
What the world will look like after the COVID-19 crisis



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This report anticipates what the world will look like after the COVID-19 crisis, since some deep and long-lasting changes are expected as we approach a “new normal”. It is the result of work by experts from our Atos Scientific Community, who have been actively analyzing the topic since the early days of the crisis.

Several aspects will become singularly relevant. Remote collaborative work will be a new social norm; those who were averse to it will have to adapt quickly. Cybersecurity will be even more critical since vulnerabilities are increasing. Traceability will also become a major issue and Internet of Things and Blockchain technologies could play an even more prominent role. Supply chains will be strongly reshaped in the coming years, both in the physical world and in the data world, with digital sovereignty gaining considerable relevance. Finally, decarbonization in all production processes, including digital, will sharply accelerate.

The document is intended as a thought-provoking exercise for readers, not a comprehensive analysis.

Please read on to find out more about our vision for the world after the COVID-19 crisis.

The post-crisis scenario

Recovery prospects

The COVID-19 crisis has been severe at a human, healthcare and societal level, and the outlook is challenging in the short and medium term. It is already having deep economic repercussions for individuals, business and nations. In addition, it has come at a moment when the economic and financial scenario was already in turmoil (inverted yield curves, disruptions in the repo market, pre-recession in several countries, etc.). Some countries seem to be weathering the storm better than others, but it remains to be seen whether this will bring them any power and productivity advantages, or whether a global recession will overshadow their performance. The current virus outbreak is likely to be the first of several waves; even if we manage to contain it now, it can resurface. Therefore, despite the extraordinary monetary and fiscal measures announced, we do not expect a V-shaped recovery, but a U- or L-shaped recovery. We also expect a "new normal", not a "going back to normal".

Important challenges ahead

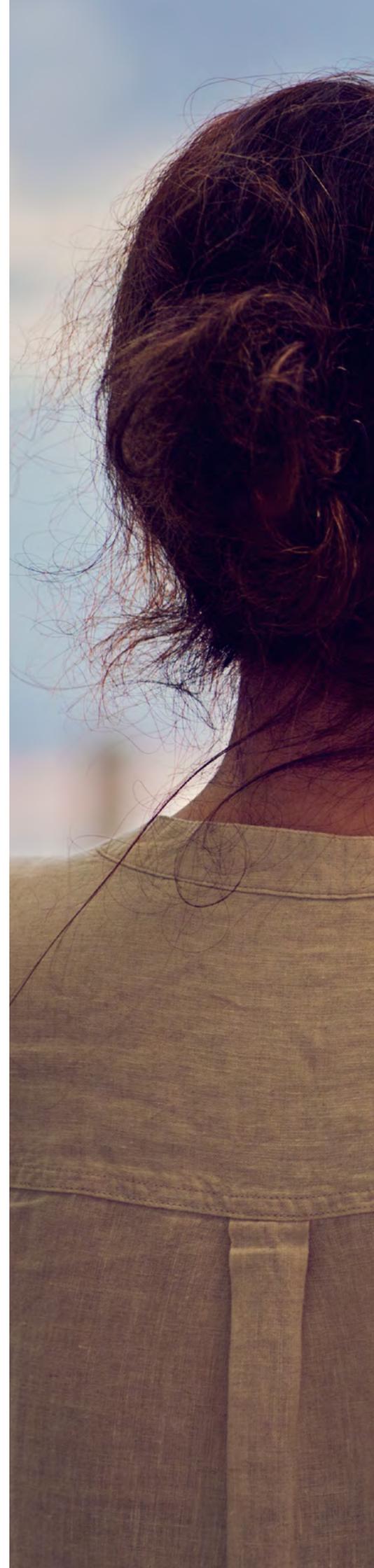
We face an economic paralysis, quite widespread in the second quarter of 2020 and probably spilling into the third quarter, with double-digit GDP decreases globally. Activities like travel, tourism, retail, restaurants, cinemas, etc. have already been hit very hard. Despite extraordinary measures, many small and medium size businesses (SMEs) may be wiped out, while unemployment is surging. We may see a number of private industries taken under public control. Such extraordinary measures will result in yet more debt (public and private) so, coupled with the ageing of some societies, we face a risk of Japanization¹. Financial markets, including currencies, will continue to be volatile. The stock market

crash may have huge impacts on pension schemes, further exacerbating the funding black hole that corporates and governments are expected to fill. In addition to the COVID-19 and financial crises, the ongoing oil price-war impacts Oil & Gas companies amongst others. Some Business-to-consumer (B2C) platforms like Airbnb and Uber have been hit hard due to the freezing of people's mobility, while others with a delivery or logistics focus have fared better and may boom. The crisis has shown that key aspects like digitalization (ultimately, agility and flexibility) or business continuity were not mature enough in many private companies. At a public level, once again we observe that many societies have failed at preparedness and early response.

Is there a model for crises?

In the Atos vision Journey 2024, to be released soon, we analyze in full detail this type of situation. Besides COVID-19, there are high probabilities of disruptive events, which we call "event horizons", some of them potentially positive but others potentially catastrophic – and all of them quite unpredictable. Also, huge disruptions may be triggered by very small changes – something that we have modelled as "cusps" (based on mathematical [chaos](#) and [catastrophe theory](#)). Cusps are surfaces that show how small changes in trajectory can result in either smooth outcomes or deep discontinuities. Applying this model to the current crisis, we believe that effective [risk and crisis management](#) efforts will enable the transformation of unpredictable event horizons into challenging but manageable cusps, which can be navigated with appropriate strategy and flexible execution. Customers will be attentive to this approach, to prepare future crisis management.

