Strategic Orientation
Report 2020

The age of reason... what's next?

For sustainable, responsible and trustworthy digital world: 2025-2030 prospects

Cigref
RÉUSSIR LE NUMÉRIQUE
50 ANS

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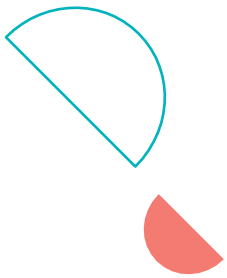
Foreword

Bernard Duverneuil,
Chairman of Cigref

At its last 2019 General Assembly, Cigref announced that the digital world was entering its age of reason. We were calling upon our ecosystem to become aware of the need to build digital technologies together that are sustainable, responsible and trustworthy. As a follow-up to this approach, we wanted to create a new impetus and commit to a fundamental reflection on the new digital age and its development prospects.

Up until last year, Cigref's strategic orientations were the result of research conducted upstream that led to the drafting of a five-year strategic plan. Thus, the Cigref 2020 strategic plan, which our association has been rolling out since 2016, was the product of work conducted between 2010 and 2015 within the frame of the Cigref Foundation. We felt that it would be interesting, and no doubt also necessary, to introduce more energy and agility into our strategic thinking and to rely on the method of prospective reasoning.



The aim of this new approach is to shed light on Cigref's reflections through broader projections and highlight themes that should be addressed in the frame of our collective intelligence work. It is based on an annual cycle and relies on two key tools and a strict methodology. The first of these tools is the Strategic Orientation Council, composed equally of Cigref member representatives and qualified personalities. I would like to take this opportunity to thank them sincerely for the time they have devoted to this exercise which was particularly enriching for Cigref and, we hope, a source of further reflection for them too. The second tool is this strategic orientation report, the first edition of this annual work. Drafted under the guidance of the Strategic Orientation Council, we have made choices and adopted positions to present Cigref's future vision without any intention of being exhaustive. This document should now guide our association's strategy for action and structure our annual activity plan.

Forward-planning is a complex exercise, especially in troubled times such as the ones we are currently experiencing. The present crisis has disrupted all sectors of activity and increased uncertainty, accentuating the need for tools that can shed light on the future. We have asked ourselves many questions about the relevance of our thinking as the health and economic crisis has unfolded. Nevertheless, we believe that most of the underlying societal (social?) themes identified previously will continue to apply in the long-term and that the huge disruptions caused by COVID-19 will only add to the complexity of our approach in the coming years. Forecasting does not mean making predictions about the future, but giving the organisation that is carrying out the exercise a head start and anticipating changes before events force it to do so. It has been a pleasure for us to have carried out this work with Futuribles, one of Cigref's historic partners, and benefit from its methodological input and experience in forecasting.

I hope you enjoy reading Cigref's first strategic orientation report!

Introduction

by **Henri d'Agrain,**
General Director of Cigref

Background

In this publication, Cigref presents its first 10-year forecast carried out in the frame of its new strategic approach. It will not have escaped anyone's attention that the context in which we finalised this forecasting work, between March and July 2020, is highly unexpected. It has greatly increased the uncertainty around the analyses of each transformation field we have chosen. This uncertainty, associated with the global situation in which the digital issues we have tried to describe and analyse are embedded, deserves a preliminary chapter in which we will provide a few elements that may prove to be necessary for completing our report. We will make very little mention of digital technology in this chapter which sets the context. However, with great humility and care, we will try to highlight some of the strategic ideas that, in the coming years, will structure the digital activity of the large companies and major public administrations for which we have carried out this forecasting work.

Any reflection on the conditions for finding a way out of the health crisis and its consequences in terms of resuming business and kick-starting the economy must be accompanied by high-quality forecasting work, particularly in view of the many uncertainties that still remain. Firstly, there are the scientific uncertainties that dictate all the others relating to contagion, lethality, the possible mutation of SARS CoV-2, and the speed at which a treatment or vaccine can be developed. Secondly, there are the economic and political uncertainties that sway between two extreme scenarios.

