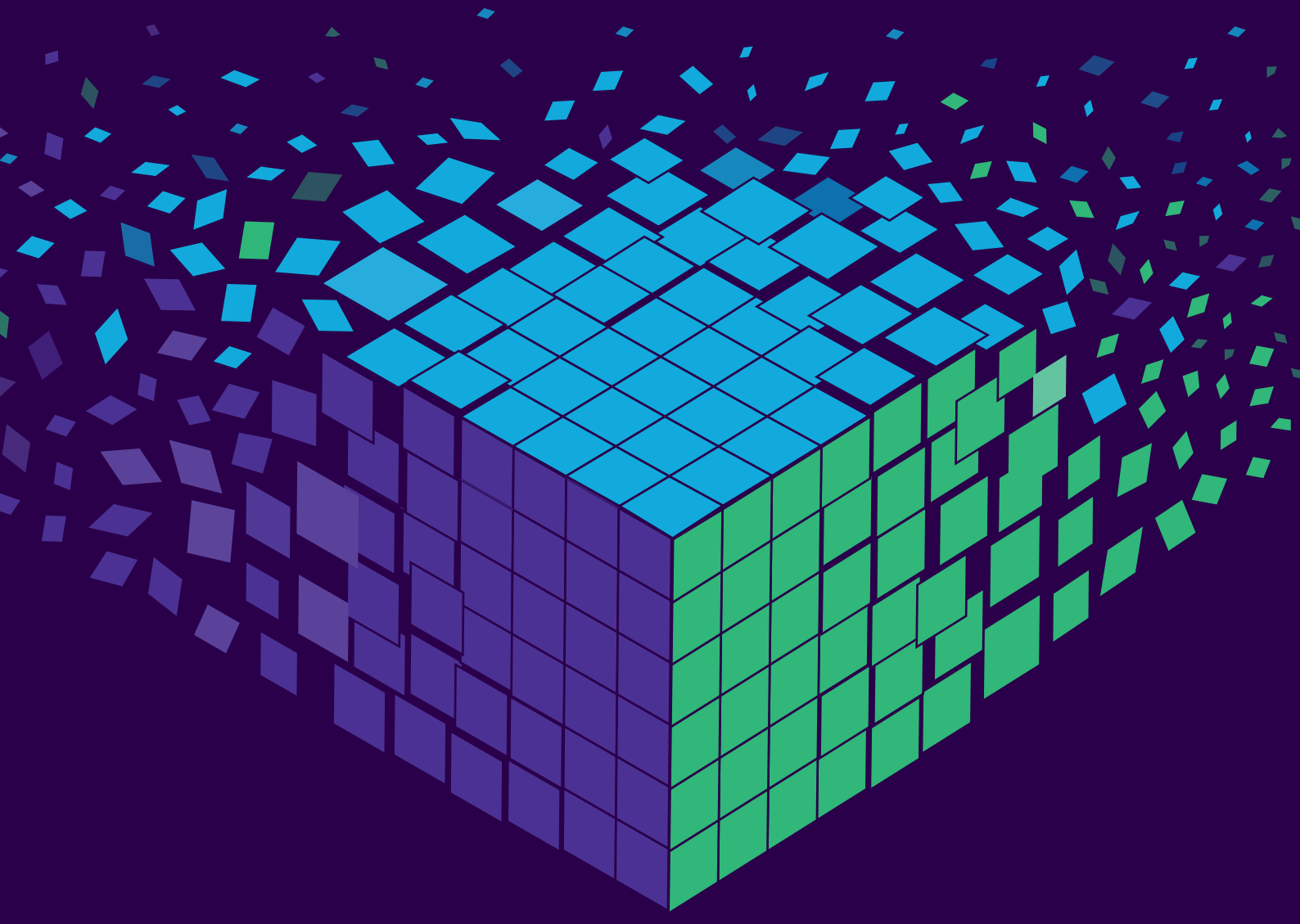
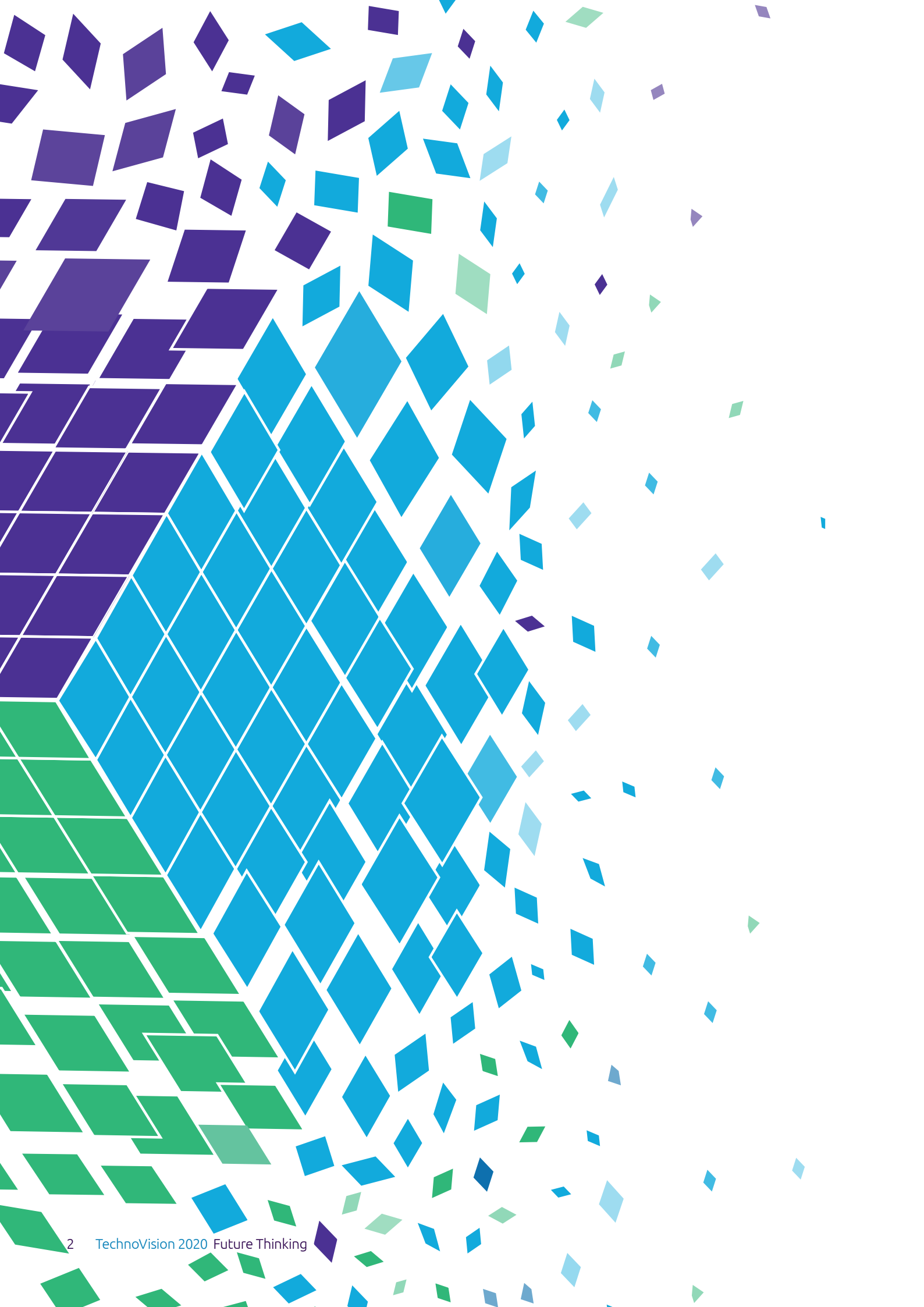
Capgemini