¹long-term over-indebtedness, stagnation and deflation





Implications for Industries

Financial Services & Insurance

For banking and insurance, the outlook is negative for the next trimesters, and uncertain after the crisis. Very low interest rates, lowered consumption (i.e., less consumer loans and mortgages) and surges of unemployment (i.e. more defaulting loans) will be the first impact in the banking sector. Insurance faces similar challenges from all manner of claims - travel cancellations, unemployment, business interruption, etc.

Incumbents in both sectors can be displaced by non-traditional competitors, since some participants in industrial digital platforms will be better able to calculate risks (and therefore loan prices or insurance premiums). The new entrants are also less likely to be constrained by historical commitments. Some FAANGs² could take advantage of incumbents' weakness to launch financial services. If international or national monetary authorities launch or endorse digital currencies, the role of banks would be deeply questioned; they could face a profound redefinition or disappear.

There could be significant M&A activity in the financial sector for consolidation, perhaps cross-country ones within the EU. There could be opportunities in full digitalization, both for new products and services (personalized loans or premiums, micro-insurance, micro-investing) and for efficiency (all types of automation).

Healthcare & Life Sciences

These sectors are experiencing a boom. In Healthcare, the crisis is revealing two key facts: there was excessive cost-cutting post 2008 (with remaining resources and capacity proving to be quite insufficient during the crisis), and the sector has not extracted most of the benefits of digitalization - it is still riddled with inefficiency and insularity. Therefore, investments are likely to take place such as equipment for hospitals, telemedicine and remote care.

Life Sciences have been a sector in themselves, but the crisis is bringing some areas into the public eye and to business: the importance of epidemiology, molecular research for finding vaccines, treatment personalization (predicting the effect of several medicines in persons with different co-existing diseases), etc., and may bring genomics to a similar status soon. Some of the traditional stringent conditions for drug development and testing are being and could continue to be relaxed in a controlled manner for specific diseases or episodes.

Manufacturing

With depressed consumption, some areas of manufacturing may see markedly lower activity. However, there will be opportunities in the sector, especially after having witnessed the power of adaptability and flexibility (such as car or vacuum cleaner factories manufacturing respirators during the crisis). Another source of opportunity is a likely partial rewind of globalization (re-localizations) for financial and sovereignty reasons: the manufacturing of certain items could be moved back to national soil, especially key products with very few or only a single vendor in the world. Adaptability, automation and Industry 4.0 will be key to bring such flexibility.

Automated Guide Vehicles, robotics and similar solutions may boom. Demand will increase for solutions for remote work, training and education with technology such as virtual reality or augmented reality. As people realize that remote work is perfectly possible, older cohorts may join younger ones in disregarding cars as an absolute necessity. This would negatively impact the automotive sector for regular cars. For autonomous vehicles it could mean either decreased demand (people wanting to commute less) or increased demand, if the ownership pattern transforms into a use pattern - people not wanting to own a car or to drive it, but not minding commuting in an autonomous vehicle.

²Facebook, Apple, Amazon, Netflix, Google



Public Sector & Defense

In the crisis, the public sector seems to be responding well and regaining at least some of the good reputation that had been eroded lately³. Together with fiscal and monetary measures, this gives them good momentum to advance in digitalization, catch up with the private sector and increase public services with controlled costs. Defense and sovereignty activities will surge, and governments may well call the shots in a highly debt-constrained economy.

Governments should provide conditional aid to affected stakeholders. Due to electoral pressure, governments may have the incentive to provide aid that will be used to pay wages, interest, rents or other short-term obligations which are not productive or conducive to a transformation of the economy. Government aid must not be used to re-start business with the same weaknesses they had before the crisis, it must be conditional on restarting business in a positively transformed way. Government aid must become the driver for the digital transformation of the economy – across all enterprises, companies (large, medium and small) and freelancers. Specific guidelines for adequately channeling aid can be derived from this paper, such as data-driven companies, digital industry platforms and ecosystems, true digital workplace capability, remote working, automation, traceability, etc.

There could be a push to IMF- or national government-sponsored digital currencies (not Bitcoin), as well as a big push toward totally cashless societies. Traceability of income could then be pursued in order to reduce tax evasion and fraud, and enable targeted, personalized support to individuals and businesses. Nationwide and international Security and Identity Management systems will be a key foundation of this. The financial and demographic pressure on public pension schemes will continue.

Energy, Utilities, Retail, Transport & Services

These industries are being very negatively impacted by the crisis. In Services, activities such as travel, tourism, leisure and outdoor entertainment are frozen, and may experience successive freezes if the virus reemerges. Many of the small, bricks-and-mortar players can be wiped out. Conversely, all virtual, digital counterparts or alternatives to those activities may surge – if the experience is good and the pricing reasonable. Delivery and logistics companies may also experience a boom due to the decreasing physical activity of consumers.

The energy grids are responding well in the crisis, but they could be strained, as they are coping with changes to the balance of renewable generation and mass electrification. Significant changes will be necessary to accommodate the new ways in which energy is generated, stored and consumed. With the oil price war, the Oil and Gas sector may accelerate the transition to renewables, including the rise of a whole new hydrogen economy. Also, the current activity freeze is clearly showing how [pollution drastically decreases when human activity decreases](#) – so Climate Change detractors may lose traction. If the extraordinary fiscal and monetary measures are well coupled to the [Green New Deal](#), decarbonization will gain even more importance.

Telecom, Media and Technology

The Telecom, Media and Technology industries are likely to be positively impacted, but the telecom network is having to prove its resilience. For example, digital media giants like Netflix or YouTube lowered the quality of their streaming and contents in Europe to avoid network congestion during lockdowns. This could favor additional and larger investments in NFV (Network Functions Virtualization) and 5G, which would also help generate jobs. The crisis is bringing forward the timeframe in telecom strategies and consolidation could take place.