The first, optimistic, scenario describes an undoubtedly brutal but temporary period that is followed by a return to normality in how the economy and institutions work at the very beginning of 2021. On the opposite end of the scale, the second, pessimistic, scenario describes a situation in which the unprecedented measures taken to curb the pandemic will lead to a profound upheaval and transformation of the global economy and political and social systems. Long-term forecasts will very much depend on the intensity and duration of this triple health, economic and social upheaval and its potential aftershocks. Therefore, the conditions for coming out of the crisis will remain very uncertain, probably for many months to come. It will be a long time before we will be able to fully understand the most likely scenario, other than through personal and unsupported conviction.

To describe the context for our forecasting work, we have chosen four reference fields: geopolitics and international relations, environment and climate change, the health crisis caused by the SARS-CoV-2 virus, and finally the economy and the effects of its globalisation. Of course, these fields are not independent of each other, and we often have to go back and forth between them. But they do provide us with a few keys for understanding what will follow despite the choice we have made. Moreover, it is always interesting, from an archival and historical point of view, to describe the context as it was perceived and understood and that has served as a background to the forecasting work at the time it was carried out.

Geopolitics and international relations

Geopolitical issues and international relations remain major determining factors of the context for economic, industrial and commercial activities. The international system is largely organised by States, which are the main legal entities. The health crisis has not greatly altered this situation. However, it has highlighted several trends and has contributed to the acceleration of some of them. We will focus mainly on four of them.

First observation: China and its rise in power over the past thirty years. The rise of China, as for the rise of any new power, creates fear among the other major powers, which feel threatened. In 2001, the Director of the CIA, under the presidency of George W. Bush, identified China as the main threat to the United States. The dramatic events of 11 September 2001 distracted the United States from this threat for about fifteen years until the election of President Trump. At the same time, Western economies, under the influence of the ideology of free-market globalisation, largely adjusted to the opening of the Chinese market and engaged to low-cost production strategies in China. Indeed, they were also rather careless with technology transfers to China. This factor is one of the main elements behind the modification of the international system that President Trump has denounced since the very start of his term and which he has attacked on the level of trade. The growing tension, particularly around Taiwan and Hong Kong, offshoring and technology transfers, means that the majority of the global economy has become extremely dependent on China. The current pandemic has accentuated an unavoidable crisis. It has shown that Xi Jinping's China is actually implementing a rather trite form of imperialism, guaranteeing its access to the material and spatial resources it needs, which is why it has set its sights on Africa in particular, increasing its supremacy in the China Sea, rolling out its "new silk roads", and developing an aggressive and possessive form of communication with regard to its sovereignty. Nevertheless, China's situation in the medium-term remains complicated. Between 300 and 500 million inhabitants have now reached a standard of living in line with that of western middle classes. But there are still about 900 million Chinese people who are relatively or extremely vulnerable. Furthermore, its demographics continue to deteriorate, with a birth rate at an all-time low and an increasingly ageing population, resulting in a gradual inversion of the age pyramid. In order to preserve the country's stability and continue its transformation in a much less favourable context than in the past thirty years, the Chinese regime faces a growing need to be strong and firm.

A second major observation is the gradual weakening of multilateralism, the legal system of which was built around the United Nations in the mid-20th century. It is growing weaker at a time when the international community needs it more and more in the triple context of the global health crisis, the deterioration in relations between China and the United States, and the acceleration of climate change.

The United States, the historical leader of the multilateral system, has been turning away from it over the past decade as a counterpoint to the shift in its strategic centre of gravity from the Atlantic to the Pacific. The Trump presidency has speeded up this trend, making it one of its clear principles. Alliances such as NATO itself are in the process of being eroded. In that respect, the attitude of Turkey in the Eastern Mediterranean, within its Turkish-speaking and Islamic area of influence, a member of NATO and a candidate for accession to the European Union, is truly astounding and illustrates the weakening of the supranational organisations that regulate international relations. Now, and for the coming decade, we are facing a global system that is increasingly interdependent but less and less organised and regulated, in which there is a rising risk of chaos and confrontation, even if it remains limited.

The third major observation is the unexpected strengthening of the European Union in the wake of the health crisis, which seems to have helped to speed up the process. The history of the Union has always been written on the frontline of crises, and this is precisely what is happening now. It was the fall of the USSR that resulted in enlargement to Eastern Europe and the creation of the single currency. The financial crisis of 2008 enabled the implementation of a series of measures to consolidate the euro. And it is very likely that, as a result of this COVID-19 crisis, health policies will also be included in common policies. Moreover, the Union's financial rescue plan is unprecedented, a plan for which Chancellor Merkel and President von der Leyen defied the legality of the Karlsruhe Court!