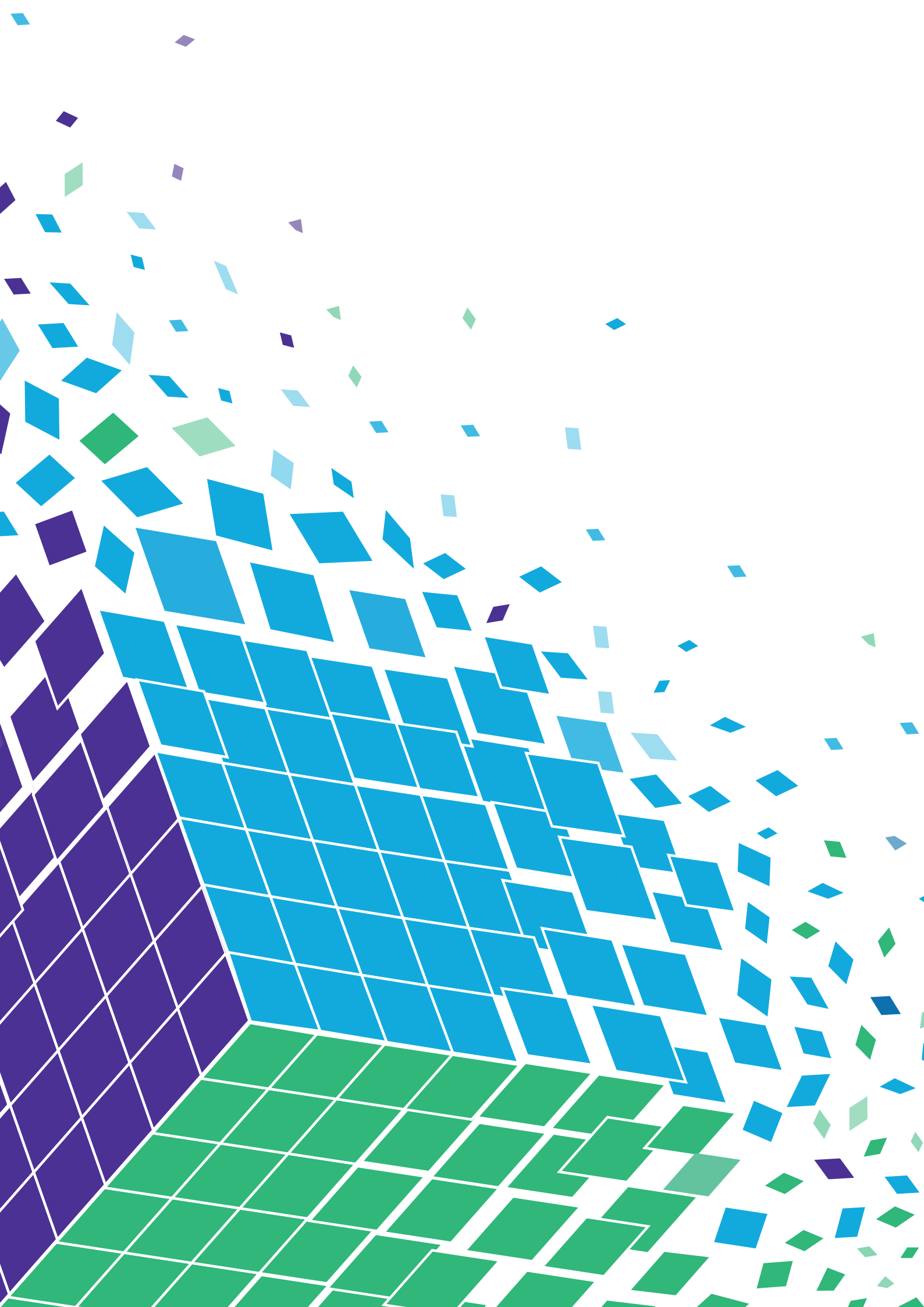
TechnoVision 2020

Future Thinking Simplified





Contents



Foreword

Patrick Nicolet
Group Executive Board Member and Group Chief Technology Officer

Working from home
May 2020

Our vision on Technology is driven by the principle of 'Future Thinking, Change Making'. This two-pronged approach has never been more relevant: we help our clients consider what the future holds; and then translate that into change that fuels growth and success.

The 'Future Thinking' report in front of you helps business executives anticipate and assess emerging technologies as part of their strategy creation. Technology has always been a key lever in a company's arsenal, but new consumer behaviors and macro trends mandate tech-driven innovation as part of any development strategy.

Our approach has always been to equip clients not just for today and tomorrow, but also for ten years' time through an 'architect for change' approach and a simplify mindset. Ensuring readers can anticipate new trends, assess their potential, and through 'Change Making' validate their enterprise-readiness, and exploit them responsibly remains our mission. Today's challenging business environment underlines this need even more acutely.

To generate the insights in this report, we leverage our expertise in Future Thinking from across our Invent consulting colleagues and Technology Innovation Ventures network, capturing trends in our comprehensive technology database and augmenting it with intelligence from our top-ranked Capgemni Research Institute.

I thank my global team of technology and innovation officers and experts who have contributed to this report. Their tireless focus on sustainable innovation underpins the perspectives in each chapter. I am proud of the transformational work they've delivered for clients and continue virtually in our respective lockdowns.

Wherever and in whatever format you find yourself reading this report, I encourage you to reach out. Simple.

Executive Summary

Simplifying the New Normals

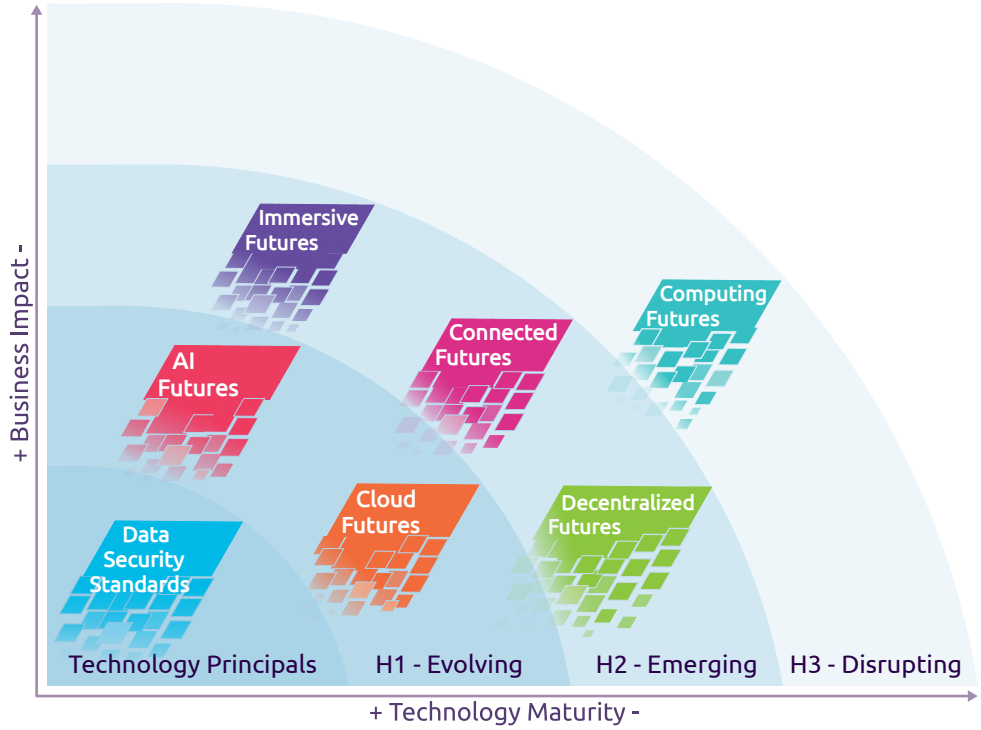
We hear and read it all the time: every business is now a Technology Business. For business leaders, that means they need to be more tech savvy than before to consider the impact of technology on their strategy. That is what this report aims to help you do.

To cope with an environment reshaped by the COVID-19 crisis, enterprises must be agile and adaptable, even 'portable' to new business opportunities. Technology is the key to success.

However, exploiting technology is easier said than done as the scale of change is huge. In the flood of technologies, which ones matter most? Where should you put your money?

We try to support your thinking with a simple framework in four parts. One, for your enterprise, what are the essential technology drivers and where do they manifest – the *Technology Principals*. Two, among the technologies *Evolving* today, which ones should you focus on. Three, among the *Emerging* technologies,

Technology Principals and Horizons



Technology Domains aligned with Future Thinking, in four categories;

Principals; The technology drivers

Evolving; Technologies in wide enterprise adoption but evolving significantly

Emerging; Technologies in limited enterprise adoption but emerging strongly

Disrupting; Technologies not yet enterprise viable, but with big disruptive potential.

which ones will count. And four, among the future technologies, which ones will turn out to be *Disrupting*.

Technology Principals are, in our opinion, Data, Security and Standards, which influence the whole landscape but with notable manifestations in key technology domains.

Data, because it has become your main asset – technology is the way to get data, store data, make the most of data, and communicate data.

> *Data + Artificial Intelligence* = the only way to simplify decision making from vast quantities of information.

Security, because it will keep your enterprise alive.

> *Security + Cloud* = the only way to take advantage of the cloud's immense potential.