Many broadcasters have seen ad revenue decline, which could remain low until economies fully recover. The outlook is favorable for digital media and content, following the expected rise in remote work, remote training and digital entertainment – with a trend toward remote and efficient production. Some firms invested heavily in sports, and are being negatively impacted by the cancellation or postponement of tournaments and live events. The situation will improve as competitions are resumed, and it remains to be seen whether eSports may permanently occupy some niches.

The crisis has triggered an appetite for veracity that could end up translating into a fight against fake news – and a possible return of the experts and decline of the celebrities. Technology is on the rise, probably with additional focus on user experience (UX), accessibility and any other facet of “technology for the people”.

³Some had questioned the value of the Public Sector since it was perceived as non-innovative or flexible enough – a late adopter of digital transformation. With the crisis, the value of public healthcare, public security, the armed forces, etc. – and their capability to respond fast and effectively – has become evident. In addition, governments and central banks have stepped up to rescue or help private companies and households. As a result, we anticipate a strengthening of its reputation.

Transversal implications

The crisis is likely to bring a lasting reshaping of important elements of the world, so our thinking should not be limited to immediate implications. The following sections explore areas of activity and technologies which can bring transformational impacts to businesses and societies.

Complete digitalization

An obvious result of the crisis is that companies need to accelerate and mature their digitalization, and to master business continuity and flexibility. This includes digital platforms, automation, workspace aspects and much more:

- **Redefinition of purpose and strategy:** up to now, the private sector has tended to focus too much on efficiency (doing things right) and not efficacy (doing the right thing), so purpose and strategy may well benefit from rethinking. In terms of strategy, most companies need a new one, 100% digital. "Digital strategy" is an obsolete term, since any valid strategy must be digital native by now.
- Accelerating the **transition to the Cloud:** large companies were first resistant toward the Cloud due to security or data ownership concerns. Then they were overwhelmed by the size and complexity of the move: huge legacy application and data landscapes on one side, and lots of Cloud-enabling vendors, tools and technologies - often complicated on the other. As a result, the COVID-19 crisis caught them, at best, in the midst of cumbersome migration efforts. Organizations need to leverage the crisis to accelerate Cloud efforts, toward a flexible hybrid Cloud. The crisis showed that even big names in webscale computing had [trouble adjusting quickly to growing demand of public Cloud and Cloud-based services](#), which forced them to prioritize attention to customers (health before other sectors, some regions before other regions, etc.). This is an argument in favor of hybrid Cloud as a final state, not as a mere intermediate step toward full public Cloud. Organizations need to wisely balance applications and workloads between private and public Cloud - and among several public Cloud providers, not just one. Another strong argument in favor of hybrid Cloud is the need to have full control over critical applications to guarantee business continuity in times of crisis. Organizations need to reflect on their value chains to decide what needs to be done internally and what can be outsourced.
- From **physical to virtual:** some activities that have traditionally been physical could be replaced by virtual ones, such as [remote assistance to field workers in industry](#), training, assessing damage in houses or industries, telemedicine, etc.
- Enabling true **data intelligence:** despite marketing messages, most companies do not take advantage of and extract the full value of their data. The problem is multi-layered: data hoarding (cultural); fragmentation of data in corporate logical and organizational siloes (organizational and infrastructure); issues with data quality, lineage and governance (data management); lack of skills (talent); issues with Artificial Intelligence-Machine Learning (AI-ML) model creation, management and explainability (AI-ML management); disconnects between data scientists, data engineers, developers and business (strategy and organization).
- Enabling true **knowledge management and collective intelligence:** on top of data intelligence, the human side has long been neglected in many companies. Efforts to extract information from siloes into corporate data lakes must be accompanied by efforts to make implicit knowledge explicit, to substantially improve search capabilities, by tools to find the right person for a specific question or task, by tools to help people connect to each other, etc. These efforts need to be data-driven, relying on Natural Language Processing (NLP) and semantics approaches (ontologies, knowledge graphs) but with a high degree of automation to avoid the traditional pitfalls of NLP and semantics - lots of manual labor to build and maintain ontologies and knowledge bases, to fine-tune the tools to a specific use case (losing generality for future potential re-use), etc.

Since humor often reveals uncomfortable truths, here is a bit of recent Internet humor to finalize this section:





Transversal implications

Digital Platforms and Ecosystems

Organizations need to achieve **digital capacity and flexibility** with digital platforms and ecosystems. Companies will need to focus more on their core business and purchase or broker non-core services from third parties, creating or joining platform-based ecosystems, and leveraging on the ecosystem to acquire scalability and flexibility. For example, not owning huge data centers and instead moving to the Cloud; not owning large fleets and instead relying on partners for mobility, etc.

Industry (B2B2C) platform ecosystems will be a huge enabler of dynamic and robust value chains. There will be opportunities in creating platforms for large customers or combinations of them, to create value from synergies and data sharing. For example:

- A large industrial company, plus a large bank or insurance company, to boost an industrial sector, providing tailored insurance or financing.
- Public and private health stakeholders, plus insurance companies, to enable shared data for healthcare and associated services.

Some B2C platform models such as Airbnb or Uber are facing difficulties due to people's extremely reduced mobility during lockdown - and to the fact that they ended up as

vehicles for regular business (people owning multiple cars or flats) rather than a sharing economy (people sharing temporarily their main car or residence). Other B2C platforms (e-commerce, logistics) may have thrived, as lockdowns constrained physical shopping.

Altruistic models and platforms could also emerge, to enable a shift from donating money to donating content, time or skills. Such platforms could be publicly or privately owned or sponsored.

