematic and future focused approach is pivotal in helping to shape the business and the network's future and ensure Powerlink can adapt and evolve in the face of ongoing change in the global energy industry

In the mobile payments industry, the rapid pace of digital advancements is driving unprecedented change, presenting a critical turning point for organisations to create a roadmap for their future and ensure they are well placed to thrive in this connected, digital age. With consumers increasingly demanding solutions that support their mobile lifestyles, those organisations leading the way are building their capacity to thrive by preparing their people, back-end systems and infrastructure, which power these payment services. By embracing strategic leadership and digital ways of working, consumers and organisations are benefitting from speed, reliability and transparency. They are improving information sharing and interaction, leading to a more effective and seamless user experience, and creating new commercial opportunities.

The future is coming, are you ready to thrive?

The second wave of Our Digital Futures research shows that digitisation will catalyse great change. To flourish through this transformation and into the future, organisations must build their capacity to navigate uncertainty, anticipate change and act effectively. These efforts need to be guided by closely monitoring the changing landscape and looking beyond technology to underlying economic, business and social implications.

The micro-scenarios explored in this report show the common threads of change that digital technologies are influencing and that organisations must adapt to, such as economic shifts, business model transformation, the changing nature of work and consumption.

This research sends a strong message that organisations must begin to reshape, repurpose and retool now, if they want to reap the long-term benefits that digital initiatives can bring. They must anticipate change through futures research to invest wisely, integrate critical tech, build their workforce of the future through upskilling and automation and create agility to transform business models.

As we traverse an increasingly complex digital future, at Aurecon we are committed to ensuring these new insights pave the way for smart digital ways of working which will bring out the best in our clients' operations – and their people – and help them make strides for many years to come.

aurecon
Bringing ideas to life

About Aurecon

Aurecon is a design, engineering and advisory company. Our purpose is bringing ideas to life, to imagine and co-create with our clients a better future for people and the planet.

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