Standards, because they are necessary for technology portability – preserving your independence – and for technology interoperability – enabling you to work with others.

> *Standards + Decentralized technologies* = the only way to create your new ecosystems – technology-fueled, not technology-dependent, leading to the idea of the Portable Enterprise, which, amongst the perspectives in this report, we believe is critical. In an age of fast-changing circumstances, being a technology-enabled Portable Enterprise will give your organization the freedom to go wherever it needs to.

Among the technologies *Evolving* today, we suggest you focus on Artificial Intelligence and Cloud.

Artificial Intelligence has now come of age. With data as your main asset, AI will be ubiquitous and will drive developments in Immersive technologies.

Cloud is the platform on which every Technology Business innovation is delivered. Linked with Connected technologies, it equips your company to create new, machine-only environments.

Among the *Emerging* technologies, we suggest you keep your eye on Immersive, Connected and Decentralized.

Immersive technologies will give us an effortless, intuitive way to make sense of data – augmenting and simplifying reality.

Connected technologies, notably 5G, will be your new umbilical cord to the world and power the edge.

We see Immersive and Connected technologies as two sides of the same development – as Connected enables machine-to-machine environments, Immersive will enable humans to interact with this new world.

Decentralized technologies will give you the tools to create new, federative businesses.

And finally, we suggest new forms of Computing will be the *Disrupting* technologies. Neuromorphic computing will let AI fly. More radically, the general-purpose Quantum computer will rewrite the rules of information as we know them.

Each of these four parts will be tackled in turn, after we trace a perspective on Technology Business.

The Technology Business Perspective

> **“Since the start of the coronavirus crisis, experts have talked about adapting to a ‘new normal’. These plans are noteworthy, but a fundamental point is overlooked – markets and companies do not change at the same rate or in similar ways”**

Kariappa Bheemaiah
Technology & Business

Technology and Business: Towards multiple new normals

Forget 'one new normal' – we need a more nuanced explanation of how businesses can use technology to respond quickly to fast-changing market demands.

Out with the old

Since the start of the coronavirus pandemic, experts have talked about adapting to a post-COVID 'new normal'. These plans are noteworthy, but a fundamental point is overlooked – markets and companies do not change at the same rate or in similar ways. The way the airline industry adapts to the crisis will not be not the same way that the retail industry adapts.

> "We will witness multiple new normals as firms match their capacities and resources to new market demands"

A more nuanced view is to consider multiple new normals. Markets and companies have varied challenges, based on their value chains, existing assets and technological maturity. Their adaptations will be based on how they use their resources to overcome their challenges. More importantly, these adaptations will be based on a response to new market demands.

As confinement measures relax in different geographies, new market demands will be created for another short period of time. Hence, we will witness multiple new normals as firms match their capacities and resources to new market demands.

A brave new world

Adapting to uncertainty and changing demands will always involve trade-offs. Prior to the pandemic, firms prioritized efficiency over resilience, so that they could respond quickly to anticipated demands. But as new normals get created, reactivity to new demands means that responsiveness trumps preparedness: speed takes precedence in strategic decisions.

> "As new normals emerge, all firms will need to build for speed"

Take the example of Epic Games. The software developer, which specializes in creating engaging online experiences, saw that people isolating at home due to COVID-19 were hungry for real-life experiences. Epic responded quickly to this new demand in a matter of weeks.

Development teams in Asia created an event for musician Travis Scott on Epic's Fortnite gaming platform. The event was like a real-life concert but included immersive visuals that would only be possible in a virtual concert. More than 12 million people participated in the concert – and its success demonstrates how rapid responses to changing demands can reap big rewards.

As new normals emerge, all firms will need to build for speed by detecting emergent needs, forging new partnerships, and leveraging technology to provide new solutions cheaply and quickly. Such flexible systems might involve a loss of efficiency, but they can help businesses to take advantage of opportunities in ways that optimized systems cannot.

Hand in glove

Technology will be a key ally in helping businesses to survive and thrive in our fast-shifting landscape of multiple new normals. We believe data will be of critical importance – having the ability to detect needs from raw data, and develop measures in response to these detections, depends on having the ability to separate insight from noise.

For example, Texas grocery chain H-E-B used data from Chinese and EU retailers, who were further along the COVID-19 curve, to respond to a shift in demand. They partnered with local restaurant suppliers to fill gaps in stock and distribution. Similar data-based actions are now being executed by actors in plants, supplier factories, distribution centers, and retail outlets. The importance of data will only grow as firms adapt to new normals.

> “Business and technology will need to act as one to navigate new uncertainties”

If the value of data is changing, so is the way it is created and distributed. Decentralized development efforts in combination with incumbent R&D teams are powering technological advances in artificial intelligence (AI) and blockchain. Decentralization and AI provide a scaffold that will help companies to reduce the cost of IT operations and provide new revenue streams. A new modus operandi is being created, where distributed business models and transparent rules of engagement define the balance between efficiency and resilience. For example, the OpenAI initiative provides the ability to leverage a distributed network of developers, data scientists and small businesses to create AI based solutions. Attracting support of big tech players–like Microsoft and their Azure cloud platform–enables AI workloads to be processed at scale, enabling enterprises to access a decentralized development ecosystem and deploy it rapidly to fuel their innovation agenda.

Asking the right questions

We are living in a fast-changing world, where society is the driving force shaping how technology develops. As they apply innovation, business leaders must consider not just technical and economic viability, but also social the desirability and human costs of the tools their organizations use.

Find more here

However, the development of scalable solutions based on decentralization and AI will only occur if clear rules exist that provide clarity to stakeholders and which establish incentive structures. That’s why we believe security and standards will also grow in importance, as it is via agreed norms that ecosystem actors decide who to collaborate with and why. Trust, after all, is a value-generating commodity, and standards and security act as stewards of trust.

Crises are milestones of history that always create new normals. As we embark on a journey shaped by the COVID-19 crisis, business and technology will need to act as one to navigate new uncertainties. This is an undertaking that must be led by executives of the enterprise, to open up vast expanses of global opportunity in an age of multiple new normals.

Technology Principals

Data

Security

Standards

“What are the essential technology drivers and how do they manifest in your enterprise?”

Steve Jones
Data

Luis Delabarre
Security

Dolo Miah
Standards

Expert contributors

Mukesh Jain
Samir Khare

Data

What's yours is mine

Hoarding huge amounts of data inside your enterprise does not create a competitive advantage. The real value from data comes from taking a collaborative approach to analytics.

A significant shift is taking place – one that moves the process of value creation from traditional physical supply chains and towards new collaborations that are based around data-led analytics. For business leaders, this shift represents a threat to the traditional ways of managing and operating on data.

Many businesses today view information as a post-transactional recording of state. The exchange of data between organizations is often simply a functional request for service or the confirmation that a service has been delivered.

> "Replacement of traditional vanguard enterprises by more engaged, data-led pioneers"

In the future, a new dynamic will dominate. Success will be dependent on the ability of organizations to collaborate and provide value through analytics held on disparate data sets. Companies that are unable to engage with these information flows, and add value in the process, will be disintermediated from value creation.

We see the potential result of this disintermediation in the replacement of traditional vanguard enterprises by more engaged, data-led pioneers. Signs of the shift, which we think of as distributed analytical collaboration, are already apparent.

Let's get together, right now

First, the rise of ecosystems. Companies are collaborating to deliver new services and value to clients. An example includes Skywise, an open-data platform for the aviation industry, created by Airbus. Other new ecosystems will emerge, characterized by the generation of new business models that are based around the collaboration of information rather the creation of a physical object or service.

Second, the sharing of information is becoming restricted. Companies might have traditionally looked to share data at low volume to enrich existing datasets. Yet this low-level sharing is incompatible with increased digitization, where the sharing of data ceases to make sense when the data itself is the valuable commodity, and where data sharing risks falling foul of privacy legislation.

> "Collaboration is now about the achievement of outcomes rather than simply the sharing of data"

Finally, collaboration is now about the achievement of outcomes rather than simply the sharing of data. Historically, data sharing has been a single-step process, with collaboration based around the desire to report an outcome. Now, the focus is shifting – successful data collaboration in an age of distributed analytics means working together to achieve an outcome.

Giving your partners a fair share

Yet this shift in data use also creates a conundrum for business leaders. While companies must be able to engage in data-led collaborations, all is not necessarily well. Too many companies still find it hard to make the most of the data they hold.