The European Union is now, it would appear, committed to an existential dynamic of power and is no longer a passive subject of international relations. Indeed, the concepts of sovereignty and strategic autonomy are no longer viewed in a negative light but are identified political options that form part of the Commission's roadmap for the next five years.

Our fourth major observation concerns the systemic, even totalitarian, place that cyberspace now occupies in the world, in the affairs of States as well as in companies, but also in the personal and even private lives of more than half the planet's population. A global common for some, and as such, a vector of development and opportunity for humanity, a new area of conflict for others in which strategies of power and confrontation are mainly deployed, the place of cyberspace in international relations is still under construction. This space, which does not fit into the traditional categories of territory, borders and sovereignty, does not yet have an international public law regulating its use for the benefit of the greatest number, freeing it from illegitimate appropriation by state or private interests. On this point, we note and support the "Paris Call" initiative, launched by the President of the French Republic Emmanuel Macron on 12 November 2018 to promote confidence and security in cyberspace. The "Paris Call" carries the beginnings and hope for a new world order in cyberspace for the benefit of its development as a vector of progress for humanity.

Environment and climate change

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It is now clear that global warming is Anthropocene in nature and that it is urgent to implement all necessary measures to reduce greenhouse gas emissions. As news remind us every day, predictions about the climate's future are very gloomy indeed. It seems unlikely that humankind will manage to escape the painful consequences of climate change unless we turn our backs on our growth model. While science and technology are being harnessed in the search for possible solutions, they alone will not be enough to prevent the most pessimistic scenarios from happening. It appears increasingly likely that we will have to face up to the need to think in completely different ways and urgently change our lifestyles, business practices, and growth model. All European States, all global companies, all major organisations have now integrated this requirement into their strategy and communication. Yet, it is with very little result so far if we focus solely on the figures for climate and fossil fuel consumption models. Only a drastic reduction in the use of the latter would have a real effect on climate change. But humanity does not seem to be moving in that direction. The use of coal and hydrocarbons, especially non-conventional ones, is steadily increasing, particularly in China and the United States, which together account for between 40% and 45% of global greenhouse gas emissions.

However, the environmental issue cannot be reduced to climate change alone, even if it does appear to be the main long-term threat to humanity. The use of raw materials, the preservation of natural areas and biodiversity, waste management and recycling, the availability and quality of water for various uses and the associated conflicts are just some of the many difficulties that political, economic and social stakeholders will have to face in the coming decades in an extensive and coordinated manner. And the next 10 years will undoubtedly be decisive for defining the path that the international community will agree to follow.

The efforts to be made to modify and reorient the carbon-based development model adopted during the 19th century are huge. Many critics, taking advantage of the disbelief generated by the health crisis, are trying to reuse past ideas, such as the concept of degrowth or the collapse of capitalism, and even the temporary suspension of democracy to tackle the environment emergency. These approaches, with very ideological connotations, essentially Malthusian ones, some of them even demagogic, unsupported by facts and science, will, over the next few years, enter into increasing competition with reasoned growth approaches. The latter will use voluntarist strategies of environmental sobriety along with scientific research and technological innovation, vigorously directed to provide concrete solutions to the environment and climate issue.

Pandemic and health crisis

The pandemic caused by the SARS-CoV-2 virus is probably one of the main factors that will govern and structure the context in which companies will have to rethink their activities over the next few years. Firstly, with the world not yet having emerged from this health crisis expected to last many months before some sort of vaccine is released on the market, it is dictating all industrial relations and, with the ever-present threat of a further lockdown, companies are investing a great deal of energy in setting up the conditions and protocols that will allow them to continue their activities, at least partially. Some sectors, starting with aeronautics, but also tourism, catering and culture, will be deeply and lastingly affected. These sectors are unlikely to escape dramatic restructuring if the consequences of the pandemic on their activities continue, as seems to be the case for many of them.