Some vertical considerations on industry data platforms:

- Industry data platforms will be an increasingly important concept for orchestrating trusted sharing of valuable data. Particularly in **Manufacturing** they will be the cornerstone for more robust and dynamic supply chains. The COVID-19 emergency has proven that existing **supply chains** were too geographically spread and too siloed, with most of their participants operating as islands. After the emergency, we expect some relocation of segments of the supply chains (to regain ownership), and the use of industry data platforms to allow end-to-end visibility of demand requirements, sourcing choices and all intermediate steps. They will enable managed data sharing among the supply chain participants, which will provide the necessary control and trust - which was absent in certain critical moments of the crisis. Industrial data platforms will also be the protectors of Intellectual Property

and help turn otherwise competitive relationships into value-add cooperative ones. The resulting data-platform-based supply chains will be a key enabler to traceability efforts.

- In the **healthcare** industry, more effective and widespread Health Information Exchanges will be critical for dealing with future pandemics and addressing the general efficiency and efficacy of medical treatments and care. Data privacy concerns have up to now been something of a blocker to Health data exchanges. Auditable and regulated platforms, coupled with new data exchange legislation that could be expected post COVID-19, will reduce the constraints of these inhibitors.
- Within the **Energy and Utilities** sector the significant changes resulting from the growing trend to renewable generation and sustainable microgrids, have created a multi-sided marketplace for production and consumption of energy - particularly electricity. Energy and Utilities data platforms will be essential for maintaining the integrity and security of the grid network.
- The **Financial Services** industry will have a real challenge to recover quickly from the underlying economic collapse that is accompanying the pandemic. Rebuilding trust and creating resilience will require economies of scale, anti-fraud collaboration and data transparency / auditability. Existing PSD2 regulations will serve as a



further catalyst for a fresh wave of open banking platforms, bringing much needed innovation in this space.

- The **Telecom** market has already been somewhat virtualized by MVNO's (Mobile Virtual Network Operator) and NFV technology. The current pandemic has emphasized the criticality of IT and OT networks in maintaining core services and allowing working flexibility. As 5G becomes more widely deployed, the range of over-the-top services that are expected to emerge will require multi-sided platforms for their delivery and monetization.

Workplace

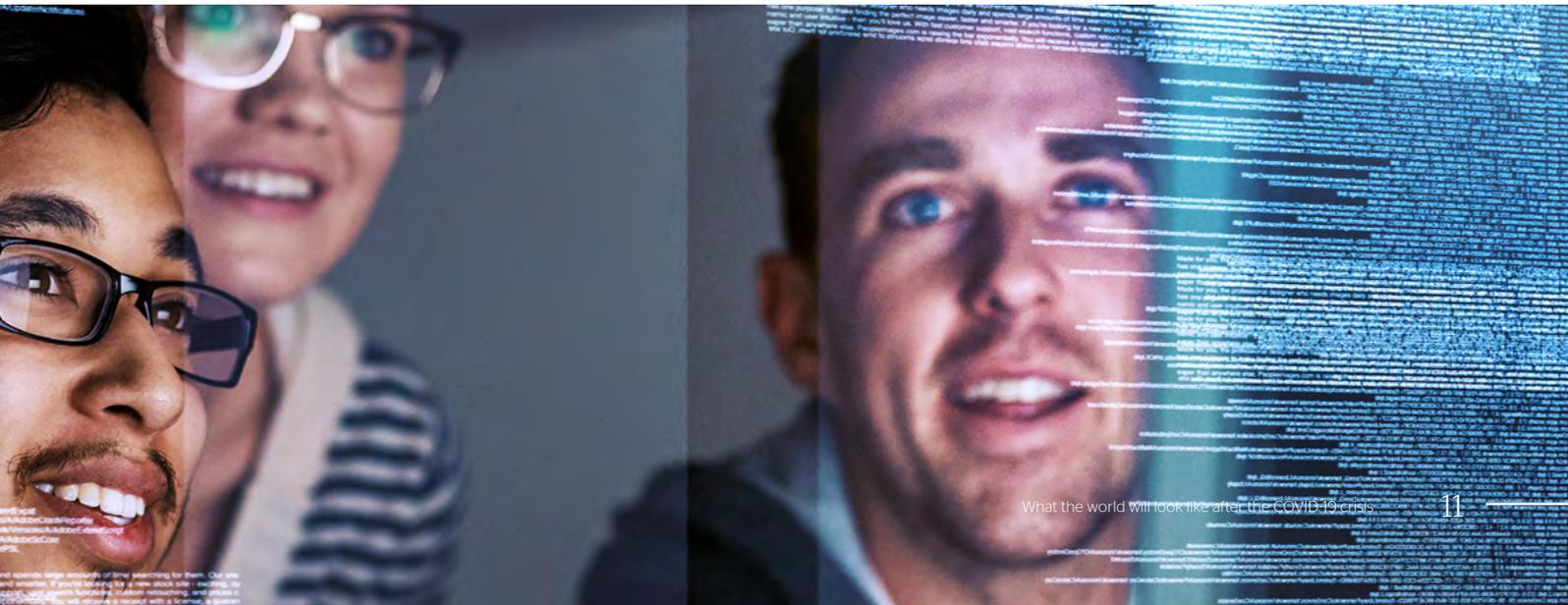
After years of paying lip service to digitalization, most companies (even large ones) have been caught unprepared for something as fundamental as mass remote working, both on the technology and on the organizational front. Companies are likely to emerge from the crisis with their basic needs covered, but much more will be necessary: cultural and change management, effective digital tools (in-house and third-party), intelligent automation to enhance satisfaction and reduce costs (for example in ticket management and call centers), smart collaboration tools, unified communications, etc.