Internal collaboration remains a key sticking point. Many businesses are unable to use their information across the organization, with data held in departmental stove pipes and disjointed views on customers. The

result is poorly connected departments producing unconnected sales campaigns that rarely benefit from multi-site analytics.

Too many companies also still rely on copying data to enable analytics to take place in a central location. This copying of data is incompatible with the ever-increasing volume of data held by businesses. Organizations will need to find new ways to ensure that analytics takes place on data in real time, rather than having to move it to a single location first to complete analytics.

> "Organizations will need to find new ways to ensure that analytics takes place on data in real time"

In short, we are seeing a shift away from isolated walled gardens of information and towards a new value chain based around negotiation between organizations and their data. This new collaborative approach means analytics must become an active participant in distributed value chains.

Analytics from one organization will need to run on the data of another, without the actual data being exchanged. It also means that these analytics will need to interact directly to negotiate overall outcomes and solutions that balance organizational needs and policies.

Everyone can benefit, so long as we know the rules

So, what will the rise of these collaborative analytic value chains mean for business leaders and their enterprises? We believe that this new area of analytical collaboration will support the creation of even more business models. As companies actively collaborate on outcomes across enterprise firewalls, data sets and geographies, new business opportunities will be identified and created.

> "A new industry based around analytical collaboration design will be needed"

Yet none of this is straightforward. Data security is a significant hurdle. Today, there are no standard ways to define security and policy at the data level, or to establish how analytical algorithms and machine-learning solutions can interpret these policies.

Love at first flight

Airbus' Skywise cloud-based platform allows airlines and their partners to store, manage and analyze data across the aviation ecosystem. By collaborating, airlines can boost operational and economic performance – and you can expect this kind of joined-up thinking to spread across all industries.

Find more here

It's also true that current design approaches focus on the transaction and human, rather than on the data itself. A new industry based around analytical collaboration design will be needed, with fresh ways of thinking about federated collaboration, and how such collaborations will be measured and constrained.

Finally, we will need to establish costing models for the value of data. Just as the market struggled initially to correctly price e-commerce firms against traditional businesses, so new classifications will be required for information supply-chain specialists and the value they create.

Best friends forever

Just as the internet pushed external collaboration around functions, and the cloud moved processing from siloed data centers to federated solutions, so the next generation of information supply-chain solutions will reduce the value of current approaches to data and require firms to adapt to a new business reality.

To prepare for this shift, business leaders must ensure they have an internal collaboration network that supports value creation. If your enterprise cannot use data to collaborate internally, then you cannot hope to collaborate externally.

Security

Protecting the crown jewels from the outside enemy

Cyber criminals and nation-state hackers are out to get your data, but a series of emerging technologies will help your business keep its information safe and secure.

The concept of cloud computing is nothing new to business leaders – its potential ability to deliver scalability and agility to enterprises has been the dominant narrative behind enterprise technology stories for the past decade or more. What is new, however, is that the public cloud – computing services offered by third-party providers over the internet – is now the foundation for enterprises looking to bring resiliency, performance and competitiveness to their core applications.

> "Enterprises that do not embed cybersecurity in their transformation will put their future prosperity at risk"

New technologies with containers – a self-contained unit of software that packages an application's code and its dependencies – at the heart of their delivery approach are already improving the experience of users when it comes to the cloud. Such containerized approaches help to boost developers' creativity and make it easier for enterprises to create truly agile business processes that might finally deliver the business' long-desired digital transformation.

Significant conflicts remain, not least around the requirement for security. When your data resides on the internet, which is also home to cyber criminals and nation-state-backed hackers, you ignore security at your peril. In the connected age, enterprises that do not embed cybersecurity in their transformation will put their future prosperity at risk.

What we believe is that businesses must embrace new solutions – such as confidential computing and post-quantum encryption – to operate with more confidence in our inherently insecure world. We believe enterprises that can leverage security-led business transformation will be best placed to embrace technology-enabled business change with confidence.

Getting out of this right royal mess

To really place security at the heart of their enterprise technology strategies, businesses need to ensure that they do not rely upon long-standing approaches to cybersecurity. These traditional approaches – that bring security techniques to the infrastructure or the application – will not suffice.

The cloud and the rise of serverless computing brings new attack vectors. IT departments looking to protect their business' data assets will have to adapt to a platform-based and ecosystem-driven approach. They should look for new technologies and practices to manage new risks. And they should look for an iterative approach through an integrated development, security and operations lifecycle known as DevSecOps, which embeds security rather than appending it as an afterthought.

Security that's fit for a king or queen

Enterprises that get their security strategy right will be able to enable new ways of working. Think of mobile development, where strong cybersecurity makes it possible to move applications and data between cloud providers in order to take advantage of better performance and prices. Then think of agile development, which has already been adopted in many organizations, but which could be automated through the use of embedded cybersecurity processes.

Enterprises looking to create a new enterprise security strategy that is suitable for our ever-increasing reliance on the cloud and containers will need to embrace unconventional thinking and disruptive solutions. That means looking beyond traditional vendors and towards open-source communities in order to source innovative thinking and best practices in enterprise security.

Embracing disruption also means thinking of how to develop a platform that can provide end-to-end encryption runtime as-a-service, so that only trusted end users can read data during communications processes. Disruptive thinking also means focusing on a new development paradigm, where security as code becomes the norm and enterprises build security processes into DevOps tools and practices, so that developers always think about how their actions affect operations.

> “Organizations need to think now about the longer term confidentiality of their data and the potential for post-quantum encryption”

In addition, we believe embracing disruption means taking advantage of confidential computing, an approach that enables data to be processed without exposing it to the rest of the system thus maintaining privacy. This solution to the problem of securing data that is in-use, is supported by a consortium of hardware vendors, cloud providers, and software developers. It’s a technique that prevents unauthorized access or modification and helps organizations manage sensitive and regulated data.

Finally, embracing disruption means taking account of the rise of quantum computing and the potential to process mathematical calculations at a much faster rate. This faster processing could be used to break certain forms of encryption – and that means organizations need to think now about the longer term confidentiality of their data and the potential for post-quantum encryption.

How to win your battle royale

Cybersecurity threats are in a constant state of flux. Technology continually evolves, as do the techniques of the hackers trying to get hold of your data. As more information moves to the cloud, how can you ensure data security without hindering the pace of innovation?

Find more here

Happy and glorious

As we have already stressed, the use of IT by the business has been built on the core parameters of cost and performance for many years. The continuing digitalization of society, and the associated transfer of value creation to online channels, means that security is now integral to the parameters governing technology implementation. We must ensure security becomes a parameter, too.

> “Build efficient and cost-effective cybersecurity mechanisms that create trust and build confidence between all stakeholders”

As we have stressed, the genie is out of the bottle. We must recognize that the cloud is the new normal for business IT and that cybersecurity threats must be approached in a very different manner. Business leaders must look to their IT departments to build efficient and cost-effective cybersecurity mechanisms that create trust and build confidence between all stakeholders.

Standards

Being open to a change in direction

If you want your business to get ahead, then you can't afford to be dragged back by old technology. Open standards provide a way for your organization to embrace innovation.

The very nature of what business leaders think of as an enterprise is changing. No longer tightly confined to a specific market, the successful business of the future will be collaborative and technology-enabled by definition.

To be agile enough to compete in this highly connected and dynamic marketplace, enterprises will need to take control of their data and technology. They will use this control to participate and innovate in an environment where consumers will receive goods and services through ecosystems.

> "Open standards will allow faster integration, better support, and freedom to switch"

The successful enterprises will evolve from centralized, to distributed, and ultimately to decentralized system architectures to become what we call the Portable Enterprise. And to do that, they will need to embrace the full potential and innovation in open standards and technologies, which become critical for several reasons.

The increasingly connected world that organizations operate in is fostering the creation of customer, client and partner ecosystems. The exchange of data within these ecosystems can only take place through effective use of standards, such as application programming interfaces (APIs).

Business leaders must also recognize that technology continues to evolve rapidly, with innovations being pushed as the new 'must-have'. Skipping the hyperbole and investing in the technologies that address business objectives is critical, as is the ability to protect against obsolescence and drag.

The COVID-19 situation means organizations must be even more adept at dealing with a fast-changing societal and business environment. This needs technology that is agile and resilient to help turn threats into opportunities, and those based on open standards will allow faster integration, better support, and freedom to switch.

How to avoid being held up in traffic

The Portable Enterprise sees standards as a way to enable, rather than inhibit, innovation. These organizations will interoperate seamlessly, exchanging information freely across enterprises boundaries to create new, compelling value chains. They will use open standards to take advantage of new technological innovations quickly – without adding complexity and risk.