Public authorities, at least in Western countries, have massively supported businesses at the cost of the vertiginous growth of public debt and the issuing of currency. They have had to deal with sudden and significant increases in borrowing and volatile market conditions. The ability of States to find long-term solutions to these liquidity and funding challenges is essential for supporting the effectiveness of their emergency response and the smooth functioning of financial markets. In this respect, we should note the European Union's unprecedented response, which has equipped itself with a tool for pooling debt.

This happened for the first time in its history, contrary to the doctrine repeatedly recalled by the German Constitutional Court in Karlsruhe, and despite the opposition of four member states from the so-called "frugal" group. Although some observers believe that the ambition of this measure remains restrained, it is clearly inspired by federalism which might commit the European Union to a new stage in the deepening of its institutions, as so often in its history, in the wake of a crisis.

The social consequences of the pandemic are also expected to be particularly severe. The spectre of recession is looming, with its serial bankruptcies, massive increase unemployment, and spread of insecurity, poverty and misery, despite the unprecedented efforts in the field of national solidarity, especially in Europe. This rise in unemployment will have a particularly damaging effect on the employment of students leaving higher education and trying to enter the job market. Young 2008 graduates have been suffering the effects of the financial crisis on their career and remuneration over the past ten years or so. It is feared that generations graduating in 2020 and the following years will suffer the same fate to a much greater extent despite the measures introduced to promote their employability at a reduced cost for companies.

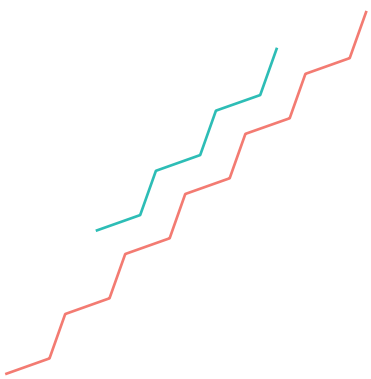
Economy and effects of its globalisation

Over the past 15 to 20 years, the world economy has seen a massive increase in the globalisation of value chains and their extension on a global level. This phenomenon, which has affected almost all sectors of activity. It benefited from the convergence of several factors. The combined effects of these factors are exponential. Clearly, the first factor is the opening up of China and the world economy's access to particularly low industrial costs leading to a massive transfer of many production operations to Asia. The second factor is that, in less than two decades, this movement has been amplified by the meteoric growth in communication with the advent of the Internet - offering the capacity for the ubiquitous production of goods and services on a global scale. The third and final factor is the collapse in transport costs over the past twenty years. Between the early 2000s and the present-day, the size of the largest container ships more than doubled, from 8,000 twenty-foot equivalent containers to more than 20,000!

One of the main consequences of this globalisation of value chains is the optimisation of flows and the gradual elimination of stock. This situation makes all these value chains extremely vulnerable to even the slightest break in one of its links. The lockdown in some regions of the world, especially in China and the Wuhan region, to fight the pandemic in 2020 spring resulted in many factories shutting down and has had serious impacts on the production of goods for a great many companies. For example, it affected the supply of certain drugs or pharmaceutical preparations, and even simple surgical masks which many countries no longer knew how to manufacture or supply.

Another major impact of the globalisation of value chains is the gradual shift from interdependent national economies to their systemic dependence, even enslavement, on the most powerful economies, especially China and the United States. Consequently, some economies, particularly those of European states, are extremely sensitive to the geopolitical order. And the economic war that the United States and China have been waging over the past few years is a striking illustration of their race for technological domination.

Therefore, it is reasonable to believe that many value chains will reorganise themselves over the next 10 years in order to increase their resilience in the face of certain major risks, whether these are geopolitical, health-related or environmental.



In conclusion

As a conclusion to these contextual elements, and in order to bring us back to our subject, namely digital technology, I would like to take you back in time with the following anecdote. Commissioned by the Government, Gérard Théry, the French Telecommunications General Engineer, a high-ranking state clerk, presented his report in 1994 to Edouard Balladur, the then French Prime Minister. The title of this report "Information highways" has remained famous. The Prime Minister asked him in this mission letter to enlighten *"the objectives that France should set for itself in the field of information highways, as well as on the responsibilities and means of public action in this area."* In this report, Gérard Théry attempted a forecast, setting out his vision of the future role of the Internet. Regarding this network that was still being developed at the time, he wrote that *"its cooperative method of operation is not designed to offer commercial services. Its great openness to all types of users and services reveals its limits, in particular its inability to offer real-time high-quality voice or image services."* He concluded his analysis of the shortcomings of the Internet by stating that this *"network is, therefore, not adapted to the provision of commercial services."* In July 1994, as Gérard Théry was reporting to Edouard Balladur, Jeff Bezos created Amazon in Seattle which, in less than fifteen years, has become one of the world leaders in the provision of commercial services over the Internet.