For example, most emergency actions at the start of the COVID-19 aimed to guarantee the connectivity of people and their access to collaboration tools. Of course, this was essential, but during confinement other underlying problems are starting to be revealed - and they will become more and more important in the post-crisis scenario:

- When people work remotely for a long period of time, they find that some of the company processes rely on paper or other forms of physical interaction and cannot be completed (paper-based invoicing, paper-based expense reports, etc.).
- People also find that many repositories and databases they need to access are not ready for remote access, that the permission and security schemes are rigid and inflexible, or that data is fragmented into multiple siloes - which prevents collaboration between departments and with customers, or makes it very cumbersome.
- Workers also have difficulties finding the right colleague, the right information or answers to pressing questions, which they could solve with other means at the physical workplace. Knowledge Management solutions are crucial for organizations to capture knowledge and expertise, locate experts, provide context and intelligence about a client or project, or answer questions at business speed.

To circumvent some of these problems, people are tempted to resort to popular digital tools that may do the job, but often fail to meet the security and privacy standards of the organization. This problem is exacerbated by the [increase in cybercriminal activities during times of crisis](#), which makes organizations more exposed to phishing, spoofing and other threats. In summary, remote working is perceived as a front office matter, but once this layer is solved, many issues emerge at the back-office layer. The quick-and-dirty solutions implemented at the start of the crisis - to ensure basic business continuity - do not scale in volume, time or functionality; they will not provide effective and sustained means for remote work after the crisis. Failure to acknowledge this will result in decreased effectiveness, efficiency and security.

The transformational focus should be on achieving digital maturity and transitioning from a workplace to a workspace mindset. Since tools in this area are being commoditized and niche players abound, the approach should focus on the coherent integration of disparate tools, the move to Cloud and "as a Service" provision, the provision of packaged solutions for different tiers of clients, and the use of AI & analytics for personalization, flexibility, continuous enhancement and efficiency.



Transversal implications

People and workforce management

During and after the crisis, many activities are being depressed while others are likely to surge, and this may happen within a given sector. Therefore, the management of people and the workforce will need much greater flexibility and speed. At the onset of this crisis, we witnessed early movements between large companies, on a bilateral basis, such as [Aldi Nord and Aldi Süd sharing employees with McDonald's in Germany](#). In addition, it will have to couple decisive action with human attention, so talent will not be impacted in the middle term. Therefore, there will be opportunities for tools that enable such advantages, or for automation efforts that make legacy tools less manual or cumbersome - freeing up HR people to spend quality time engaging with employees.

Many businesses have been forced to decrease their staff due to significantly lower activity but may have isolated opportunities to grasp. Therefore, gig-economy-style contracting could increase for companies of all sizes. Large companies may want to manage their own constellation of freelance collaborators but could gain from scale; SMEs will not have the capacity or reach to manage their own constellations. Therefore, there could be opportunities for gig-economy platforms.

Virtual training and reskilling

The large negative impact of the crisis on SMEs and the big surge in unemployment (we have already seen [a historic rise of claims in the US](#)) call for measures to enable people to re-train and re-mobilize. We could expect a greater popularization of virtual training platforms such as Coursera or Udacity - some of which have granted 30-day free access as a "quarantine special". Such platforms are generally better suited for digital-savvy, relatively young (millennials or younger - under 37 years of age) people, so their effectiveness for older cohorts or less digitally-oriented people will be now tested. If not effective, opportunities will arise for other platforms suited for these target groups and/or for peer-to-peer training, which could provide opportunities for unemployed people to secure an income by sharing their knowledge and expertise in training others. Such platforms could be less focused on training content than on connecting trainers and trainees.

The crisis is also showing the great response of civil society, such as people shopping for elderly neighbors. These activities could end up becoming new services, built upon an altruistic purpose, which will be first articulated in social networks in a fragmented way. Despite being mostly local, those activities could benefit from a platform approach to avoid such fragmentation, maintain trust and sensible governance.

Digital identity

Digital identity could greatly help in automating activities and transactions, and in avoiding fraud, both in the public and private sector. Digital identity can be arrived at by making traditional schemes digital or by fully digital means. Blockchain can be a key technology in enabling digital identity in decentralized and essentially trustless environments. With digital identity you could easily verify that the person coming to your house to check the water boiler is actually the person sent by the energy or appliance company; governments could better trace who requests an aid and whether they should get it; citizens could get access to all public transport in a region without carrying multiple cards or tokens - one per transport company or consortium, etc.



Digital currency

Since Bitcoin became a phenomenon outside the technology world, cryptocurrencies have been a matter of study for central banks. In these moments of geopolitical instability and tensions in currency markets, there could be a push to IMF- or national government-sponsored [digital currencies](#). Since these currencies would be centralized, Bitcoin and other public Distributed Ledger Technologies (DLTs) would not be strictly necessary. Private, centralized, permissioned DLTs could be used.

Such move can be accompanied by a big push toward totally cashless societies, for different reasons - health and sustainability are arguments for the public; the fight against fraud and illicit commerce or a tighter control of monetary authorities over household spending being more profound reasons. The latter has ethical implications since some experts promote digital currency to enforce negative rates at individual and household level.

With both schemes, traceability of income could be pursued in order to reduce fraud and enable targeted, personalized support to individuals and businesses. Nationwide and international Security and Identity Management systems will be a key foundation of this (see Digital Identity).

Traceability

Before the crisis, effective and efficient traceability was essential for some business scenarios and a matter of regulatory compliance in others, but not essential or very efficiently implemented in most others. The world after the crisis is going to demand increased and more efficient traceability, ideally automated and built-by-design. Different technologies will be used: public Distributed Ledger Technologies (DLTs) for strongly decentralized and trustless environments, and a variety of other technologies for more centralized and trusted environments: private and permissioned DLTs, logical or physical codes, chemical markers, smart materials, 3D-printed signatures, multi-spectral scanning and image recognition or AI for telecom network data among others.