Yet before this can happen, enterprises face challenges that need to be addressed. Most crucially, perhaps, businesses carry 'technology debt' in the form of legacy and closed technologies. These older technologies create security and compliance risk due to the cost of keeping these systems running and the dependency on a single vendor for maintenance.

> "Businesses carry 'technology debt' in the form of legacy and closed technologies"

Technology freedom remains a challenge. On the one hand, proprietary technologies have provided attractive solutions to business challenges, but on the other, they can create innovation drag as they are costly to maintain or replace.

The integration of new systems and services is a time and cost sink. Enterprises dedicate too much resource to integration, which reduces their ability to be agile. To achieve growth, business leaders need an enterprise technology strategy that manages risk and is an enabler to exploit opportunities.

Moving into the fast lane

In its simplest form, the enterprise technology strategy has to cover a number of areas: fitness (agility, responsiveness, scalability); efficiency (costs, delivery and operations); resilience (continuity, recovery, overcoming lock-in and obsolescence); and compliance (delivering technology that is secure, trusted and auditable).

A key task is to question which technologies will support the strategy, and which will not. We believe the answer is in looking at technology through the lens of standards. To this end, the delivery of an enterprise-ready technology strategy in the future will be determined by a few key considerations.

First, the strategy must enable fast composition and re-composition of processes and services to enact rapid reactions to business challenges across departmental and technological boundaries. There are approaches to achieve this, including promoting API-enabled architectures that can reuse and change components rapidly when the business need arises.

> “Businesses need to participate in ecosystems of peers with shared trust and security models”

Secondly, the strategy must aim for business interoperability. This should be beyond the technical domain and into business and industry domains. Interoperability in this way (up the stack, as it is known) enables organizations to be collaborative at business, rather than just technical, levels.

Critically, the strategy must support the rise of decentralized ecosystems. This will manifest in the ability of businesses to participate in ecosystems of peers with shared trust and security models. Technologies are being developed to execute processes without being tied to any specific platform, using encryption and validation techniques that guarantee accuracy and resilience.

Take the journey together

Open standards can help your business to collaborate, but all parties must agree on best practices. In open banking, for example, finance firms face a complex mix of standards for application programming interfaces. The answer is collaborative regulation, which can reduce market friction and help firms to innovate on behalf of their customers.

Find more here

Putting your pedal to the metal

Standards have always been a key enabler to technology innovation, adoption and choice. Take the open standards of TCP and HTTP protocols, which have powered the World Wide Web, changing our world and enabling the rise of cloud computing. In the cloud, Kubernetes is now emerging as the de-facto standard for the management of applications. Enterprises, meanwhile, are currently planning for opportunities from a new era of connectivity through 5G, yet another standard.

Technology evolutions continue unbounded, creating a complex landscape which is challenging to decode. Yet one of the constants we see is open standards and this should be factored into the technology strategy decision-making process of the enterprise.

Organizations that embrace open standards and open technologies will be well positioned to weather storms, embrace disruption and experience strong innovation-fueled growth. Now is the time to look at becoming a Portable Enterprise.

Horizon 1
Evolving

AI
Futures

Cloud
Futures

“Among technologies evolving today, which ones warrant focus to realize their value (and before it’s too late)?”

Ron Tolido
AI Futures

Lee Beardmore
AI Futures

Luis Delabarre
Cloud Futures (Acting)

Expert contributors

Yashowardhan Sowale
Sonal Chaturvedi
Jose Kuzhivelil
Ajith NC

AI Futures

AI is the real deal

There's nothing fake about the game-changing impact that artificial intelligence can have on your business processes – but we must consider how humans are affected, too.

Artificial intelligence (AI) is here to stay. Many valuable industrial processes are already unthinkable without it. Yet while AI is often perceived as a way of dealing with repeatable, mundane and error-prone tasks, it is now entering domains that we previously believed were exclusive to humans.

This expansion in use cases creates a surge in innovation opportunities, including augmented creativity, self-optimizing systems tending towards fully autonomous products, and ultimately entire enterprise ecosystems that are 'self-driving'.

Exciting as these opportunities are, there is a need for reason – we must balance the potential power of AI with the human side of intelligence. An ever-increasing reliance on AI demands reliable and assured training data and algorithms. This requirement will ensure that AI does deliver high-quality results, but with an ability to operate within a well-defined ethical construct.

> "An AI-first mindset will challenge the foundations of doing business as we know it, as long as we eliminate any structural constraints that could limit progress"

As AI provides a growing set of functions that surpass human capabilities, we encounter a unique challenge when it comes to applying the technology to our current business models. An AI-first mindset will challenge the foundations of doing business as we know it, as long as we eliminate any structural constraints that could limit progress.

To achieve the right balance between the power of AI and the human side of intelligence, there must be a reinvigorated emphasis on both corporate and individual emotional intelligence and ethics. We believe this focus represents the human antidote to the emotionally detached technical foundation of all AI systems.

We're only human after all

Capgemini Research Institute studies reveal the extent to which AI has already penetrated into business. It is indispensable to sports, retail, customer experience, smart factories, financial services, automotive, and energy & utilities. It might be surprising to some business leaders quite how deeply AI is embedded in daily operations, with many services unable to exist without it.

> "Many organizations are not ready for full AI adoption"

With growing cognitive capabilities ready for addition to highly automated processes, it is possible to radically extend the reach of AI way beyond the currently accepted norm. There are advanced products and services that embed AI to create almost-psychic experiences, seamlessly anticipating the next actions or content required by users. AI also regularly exhibits creativity, producing press releases, sports coverage, marketing campaigns and even works of art.

Yet massive growth in the use of AI also creates a new set of challenges. Many organizations are not ready for full AI adoption. There is a need for a more complete understanding of its potential, an increase in organizational readiness, and a rapid growth in the specialized skills needed to develop and manage the next generation of AI solutions.

The deep dependency on training data – and the AI algorithms that require this data – has triggered fresh

challenges in areas of control, acquisition, management, quality, privacy and ownership. The continued and explosive growth in data means that AI becomes the only viable means of extracting usable insight and deriving viable actions.

> “Ethics must gain greater prominence in framing the purpose that the technology might or might not serve”

Against the context of what seems like the unstoppable rise of AI, ethics must gain greater prominence in framing the purpose that the technology might or might not serve. AI must be transparent, explainable and fair when it comes to thinking about how the technology positively or negatively impacts an enterprise's operational activities.

Finally, with AI now increasingly intersecting with capabilities deemed uniquely human, we must consider fundamental questions about the future workforce and AI-first organization design.

Playing your cards right

In the longer term, the AI productivity gap will be shortened by high-productivity development tools that make the power of the technology available to more people. Marketplaces that offer ready-to-use AI solutions are already becoming a crucial alternative to building solutions from scratch.

But if we promote data and AI algorithms as a key corporate asset, then we should treat them as such – understanding sources and mastering how our organizations can use them.

Creating a winning hand

The pace of effective AI-based interactions is increasing rapidly. AI tools provide ubiquitous and instant support, which often makes it preferable to interact with the technology rather than a human alternative. AI also augments employees with powerful, intelligent capabilities and automation, meaning they can achieve far more.

Raising the stakes

AI and automation are blurring the boundaries between tasks performed by machines and humans. Yet we must also remember the importance of emotional intelligence, which is something AIs struggle to replicate. Seventy-four percent of employers believe emotional intelligence will be a key requisite for success in years to come.

Find more here

But AI-based systems lack two basic qualities: empathy and emotional intelligence. There is a need to develop systems with sensitivity to emotion and to create a culture of complementary coexistence, harmonizing the best of AI and human uniqueness.

An effective balancing act between AIs and humans requires a continuous dialog about the ethical dimensions of AI that includes diverse perspectives. We anticipate that this will pave the way to formalize the proper application of AI.

An ethical approach to AI will help organizations forge new directions, win trust and the continued loyalty of customers – it will help your business to fully reap the benefits.

Cloud Futures

Blue skies ahead for companies that put cloud first

Every technology business will need to embrace the cloud if they want to thrive in the fast-changing environment of multiple new normals, but they must also keep a keen eye on the consequences.

The continued rise of the cloud is not in doubt and the current COVID-19 crisis will even accelerate the rate of adoption. But it is also true that enterprises will need to review their strategies in response to two key factors: first, the ongoing cloud-technology evolution; and second, the cybersecurity consequences.