It is not our intention to criticise Gérard Théry but rather to use this example, which is no more than an anecdote, to recall that forecasting is a delicate exercise that requires humility and method. Forecasting does not involve making predictions or describing the future, but drawing up hypotheses that help inform decision-making and counter difficulties. We hope that the following work will, at least in part, meet this requirement.

Henri d'Agrain,
General Director of Cigref

Transformation fields

Methodology

To draw up this document, Cigref, thanks to its Strategic Orientation Council, started by identifying and then selecting five major areas of digital transformation. These fields refer to areas in which there appears to be major developments, where the interplay between stakeholders appears to be shifting thus requiring special attention by Cigref and its members. Identifying major and minor signs of change was the result of the Council's discussions and contributions, Cigref's collective intelligence work, and monitoring carried out by the publication team. For each of the fields, we define: **structural trends**, that shape their evolution in depth, **emerging trends,** new phenomena that might significantly change the situation within 5 to 10 years , **major uncertainties**, and, lastly, ***wild cards,*** events that are unlikely to come about but which would have a strong impact if they did. In each of these categories, particularly major uncertainties, a PESTEL approach (Political, Economic, Social, Technological, Environmental and Legal or regulatory dimension) was adopted to ensure that all dimensions specific to each element are covered. The overall aim of this approach is to provide the reader with a global and forward-looking view of what, this year at Cigref, we consider to be the main themes to be addressed in the coming years.

STRUCTURAL TREND

- A trend with strong inertia, rooted in a more or less distant past that has a particularly powerful impact on the subject under study.

EMERGING TREND

- Phenomenon currently in the minority, often new, which may, if it is confirmed and develops, lead to the reorientation of structural trends or give rise to a new trend.

MAJOR **UNCERTAINTY**

- Decisive question for the future of the field, but for which there is currently no answer. The different answers available might lead to different scenarios for the future.

WILD CARD

- Phenomenon that is highly unlikely to happen but which would have a major impact on the subject studied.

Technological challenges and new applications

1.

Technology plays a major and essential role in the transformation of organisations, from their infrastructure and operating tools to their business models and customer relations. Digital technologies have many impacts on organisations: optimisation of their means of production, diversification of their services, customisation of their offers, redefinition of relations with their ecosystems.

The COVID-19 crisis has highlighted the maturity of a significant number of organisations which were able to switch very quickly to the widespread use of remote working. Thus, they used the opportunities offered by online collaborative tools and remotely-managed systems. This transition was relatively quick despite the obstacles that existed prior to the crisis. According to a survey by the Forum Vies Mobiles in April 2020[1], 33% of the working population was working remotely whereas this figure was just 7% before the crisis, according to INSEE. Similarly, faced with travel restrictions, many players offered new or updated services in order to continue to meet their customers' needs (in particular large-scale food retailers setting up a weekly packed lunch service, delivered directly to customers' homes).

It is clear that digital technology has played a key role in these transformations. **However, such changes take time to become established.** Indeed, it is the gradual integration of technological innovations into organisations and **the long infusion of digital into individual and entrepreneurial practices that have facilitated this switch**. Despite the obvious qualities of digital technologies, clearly demonstrated in a difficult context, many questions still remain concerning future technological developments.

[1] Survey on the impact of lockdown on the mobility and way of life of the French, April 2020

STRUCTURAL TRENDS

Mature technologies able to transform organisations from top to bottom

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The aim here is to identify the technologies that appear to be the most mature at the time of writing and, therefore, most likely to play a major role in the structuring and the activities of organisations. Some technologies have already led to changes in practices and offers.