The applications will be multiple:

- tracking and tracing food, chemicals or medicines, tracing the flows of people indoors and outdoors at many different scales (for safety reasons in a stadium, for epidemiology across the world's airports),
- tracing grants and aid (and their effectiveness),
- tracing people's professional career and studies,
- tracing physical documents and digital files,
- tracing news back to their origin (to identify sources of disinformation or to establish veracity scores),
- tracing people's income to avoid fraud and make the tax process faster and fairer, etc.

Supply-chains would greatly benefit from an industrial data platform approach, where all stakeholders will share data in a managed way in order to provide enhanced control features. With such reformulation, data-platform-based supply chains will be a key enabler to traceability efforts and applications.

Virtual tourism and entertainment

The most impacted sectors (tourism, travel, non-virtual entertainment, etc.) need to reinvent themselves, leveraging digital technology (such as augmented and virtual reality) where possible to provide immersive, virtual experiences. There are many possible business use cases, such as virtual and immersive visits to towns, historical landmarks or museums that people could do from their homes.

The same could apply to events and sports, such as being able to attend a concert or sport event remotely - these cases admit a range of experiences, from being virtually in a real life event (in an opera, for example) to mixing the real and the virtual (choosing your personal repertoire, singing along with the artist, etc.). Such mixed scenarios provide a natural bridge to personalized digital content, which - together with gaming - is likely to surge as well.

eSports have already become a massive mainstream phenomenon, so disruptions such as the postponement of the Tokyo 2020 Olympic Games could accelerate the recognition and classification of eSports as proper sports.



Transversal implications

Cybersecurity and fraud management

The process of digitalization is providing great tools to security professionals, but it has also augmented the surface attack and the cheap access of powerful technology to cybercriminals. Unfortunately, disruptions such as the present COVID-19 emergency have been accompanied by surges in cybercriminal activity – sometimes even targeted against those fighting in the frontline (hospitals) or those more vulnerable (elderly). As technology becomes cheaper and better, and the incentives increase (inequality, unemployment, etc.), we foresee a growth in fraud – both organized and individual. Fraud management is going to require a multidisciplinary approach and a broad range of possible solutions, such as digital identity, traceability, digital currencies, Artificial Intelligence-Machine Learning (AI-ML), Blockchain and other DLTs (Distributed Ledger Technologies), biometrics, etc. Cybersecurity is in a difficult but promising moment. It has many technologies at its disposal (Identity and Access Management, biometrics, homomorphic encryption, etc.) but they are also available to criminals, so there is a continuous race between both sides.

In parallel, private and public organizations are in very bad shape when it comes to cybersecurity: many are victims of ransomware or DDoS (Distributed Denial of Service) attacks, most do not even know the breaches they have suffered, most do not have a strategy or fail to implement it, etc. When it comes to products and services, especially digital ones, security is quite often an afterthought – there is no cybersecurity by design. It is true that there is lack of awareness on the topic, but that is not the only or the most important problem. Security resources are scarce, and there is high dependence on them to effectively practice cybersecurity by design, and to enforce corporate security strategy and plans. The solution to this conundrum could be a big opportunity: the democratization of cybersecurity. Automation and AI (plus training) can be used to enable many profiles to use cybersecurity as a self-service of designs, architectures, tools, etc. The goal would be to decouple cybersecurity by design from cybersecurity experts, so they do not become a bottleneck.

Automation

Automation will continue to be on the rise, in its evolution from lower-level, more basic forms of automation (such as Robotic Process Automation (RPA) or basic physical robotics) to higher-level forms. On the physical side, automation may evolve toward near fully automated plants where humans supervise robots and automated production chains. One key aspect here will be adaptability, to quickly change the process or product being manufactured or to allow for higher degrees of customization. At logical level, automation will focus on whole processes, integrating modules with AI-ML capabilities to reach higher levels of intelligence and cognition. For example, the bot that addresses your complaints about the amount being invoiced to you by the water company will access a computer vision module to interpret the photograph of the water meter that you attached.

Despite corporate and individual opposition, automation may enter decision making in public and private organizations, either making some decisions on behalf of humans or providing traceability of the decisions made by humans along business processes. In all cases, automation will be messier than depicted by some analysts: reality (including humans) is plagued with inconsistencies, uncertainty and accidents, so automation efforts need to be carefully planned and executed with customers.

As a companion to automation, Digital Twins are drawing more and more the attention of customers. Digital Twins are virtual replicas of products, services or processes that enable the simulation of new designs and new performance conditions, the optimization of assets, the mixing of simulated and actual, real-time data for enhanced control amongst other possibilities – ultimately breaking the barrier between the physical and the virtual world.

Artificial intelligence and machine learning

Artificial intelligence (AI), machine learning (ML) and data analytics continue to be key, as they permeate business processes (outside in), revolutionize organizations as they become data-driven (inside out) and enhance other technologies – AI-ML is enabling automation or cybersecurity to become more aggressive and focused on higher-level tasks (automation of decisions, prescriptive Security Operations Centers (SOCs), etc.).