A breath of fresh air

There has always been a shared responsibility model in cloud with two roles: provider and consumer. Cloud providers have been gradually abstracting their services, which shifts the responsibility of the consumer from technology infrastructure to business services. This shift is ushering in a world of serverless computing; here, the consumer does not deal with the infrastructure (the servers are 'invisible') – the cloud provider decides what is needed and where to run the business services.

> "Shifts the responsibility of the consumer from technology infrastructure to business services"

Providers are adding a portfolio of advanced features to this abstraction, such as artificial intelligence (AI), the Internet of Things (IoT) and edge computing. This is key for enterprises, as it would not be feasible to deploy many of these services outside the cloud. Think of the huge computing and storage requirements for advanced analytics and AI-model training.

The result of these trends for enterprises is higher development velocity; businesses can move from idea to implementation faster. Coupled with low-code and no-code platforms that democratize application development, we come to a point where applications will change as rapidly as the enterprise needs.

Get ready for a change in climate

Rather than relying on a single vendor, enterprises should ensure their cloud strategies leverage features and economics of different providers. This trend explains the increasing adoption of a hybrid multi-cloud approach, where workloads can be moved between clouds and on-premise facilities flexibly.

This flexibility is enabled by containers, a technology that packages an application and its dependencies in a standardized way so it can be deployed and operated across different environments. We now see massive adoption of this technology, similar to that of ocean shipping containers in the 1950s.

> "Workloads can be moved between clouds and on-premise"

However, containers are not a silver bullet. Many workloads cannot be containerized and using cloud-specific services, such as AI, will create dependencies that cannot be easily avoided. The right strategy involves a trade-off between cost, performance and dependency.

Dark clouds with silver linings

While the cloud holds enormous promise, we must consider the consequences of its adoption – particularly around cybersecurity. Placing sensitive data and applications on a third-party cloud platform means the service provider must be trusted to protect data from external threats.

Enterprises must also comply with regulatory requirements, such as the EU's General Data Protection Regulation and the US CLOUD Act. These obligations highlight the complication of holding private data in the jurisdiction of one entity but stored in a cloud under the jurisdiction of another.

Containers add another security complication, as they are still relatively new and will require the deployment of new ways of working, such as DevSecOps teams, to operate securely and seamlessly across the entire lifecycle.

Cloud providers are beginning to offer their own multi-cloud, container-management services. This approach enables deployment to serverless environments but, as the provider decides on the infrastructure to provision the containers, it creates a fresh cybersecurity concern – where is the application executed and where is the data held?

> "Cybersecurity concern – where is the application executed and where is the data"

There are several solutions that exist to address the threats to cloud consumers, but these are mainly focused on data at rest (e.g. stored in a database) and data in motion (e.g. transmitted over a network). The security of data in use (e.g. during execution of an application) is trickier to address, but it is needed in a serverless world where your application and data could be running anywhere.

An answer lies in the form of confidential computing, which enables organizations to secure their sensitive data with greater control. It allows businesses to process their data and applications in an isolated and trusted execution environment, without exposing them to the external environment and even the cloud provider. This concept has taken hold; major cloud and technology companies have signed up to the Confidential Computing Consortium to establish open standards in this area.

A promising alternative is emerging in the form of secure platforms that are not linked to any single vendor or geography – a decentralized cloud that utilizes the integrity, security and resilience of blockchain technology. Companies are right now developing new protocols on top of the World Wide Web, with the aim of creating a world computer that, when it is available at scale, will be innately unhackable and unstoppable.

Right as rain

The emergence of containers and serverless computing creates higher degrees of portability and abstraction. For your organization, that means a new form of cloud provision. As your enterprise uses the cloud to change direction quickly, data sovereignty becomes a critical concern – you must know how and where your data resides.

Find more here

Create a platform to let your organization shine

For business leaders, the traditional parameters of cost and performance in the technology equation must now include security as an equal factor.

The multiple new normals that characterize our future world are not easy to predict. The serverless abstractions introduced by cloud providers promise rapid development and deployment cycles. But the consequence is loss of control and a lack of visibility of where data is processed. This is a critical cybersecurity issue.

Confidential computing provides an answer and will complement the serverless cloud, enabling enterprises to realize the benefits while maintaining trust in the privacy of their critical data and applications.

Horizon 2
Emerging

Immersive Futures

Connected Futures

Decentralized Futures

“Among the emerging technologies, which ones will count?”

Alexandre Embry
Immersive Futures

Sandhya Sule
Connected Futures

Sudhir Pai
Decentralized Futures

Manuel Sevillia
Decentralized Futures

Expert contributors

Gita Babaria
Anwar Athar Khan
Atul Kurani
Ahmed Muhammed

Immersive Futures

Even better than the real thing

Pervasiveness of data threatens to overwhelm humans; immersive technologies provide a way forward, offering fresh opportunities for business leaders to reach further than ever before.

COVID-19 has rapidly accelerated the shift to remote working and the blurring of work, home and social boundaries. From this point there will be no return – even after the coronavirus outbreak is under control.

This swift transition to remote working as a new normal is accelerating Immersive Futures to enable people to deal with global digitalization and the creation of huge amounts of data.

Data is pervasive, not only in the office, but also at home, in public spaces or even in retail stores. The human mind – however brilliant – cannot digest and make sense of this ever-growing volume of data, and immersive technologies will bridge this gap through a human-centric approach.

Technologies such as gesture-free commands, natural-language processing and brain-computer interfaces (BCIs) open new possibilities for seamless interaction with data, replacing the tools we use today, such as keyboard, mouse or even touchscreen. Users will need a natural augmentation of their senses with 'zero touch' interaction and rich 3D visualization of data.

> "The human mind – however brilliant – cannot digest and make sense of this ever-growing volume of data"

The rise of machine-to-machine communications with sensors everywhere will create an environment that not only excludes but that is hostile to humans. The development of Digital Twins in smart factories, meanwhile, will provide intelligible interactions for users. Extended reality technology – such as augmented reality and virtual reality – will be crucial to humanizing these complex environments.

Who needs to press the flesh?

There is a new normal driving the need for these technologies. The increasing complexity of tasks and processes – often involving global travel – is no longer an option for many reasons, not least social distancing due to COVID-19. Businesses that adopt immersive technologies will help employees become more autonomous and address social issues caused by the lack of direct personal presence.

At work, immersive technologies will help employees to train and complete tasks autonomously, such as using natural-language processing to help turn speech into text. These tools will reduce the need for physical collaboration, helping remote workers to feel physically closer than they really are.

The shift from hands-free to gesture-free interfaces through BCIs will help humans to rely less on manual control processes and to interact seamlessly with data. The rapid deployment of 5G networks, combined with continuing growth in cloud computing, will help to accelerate the adoption of these new digital interfaces.

Reach out and almost touch someone

People globally now rely on consumer technologies in their daily lives, a trend that has been hastened by the adoption of 5G, cloud computing and artificial intelligence (AI). Immersive Futures represents a new opportunity for organizations to build on this adoption and to reach citizens in fresh ways.

To reach more consumers – especially the next generation of citizens, who are more culturally, environmentally and socio-economically aware – business leaders must provide exactly what these individuals want: seamless, engaging experiences that are accessible everywhere.

At home or in the street, wearables will offer an extension of AI services that are already deployed in smart homes and cities. This is a chance to help citizens interact with their environments, and data exploitation

by pioneering organizations will drive the creation of new services.

Organizations need to focus on how to deliver digital innovations that replicate and improve customer experiences. For example, using chatbots in a world where digital voice agents and wearables understand and speak our language.

> “Business leaders must provide exactly what these individuals want: seamless, engaging experiences that are accessible everywhere”

In clothing and homeware retail, and also automotive and real estate, customers can now use immersive technologies to visualize products and services in their lives ahead of purchase. From virtual try-ons to 3D-product inspections, technology not only improves the customer experience but allows businesses to reduce the size of showrooms.

We want to be together

Immersive technologies provide the foundation for the ultimate user experience – the one we don’t perceive. As futuristic as this sounds, it relies on technologies that are already on the shelf or will reach mainstream soon. The task for enterprises is to consider how they can exploit these advances.

> “Digitization of experience that has been necessitated due to COVID-19 is a springboard for future advancements”

Enterprises should partner with major vendors and innovative start-ups that can scale their solutions to defined standards. Most crucially of all, enterprises should adopt a user-centric approach that re-imagines processes from the employee and customer perspective.

Bridging the gap

If you want to make sense of our fast-changing physical world, then you need to take advantage of virtual technology. Take the example of Andy3D, a remote platform that allows businesses to create lifelike simulations of physical assets. Find out how your business can bridge the gap between digital and physical worlds.