Therefore, among the most mature, we have chosen:

The development of cloud computing and the containerisation of services

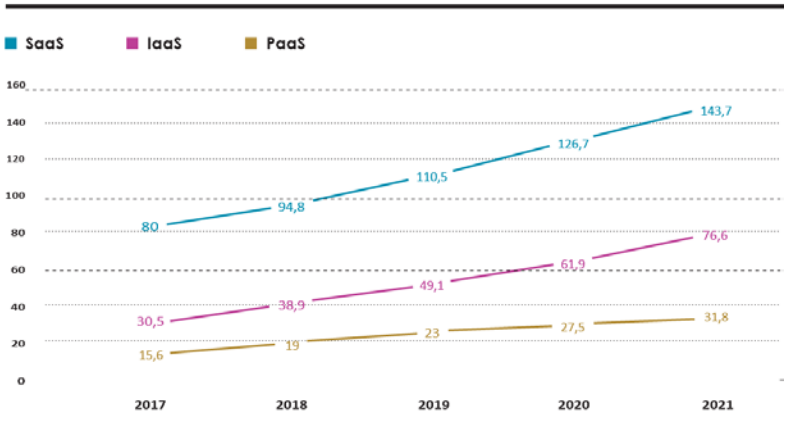
Cloud computing means on-demand and self-service access to configurable shared IT resources via a telecommunications network. Cloud offers computing power for industrialisation, standardisation and economies of scale by pooling storage and computing resources. Cloud also makes it possible to pool maintenance and benefit from pay-per-use invoicing. This helps to optimise IT resources and costs. The provision of tailored cloud services makes it easier for the user to understand, use and upgrade infrastructure or apps. Thus, companies that use it are able to make their IT architecture more flexible and resilient and deliver "agile" services ("*Business As a Service*"), and therefore, innovate. Most companies are adopting hybrid strategies with several cloud suppliers. Thus, the challenge of interoperability is a crucial one. Some platforms already propose combining access to several cloud providers on request.

There are still some obstacles to the full adoption of cloud services. Among them, the process of data migration is sometimes a problem. In order to speed it up, some companies offer automation tools.

Another limit to the development of cloud computing and the virtualisation of IT in the cloud is the increasing complexity of pricing models that makes the financial control of hosted servers and applications more difficult. It is very likely that this could become an obstacle because companies will have very few means for controlling operating costs. It could even be a major stumbling block in a crisis.

Before the current crisis, Gartner predicted a 17% increase in cloud revenue in 2020. The strong development of use via collaborative SaaS tools, which has speeded up during the COVID-19 crisis, is likely to increase the adoption of public cloud. According to Microsoft in June 2020, use of the Teams collaborative platform has grown by 775% in Italy since the start of the pandemic in Febuary. Since the need to pool resources is expected to continue in the long-term, the development of cloud could be consolidated over the next ten years.

CLOUD MARKET REVENUE (IN BILLIONS OF DOLLARS)



Worldwide Public Cloud Service Revenue Forecast, par Gartner [2]

[2] Worldwide Public Cloud Service Revenue Forecast 2019

Problem of data storage in cloud

By 2025, about 80% of data will be stored and processed in the cloud[3]. But the exponential growth in the quantity of data produced raises questions about the sustainability of cloud usage both in economic and strategic terms, as well as in terms of energy consumption. The pooling of resources made possible by cloud does not ultimately reduce all environmental externalities.

According to the activity sector and feedback from some companies, between 10% and 30% of strategic data should remain in-house (in private cloud) or in a trusted cloud which ensures technical and legal security. To do so, the cloud provider must not be subject to any extraterritorial laws. Some companies that provide cloud are indeed dependent on the laws and standards of the country where their head office is located. Such legal constraints can be problematic for overseas customers wishing to benefit from their services without being affected by such restrictions.

Deployment of optical fibre and submarine cables

The physical aspect of digital technology is also based on the development and installation of optical fibre. Fibre makes it possible to connect territories to the network faster. Also, submarine cables ensure a connection between continents, and also use optical fibre. These 400 or so intercontinental connections are essential for running the Internet. They represent a **real and invisible strategic challenge. They are in high demand** for the flow control and monitoring capabilities they provide. The issue of their correct maintenance and the risk of sabotage are equally crucial. A few powerful players are positioning themselves on their deployment: Google in the United States, the Chinese equipment manufacturer Huawei, the Russian firm Yandex, and Orange in Europe, which collaborates with various partners (Google, Facebook) on transatlantic cables.