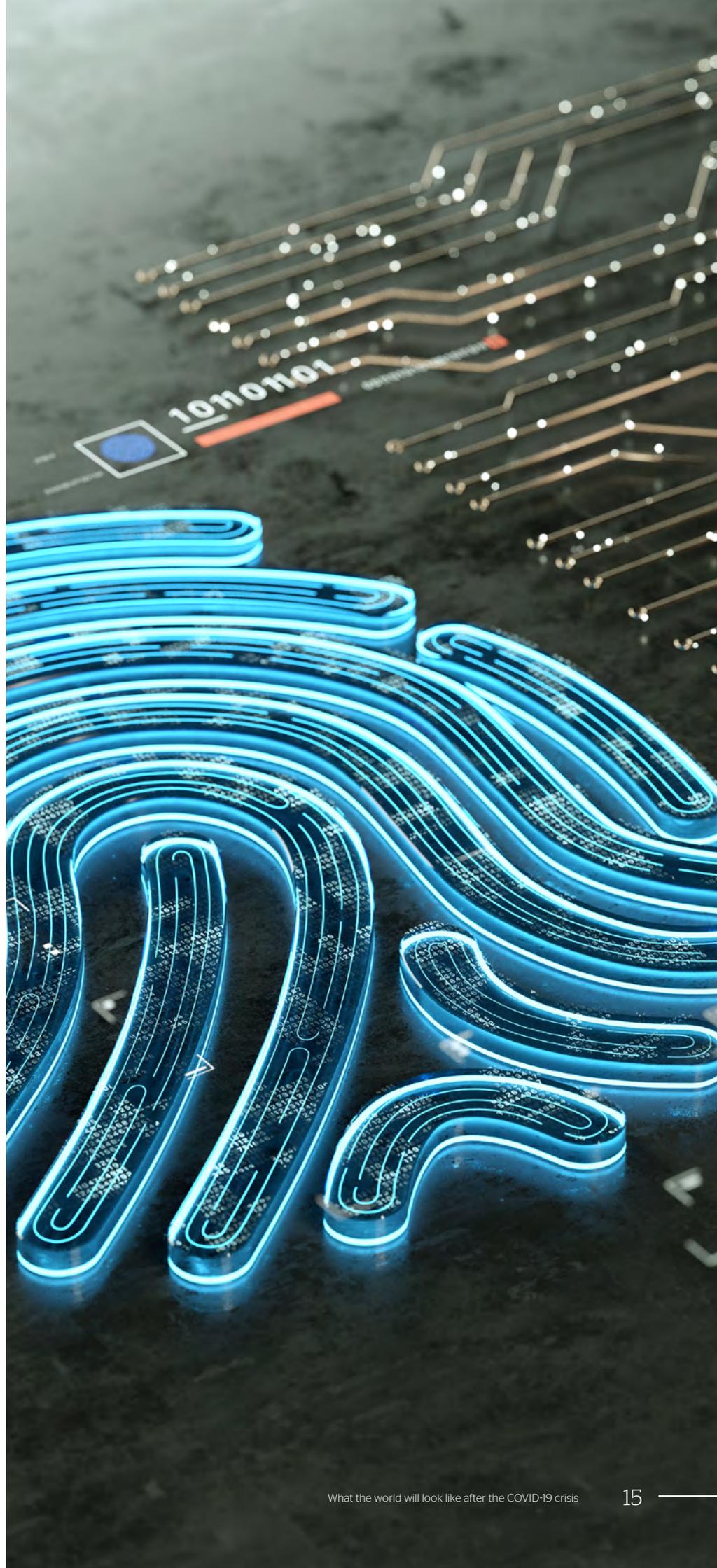
AI-ML can support countless business use cases:

- tracing people's flows for traceability of epidemics and support actions,
- self-diagnosis tools,
- building and communicating solid statistical models (epidemiology, financial markets, etc.),
- tracing incomes and received aid,
- tracing real estate to implement new housing policies (after previous housing booms have proved very detrimental),
- detecting fraud, detecting adverse events as they start to happen (early warning),
- enabling biometrics (facial, voice or iris recognition),
- identifying anomalous behavior,
- automating quality control with computer vision,
- translating texts and information to the language of the user.

There are crucial aspects beyond technology and business use cases in AI-ML:

- The ideal structure of teams working in AI-ML is being found by doing. Teams are usually composed of Data Scientists, Data Engineers and Subject Matter Experts, who rarely belong to the same department – which generally causes friction and gaps. Experts are few and expensive for the moment, but there are many high-quality training courses online, so scarcity could be less stringent in a few years. However, the problem of assembling and maintaining high-performance teams in AI-ML is likely to remain.
- Most companies are very aware of the importance of data governance, but they are only starting to awaken to the need of AI-ML model governance.

- Most companies do not have readily accessible data that can be used to train AI-ML models, either because of lack of data or because of its fragmentation in corporate siloes.
- In the B2C arena, digital giants have had access to huge amounts of personal data from billions of users to train their models and populate their platforms (Google, Amazon, Apple, Facebook). In the Business-to-business (B2B) arena, digital giants do not have such easy and gratis access to industrial data, which is kept absolutely secret by most clients. On the other side, many start-ups having very good AI-ML models do not trust digital giants or industrial giants, since all their IP is encapsulated in the model.
- In the Business-to-consumer (B2C) case, pre-GDPR, digital giants managed to get huge amounts of personal data by getting the acceptance of users once (via kilometeric, confusing End-User License Agreements - EULAs) for many future uses. With GDPR, end users must grant access to their private data for specific purposes and for limited amounts of time. GDPR protects privacy (in the EU area) but its enforcement - or the management of exceptions during crises - is still quite manual. There is an opportunity for smart contracts, automated compliance and policy checking and "soft law".
- Many powerful AI-ML models are not explainable; they give great results, but it is very difficult to explain why. This prevents many clients in heavily regulated markets to exploit AI-ML models to their benefit, since the lack of explainability can result in issues with the regulator. If a client challenges your automated decision to deny a mortgage or grant to them, how can you justify it if you cannot explain how the system came to that conclusion?
- Ethics are and will continued to be an open issue, which will need to be addressed in every effort, from malpractice or ill-intentioned uses of the technology to hard-to-detect, unconscious issues due to bias contained in the training data.