Find more here

The digitization of experience due to COVID-19 is a springboard for future advancements. Employees and consumers are getting used to improved online experiences everywhere; they expect these technologies to address other concerns too, notably sustainability and safety and how their data is exploited.

Business leaders will need to balance the opportunity of exploiting data through immersive technology with human aspiration – it will need a re-think that getting right will open the way for user acceptance and adoption of seamless interaction possibilities between the physical and digital worlds.

Connected Futures

Making sure that the vital connection is made

There is a huge change happening that is mostly opaque to business. An Intelligent Network is coming that will help your business to boost internal operations and customer experiences.

The rapid response by business leaders to COVID-19 and the switch to remote working has been a beta test for a future scenario, where employees around the world connect and collaborate across disparate networks, devices and applications.

More generally, we see an increased need to provide hyper-customized, connected and Intelligent Networks to support business growth. These developments include connected products in healthcare, the manufacture of autonomous vehicles and the emergence of smart cities.

There is no doubt that a Connected Future driven by the Internet of Things (IoT) and intelligent machines is taking shape. The confidence of businesses in all sectors to run autonomous, mission-critical applications that demand responsiveness and reliability is growing exponentially.

> “Edge computing powering the collaborative intelligence will lead to the resilience and agility that businesses need”

That confidence also comes from advancements in frontier technologies, such as 5G and Low-Earth Orbit satellites, combined with proliferation of high reliability, machine-to-machine communications that are powered by intelligent-edge computing systems.

COVID-19 showed the fragility of our structures and the need to respond rapidly. Converged connectivity solutions, with edge computing powering the collaborative intelligence, will lead to the resilience and agility that businesses need.

Keep your motor running

While IoT is crucial to the Connected Future, the results so far have often been disappointing. Many IoT projects remain stalled at the proof-of-concept (PoC) stage due to technology immaturity, huge investments in legacy systems, and poor ecosystem readiness.

> “Largescale IoT implementations demand a system of systems approach”

Moving beyond PoCs to a truly Connected Future is not straightforward. Enterprises are moving slowly towards end-to-end digitization (e.g. the digital enablement of systems, processes and physical assets). However, progress in this area is essential if IoT is to deliver on its promise.

Largescale IoT demands a system of systems approach, which adopts an event-processing architecture for intelligent machine-to-machine services. The lack of reliable and high-bandwidth networks, and an inability to securely process data at the edge, is a bottleneck to adoption. Managing thousands of connected things is a process that comes with considerable risk exposure.

But even when the vision to embrace IoT does exist, the operating models in many enterprises are more focused on cost control than organic growth. This lack of delivery creates a gap between business functions and technology departments.

Head out on the highway

We have the power to fill that gap and to create Intelligent Networks that deliver a technology-enabled business transformation. By ensuring more endpoints can plug into global flows of information, technology departments can help to deliver our Connected Futures.

> "Ultra-low latency performance required for critical machine communication, such as remote and robotic surgery"

For example in healthcare, the power of the Intelligent Network can enable the ultra-low latency performance required for critical machine communication, such as remote and robotic surgery. It can support data transfers of genome sequences and the use of machine learning, creating data-led insights that enable better diagnoses, treatments and outcomes.

We envision similar advances in all sectors. Our Connected Futures vision centers on three core elements: real-time, hyper-personalized connected products and services that generate continuous value; new business models that are powered by platformization; and improved return on investment, achieved through Intelligent Network systems that are enabled by a business and technology ecosystem.

To operationalize this vision, organizations must focus on several critical areas. Most crucially, IT departments should place the customer at the center of the journey. They should contextualize what the Intelligent Network means for their business. That means defining an architecture for chosen machine-to-machine domains, capturing technologies of interest.

Organizations should also work to develop an ecosystem approach. They should identify the key partnerships – across technology, standards and customers – that will help create the Intelligent Network. Potential technologies for consideration include augmented reality and virtual reality.

Edge computing, where computation and data storage takes place closer to the location where it is needed, is likely to be a key accelerator for this journey. IT leaders that demonstrate the power at the edge will drive the adoption of the Intelligent Network. This emerging architecture should be backed up with platforms that connect people, processes and systems.

Overtaking the opposition

Research suggests highly digitized smart factories could be worth $167 billion in added value to the automotive industry by 2023. However, only one in 10 auto firms are able to reap significant benefits right now. To turn an appetite for change into value, business leaders must explore what connectivity means for their organizations.

Find more here

Reaching the final destination

Slow progress around the IoT so far highlights how the connected age has got off to a sticky start. Faster progress will need enterprises to be bolder when it comes to the design and adoption of Intelligent Networks.

Enterprises must evaluate their potential ecosystem of partners, from technology suppliers to innovative start-ups.

> "Enterprises must evaluate their potential ecosystem of partners, from technology suppliers to innovative start-ups"

Success might mean adopting techniques from other pioneers. It might mean deploying business operating models that are powered by other technology solutions, such as blockchain and the distributed ledger, to help create transparency and trust.

Executives must evaluate the potential of the Intelligent Network now. Reach out to suppliers that are developing systems and networks, and capitalize on technological disruptions that can help you gain a competitive advantage.

Decentralized Futures

A clean break from the past

Business leaders who are fed up with the disappointing results from traditional approaches to IT will welcome decentralization and its alternative way of working.

Decentralization is an opportunity to take advantage of the collective power of disruption and to create new business models across the industrial value chain.

At the simplest level, decentralization is a clean break from the traditional mode of technological development, where power resides with a central authority. In a decentralized architecture, it is difficult – if not impossible – to discern a central authority that governs the technology.

> "Rather than being viewed as a standalone technology, the decentralized future should be treated as a combined and powerful evolution of distributed technology"

The most well-known example of decentralization is blockchain, where records are stored in a distributed ledger, with no central authority. Many business leaders are wary of the hysteria of blockchain, yet decentralization is much more than a one-time technology hype.

Rather than being viewed as a standalone technology, the decentralized future should be treated as a combined and powerful evolution of distributed technology that will manifest through cloud, applications, security and open-source practices.

Decentralization matters to decision makers because it offers an alternative development platform from which new business models can be created, honed and perfected without the need for trusted intermediaries to validate transactions.

Splitting up with old partners

The end goal of decentralization is the creation of a Portable Enterprise. Rather than a traditional business, that is often confined in its operational areas, the Portable Enterprise has the agility to interoperate in a range of business and technology ecosystems, leading to new marketplaces and revenue streams.

> "While a shift to the cloud promised a new way of managing operational IT spend, it has created a new series of dependencies on Big Tech"

That freedom to shape-shift is crucial at a time of constant change, where businesses are fighting to keep a tight reign over cashflow and costs. IT stacks are still way too complex. Among Fortune 100 companies, enterprise spending on IT operations is at about 85%, of which 90% is dedicated to reducing IT complexity.

Vendor lock-in is a big issue, too. While the cloud promises a new way of managing IT spend, it has also created a new series of dependencies on Big Tech. At the same time, the legacy systems that enterprises rely upon are non-scalable – if organizations are going to be able to shape-shift and grow, then they need agile technology solutions.

Decentralization is an opportunity for businesses to achieve their growth objectives. This platform-based and ecosystem-driven approach is a break from traditional Big Tech IT and a way to reduce costs, minimize security risks and avoid vendor lock-in.

Building new relationships

This decentralized way of operating is not a pipedream – the end goal of a Portable Enterprise is moving closer. The trust-enabling technologies that enable decentralized technology – known as the consensus mechanism – have been subject to intense computer science research over the past few years.

This research has improved the performance, scalability and power consumption of decentralized technology. Developments in a number of key technological areas will be crucial to decentralization becoming manifest, including:

- DApps: Developing consensus for decentralized applications (DApps) and smart contracts
- Data and Security: New approaches to organizing, securing and controlling data, and moving towards data-centricity through D-Web, where users keep control of their own data
- Decentralized Cloud: Solving data and complexity concerns through new protocols that help to break the reliance on legacy IT
- Open-Source Enterprise: Adopting open-source culture and best practices; collaborating with open-source communities

The very nature of this technological evolution – bottom-up, decentralized and a move away from the traditional mode of development – means many organizations and their executives might have been slow to notice that a change is happening. Yet the change is real, and every sector can expect to transform itself towards a decentralized future.