The Internet of Things

The Internet of Things is a term that describes the **interconnection between objects, places as well as physical and virtual environments.** The connection between objects and the network generates and will generate increasingly profound transformations in the uses, practices and new possibilities (and therefore services) that these interconnections offer. **The multiplication of sensors** in the physical environment, correlated with this expansion of the Internet of Things, is itself a source of opportunity for new personalised infrastructure and network optimisation services.

These connected objects include, in particular, those for professional or medical use. Therefore, some connected objects are essential to companies or public authorities for the remote surveillance of infrastructure, or the remote maintenance of critical equipment. Others are used to monitor a person's health and provide a new and more precise connection between the patient and the healthcare services. But there is a tendency for connected objects to become completely integrated into the everyday life of a large majority of users. Among the first of its kind, *smartphones* have now become indispensable for many users. It is likely that other connected objects sold and used for leisure or entertainment purposes will also gradually be widely adopted.

[3] Thierry Breton : « Pour accéder au marché européen, il faudra accepter nos règles », January 2020, and Bienvenue dans l'ère du post-cloud !, May 2019

Among less mature technologies still in development, but making constant and exponential progress, there is:

Artificial Intelligence, machine learning, and the use of Big Data

Artificial Intelligence (AI) refers to models and technologies that enable reasoning and interaction through data-based learning. Among these models, machine learning (ML) in particular has developed hugely. In line with the exponential growth of databases (Big Data), it is based on the use of increasingly predictive algorithmic models. The development of AI is based on the articulation between computing, storage and network power. **Access to exponential databases, with increasingly powerful processing, inference and analysis capabilities**, enables the growth of AI's current capacities. While AI is far from being "intelligent", its algorithms and learning models are expected to continue to improve and its applications will diversify in the years to come. Thus, the use of AI should expand, especially in response to new challenges, in particular in robotics, industry 4.0 and the medical sector in mention a few[4].

Continuous improvement of processors: strategic R&D challenges

The presumed dematerialisation of the technologies referred to should not make us forget the **importance of the hardware** at the very heart of the design and operation. In fact, digital security requires mastery of the silicon industry in order to obtain solid, autonomous and reliable processors. These processors guarantee compliance with the required functionalities. These processors are essential components in the development of algorithms and computing power. While processors have continuously improved (Moore's Law) in recent decades, it appears that the growth in performance has slowed down. If this trend were to continue, it would call into question a large number of business models based on their exponential power. Whatever the case, the battle to dominate the market is raging. The American players, Intel and Qualcomm for computers and ARM for mobiles, have been the leaders up until now. But we are seeing the emergence of other major players, such as the Singaporean firm Nvidia in AI processors and embedded AI in particular, or the re-emergence of other players such as AMD. However, Russia is manufacturing its own processor, and China is trying to catch up.

The 5G, fifth generation, network of standards in mobile telephony

By 2025-2030[5], 5G might replace 4G and be added to the existing 2G and 3G mobile networks. It offers even higher speeds than 4G and a much lower latency time. 5G was actually designed to meet the need for ever faster communication between objects. 5G is also designed to serve society's main economic sectors from the very start. 5G would indeed help to connect cars, cities and even factories to the network. It is mainly **critical infrastructures and the mobility sector** that could benefit from this continuous connection. It will also offer new opportunities for machine-to-machine interaction and production tools (industry 4.0, robotisation, etc.). Significant maturity is expected to be achieved from 2025-2030.

However, the ability of European operators to deploy 5G and maintain their sovereignty is being called into question in a context of economic crisis in which investments may be limited.

THE 8 5G PERFORMANCE INDICATORS DRAWN UP BY ITU - IMT-2020

Performance/Generation	4G	5G
Maximum speed (Gb/sec)	1	20
Speed perceived by the user (Mb/sec)	10	100
Spectral efficiency	1x	3x
Speed (km/h)	350	500
Latency (sec)	10	1
Number of connected objects over an area (quantity of objects/km2)	10^5	10^6
Network's energy efficiency	1x	100x
Speed over an area (Mb/sec/km2)	0.1	10

[4] Cigref Report: AI in companies, Strategies, governance and challenges of data intelligence, 2018
[5] Cigref Report: 5G, anticipation and opportunities, 2020

Usages, development engines, and practices that appear to be significant trends likely to speed up the adoption and progress of these technologies

Several social and economic phenomena also explain the development of technologies as well as the trade-offs that have taken place to decide on their uses. Identifying them helps to better understand the human behaviour that accompanies and motivates the development of these technologies. In this way, it is possible to contextualise technological tools and understand them as products of a socio-cultural context and not as a natural given.