Transversal implications

Human Language Technologies

Human Language Technologies (HLT) include Natural Language Processing (NLP) and adjacent areas such as voice, speech and gesture. NLP includes morpho-syntactical and semantic analysis for tasks like Natural Language Understanding, summarization, Natural Language Generation or Machine Translation. HLT are traditionally considered part of AI, but we cover them separately because of their importance and complexity.

As technology evolves, there is an increasing need for humans to interact naturally with machines, and voice could become the ultimate interface – as Siri, Alexa and similar systems reveal. Good-quality understanding of text and speech would result in a great advance of smart assistant technology, with huge impact on customer experience, usability and automation among others. However, for the moment, each problem must be addressed and solved separately, with different means. In addition, quality quickly diminishes with deviations from whatever the system considers “normal”: language, a regional accent, a peculiarity in someone’s speech, surrounding noise, etc.

The opportunities that HLT can materialize are huge – imagine automating a whole call center whilst increasing clients’ satisfaction with the service; imagine interacting fluently with a computer with your speech instead of mouse, keyboard or touch. However, given the diversity of problems, solutions and languages, opportunities must be addressed on a per-case basis, carefully choosing the most adequate partners.

Blockchain

Blockchain and other Distributed Ledger Technologies (DLTs) have been the subject of much hype in the last few years. First due to the role of Blockchain in the Bitcoin cryptocurrency, later due to the promising introduction on Blockchain in many aspects of business. With some exceptions, Blockchain has been a technology in search of a problem. Many problems for which it is advertised can be solved more easily or cost effectively with traditional solutions, due to its nature and limitations, such as not being good for centralized environments, not being real time (significant latency) or its associated huge energy consumption. These limitations of Blockchain are not significant in private DLTs.

The three main areas where we see big potential for Blockchain and other DLTs are identity, traceability and tokenization:

- DLTs enable the creation and federation of digital identities in complex, decentralized and essentially trustless scenarios (see the Digital Identity section).
- DLTs also make it possible to establish the traceability of items and transactions, for example, traceability of food or luxury items, ensuring the preservation of the cold chain in transportation of food and chemical substances or guaranteeing the authenticity, integrity and commerce of digital models to be 3D-printed.
- Finally, DLTs make it possible to tokenize assets. By tokenizing physical assets, you digitize and dematerialize them in a way that each token represents the ownership of a fraction of the asset. This enables increased monetization of the asset, lower transaction costs, enhanced liquidity and transparency – usually in peer-to-peer scenarios. For example, an oil well can be tokenized into millions of tokens so that individual citizens can invest in it; or a house can be tokenized into thousands of tokens to enable individuals to invest in it – financing the part of the cost that the bank does not cover with a mortgage. Just like servitization disrupts the way assets are commercialized, accessed, consumed (for example, car tires being sold according to the number of kilometers driven on that set of tires), tokenization disrupts the way in which physical assets are owned and financed.

Internet of Things (IoT)

After the COVID-19 emergency, we are probably going to witness the maturity of IoT. On one side, the capabilities of IoT for real-time remote sensing, intelligent processing and local actuation are of critical importance for the new scenario (automation, traceability, parcel delivery or logistics among others). On the other side, IoT will mature in three aspects: concreteness, subsidiarity of intelligence and financial soundness. The business cases for IoT will be concrete and sectorial, for example: temperature and skin sensing at certain public spaces for epidemiology purposes, automation of the payment process at shops to minimize viral exposure to staff such as cashiers, automated picking at warehouses or plants with robots and Automated Guided Vehicles. IoT will heavily implement the principle of subsidiarity of intelligence via Edge computing: intelligence and processing must be close to the data origins; local sensing and remote processing will lose traction for data traffic and latency reasons. IoT business cases will heavily depend on the deployed object base; for financial and security reasons, the large-scale deployment of sensors will happen only in the few cases where a cost-benefit analysis supports doing so. The possible shift in privacy legislation, at least for some health and safety cases, could open new business cases for IoT.

Quantum Computing and Quantum Simulation

It is very unlikely that a general-purpose, commercially available quantum computer will appear in the next few years. However, given the game-changing benefits that can be achieved – such as executing certain business-valuable algorithms thousands or millions of times faster than classical computers – organizations should start exploring the technology now. The best option are quantum simulators, such as the [Atos Quantum Learning Machine](#). Quantum simulators are classical computers that can simulate the performance of a quantum computer. They are a cost-effective way of introducing quantum computing into business, which start to be used in the pharmaceutical, chemical or financial services sectors among others.





Conclusion

We face a very challenging situation, probably leading to a new world, but with ample room for opportunity and change. Our response must not focus solely on immediate actions⁴. Since the crisis will trigger deep and lasting changes, we must focus on transformational actions; those that will enable organizations to have an even stronger position in the new post-crisis world.

In general, organizations need to pass the inflection point from legacy focus to new business focus. Agility and flexibility will derive from data-centricity, lighter processes and high levels of intelligent automation. Digital platforms and ecosystems must be a priority, since they will be the lever for that transition from legacy to digital focus.

The previous sections of this document present our view on the post-crisis scenario and describe several needs and opportunities. We have explored opportunities broadly, providing vertical and transversal examples. We hope you have found this report useful when exploring, defining and prioritizing the transformational opportunities that this new world will bring.

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⁴ which Atos is already addressing through Atos [Future Ready](#) and other initiatives.

About Atos

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Let's start a discussion together