Falling in love with decentralization

There are already real-world examples of decentralization having an impact: insurance firms are automating claim and underwriting processes with smart contracts; life-science firms are sharing medical records to speed up clinical testing and drug detection; utilities firms are partaking in real-time energy trading, especially for renewable electricity; and open banking is allowing new firms to enter and disrupt traditional finance markets.

Your industry could be next. We believe that the collective maturity of distributed ledger technology, cloud, data and security mean no business leader can ignore both the threat and the opportunities that decentralization affords. Now is the time to act.

Something you can believe in

Blockchain is an example of decentralization in action, but many business leaders are wary of the hype. Help comes in the form of the Capgemini Swinburne Blockchain Centre of Excellence, which aims to discover innovative blockchain solutions for the business challenges that your enterprise faces.

Find more here

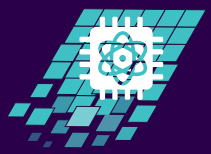
First, look outward – aim to develop new business models that cross sector boundaries. Second, leverage open-architecture models to orchestrate new services that link to decentralized networks and protocols. Third, continue to explore distributed-ledger opportunities at scale. Fourth, look to capitalize on disruptions around open source and connectivity. Finally, set up and operationalize a dedicated business squad to explore new ideas.

> “No business leader can ignore both the threat and the opportunities that decentralization affords”

Embracing decentralization will not be straightforward. Long-established habits are tough to break. However, business leaders must look to break the cycle of legacy modernization, embrace a broader ecosystem of partners and transform their workplaces, so employees can develop niche skillsets and use open-source technologies.

For enterprises that embrace decentralization, the business benefits are great. Decentralization – with its platform-based and ecosystem-driven approach – offers a route to technology-enabled business transformation.

Horizon 3
Disrupting



Computing Futures

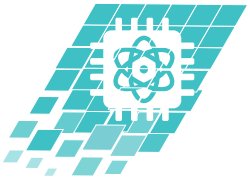
> **“Among the future technologies, which ones will turn out to be disrupting? ”**

Michiel Boreel
Computing Futures

Philippe Sottocasa
Computing Futures

Expert contributors

Julian van Velzen



Computing Futures

You ain't seen nothing yet

Digital transformation is just the beginning – a beguiling combination of bits, neurons and qubits will help push your business into a new age of computer-powered disruption.

We are approaching the end of an era. The existing strategies for creating more compute power for technology systems in business are coming to an end. Yet the demand for power will continue to rise at an unprecedented rate. So what does this mean for your business?

Your company will need new hardware infrastructure to power ever-more sophisticated software systems, with ever-increasing data volumes. Neuromorphic computing and quantum computing systems will fill this void and are already moving from R&D labs to business environments.

> "Start preparing for a Compute-Next reality now that will leverage bits, neurons and qubits in a new platform"

Businesses must start preparing for a Compute-Next reality now that will leverage bits, neurons and qubits in a new hybrid platform. Those that adopt new architectures, applications, tools and skills fastest will have a significant advantage.

Benefits include better risk models in finance, faster drug discovery in pharma, more efficient flows of goods in logistics, faster development of new materials in manufacturing, and better consumer insights in retail. These benefits will come from the ability to build more complex mathematical models through the next generation of computing systems.

Bigger gains from even bigger thinking

For over 50 years, according to Moore's law, computational power has doubled about every two years. This premise has been a driving force of technological and social change, economic growth and overall increases in human wellbeing.

The continuing miniaturization of microprocessor architecture has driven this trend. Miniaturization reached the five-nanometer level in 2020 and, although one additional step is envisioned to three-nanometer, we are approaching the boundaries of what is physically possible.

New approaches – such as high-performance cloud computing, neuromorphic computing and quantum computing – are actively being explored. These new approaches rely less on miniaturization and use different principles to create further gains.

Neuromorphic computing – which uses large-scale integration systems to mimic the human brain – offers a natural fit to artificial intelligence, the application of which supports developments in a host of computing-intensive areas, such as the Internet of Things, Industry 4.0 and Digital Twins.

> "Classical computing will also continue to evolve, leveraging both neuromorphic and quantum computing to create a hybrid computer"

Quantum computing, meanwhile, combines quantum physics, information theory and computer science to create a new field of computation. This new field makes it possible to simulate processes through complex mathematical models that were not considered feasible before.

Alongside these advances, classical computing will also continue to evolve, leveraging both neuromorphic and quantum computing to create a hybrid computer that can prepare, process and store ever-increasing amounts of data. This trend will be supported by advances in software abstraction that will allow us to distribute computing to the cloud.

Developing new ways to carry the load

We believe that the future of compute is not a choice between neuromorphic or quantum computing, but instead a hybrid combination. Businesses will apply the most suitable method of computation dependent on the characteristics of the problem at hand.

In the majority of cases, this will be a combination of bits, neurons and qubits. Neuromorphic and quantum computing will work in synergy with classical super- and high-performance computing. Here, classical compute systems will provide storage, process data and orchestrate workloads between specialized hardware.

In the next three years alone, we will enter into the exascale computing era, where systems will be able to perform at least one exaflops, or one quintillion, calculations per second. The exascale computing era will open an avenue into the exploitation of neuromorphic and then quantum computing.

> “An alternative software stack is required to make the best use of future compute approaches”

But the effective combination of bits, neurons and qubits will require a unified, cross-technology programming environment that helps developers get the most from their applications, without having to deal with each logic’s complex specificity.

That means an alternative software stack is required to make the best use of future compute approaches. The stack needs to not only deal with the massive parallelization of processing threads, but also the different processor architecture requirements. We believe that new classes of middleware will help to prepare data and program algorithms.

Furthermore, for hybrid computing – which lies between the new era of bits, qubits, and neurons – additional software will be required to orchestrate computational loads. That includes tasks such as hardware control, data persistency and advanced job scheduling.

You’ve got the power

Thanks to developments in quantum technology, computing power will continue to increase. Now is the time to think about how your organization will take advantage of this abundance of power. Find out how you can use this new computing power to push ahead, rather than being left behind.

Find more here

Here’s something you’re never gonna forget

The technology stack is developing, yet successful applications of this new era of computing will necessitate expert knowledge of software and hardware layers. Taking advantage of these emerging technologies will not be straightforward. Business leaders should recognize that their organizations need to start investigating Computing Futures now. The technology change will be as disruptive as the IT revolution of business in the early 1980s.

By using frameworks, patterns, and building blocks that are developed in close cooperation with strategic technology partners, organizations can start to experiment and become more efficient and successful in these areas of emerging computing technology.

Conclusion

We hope that the perspectives traced in our report support your Future Thinking.

Please allow us to leave you with three thoughts and one recommendation.

The first thought is that technologies in isolation will not be the pillars of your business; their combination makes them powerful and business-shaping: Data *and* AI, Cloud *and* Security, Immersive *and* Connected…

The second thought is that technology enables the collaboration with your enterprise that your customers and partners are looking for: chains of services, continuous dialogues, multi-faceted relationships.

The third thought is that technology can make your company portable: from opportunity to opportunity, from market to market, from one normal to a new one.

The recommendation is, no surprise, to move to implementation, to another stage of your transformation.

To support your teams, we suggest they use our guide for technology implementation, TechnoVision Change Making, launched in 2007 and enhanced every year through experience of applying it with over 1000 clients. As a result, it provides a systematic and playful way to map technology to the enterprise systems, and a guide to the ways and means to create, or further transform, Technology Businesses.

Thank you for your interest, and we stay at your disposal.

Acknowledgements

Dolo Miah
Head of Enterprise Readiness

Pierre Hessler
Capgemini Fellow

Bobby Ngai
Charlie Weibel
Jay Kartha
Jerome Buvat
Kai Schroeder
Manas Kar
Pratibha Sharma
Rakesh Biswas

With special thanks to **Mark Samuels** for his valued input.

Capgemini

About Capgemini

Capgemini is a global leader in consulting, digital transformation, technology and engineering services. The Group is at the forefront of innovation to address the entire breadth of clients' opportunities in the evolving world of cloud, digital and platforms. Building on its strong 50-year+ heritage and deep industry-specific expertise, Capgemini enables organizations to realize their business ambitions through an array of services from strategy to operations. Capgemini is driven by the conviction that the business value of technology comes from and through people. Today, it is a multicultural company of 270,000 team members in almost 50 countries. With Altran, the Group reported 2019 combined revenues of €17billion.

Visit us at

www.capgemini.com/future-thinking

People matter, results count.

The information contained in this document is proprietary. ©2020 Capgemini.
All rights reserved. Rightshore® is a trademark belonging to Capgemini.