In particular, it appears that:

For companies, several challenges favour the development and growing adoption of certain technologies. First of all, the integration of technologies into the internal workings of organisations aims to **reduce costs and optimise processes**. With these technologies, economic and/or commercial activities should be more fluid and, therefore, more profitable. Furthermore, the technologies are used to **improve the offer**. In this way, they can be used to **personalise** products and services to customers and **diversify** the company's activities. Finally, these tools can help to **improve the environment of employees** and work conditions.

For consumers and society, the **widespread use of the smartphone** has led to an **exponential increase** in the amount of data produced in real time, an increase amplified by the billions of connected objects installed each year in companies, homes and cities. In a hyper-connected world, each human activity produces data. Sensors, telecommunication networks, servers, processing algorithms and the various human/machine interfaces form a powerful and comprehensive system, the capabilities of which are constantly expanding. These capacities **respond to individual and collective needs**, but also generate **new applications**. Remote working, connected and personalised health, new tailor-made leisure activities, new purchasing opportunities, the need for permanent and varied social relations, more inclusive decision-making systems, etc., all these **possibilities are opened up and shaped** by technological tools.

The major convergence of two or more technologies, which increases their impact, also appears to be a structural trend for the technical issues and challenges of the future

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Chatbots: convergence of AI, natural language, and hardware

Chatbots, such as Amazon Alexa or Google Echo, have developed gradually in recent years. They help to **lighten of certain repetitive tasks**, for account manager for example. They **also offer new services to specific audiences**: HR use for new employees, traveller information, teaching, language learning, etc. The new constraints that a pandemic such as the one that started in spring 2020 can generate, highlight the crucial role that these chatbots play and might play in the future. For example, they can be used to secure the exchange of data and services thanks to voice assistance in public places, train stations, airports or supermarkets, and to provide more intuitive support to vulnerable groups, for example by allowing the elderly, who are not all that at ease with digital interfaces, to interact with robots[6].

Robotisation: convergence of AI and hardware

The increasingly marked fusion between hardware and artificial intelligence makes it possible to envisage the larger scale production of autonomous robots that **are able to compensate for what humans are unable to do**, and their shortcomings or failures in certain actions. Drones are already helping to reach inaccessible places, monitor industrial facilities such as dams or high-voltage power lines, supervise worksites, transport equipment, deliver food, or communicate vital information (particularly in the event of natural disasters). The progress of artificial intelligence in NLP (Natural Language Processing) interactions as well as mechanical automation should enable **major developments in robotisation in the coming years**. Some present-day advances could speed up this process, gradually leading to machines being maintained by robots and improved human/robot interactions. The other major question raised by robotisation remains the ethics of its functions and uses. Debates on LAWs (Lethal autonomous weapons), for example, reveal the challenges posed by replacing humans with robots, in this case in the military field.

6 Robot caregivers are saving the elderly from lives of loneliness, 2017

Point of view

"When looking at technological breakthroughs and disruption in use that they generate, I feel that there are three technologies of prime importance for the next decade: IoT, the ability to create digital twins and, above all, the promise of going beyond "Moore's Law" thanks to quantum computing. In my opinion, the market for connected objects is divided into two main categories. The first includes objects that become naturally connected without any backtracking possible, such as transport methods and everyday private or industrial equipment. They become connected as a standard: household robots, vacuum cleaners, air purifiers, and fire alarms, etc. and this more and more directly, i.e. without requiring a connection. Until now, use was often limited to one sole interface such as the smartphone, however the multiplication of embedded screens in connected products will continue to accelerate. The second category comprises objects that are non-essential "gadget" type functions, such as watches, which will not enter the first category unless they have an added value in terms of service and comfort of use that creates irreversibility!

In the industrial sector, when combined with the use of connectable machines for "reading" each of their activities and parameters in the search for a better use of scarce resources, the modelling of complex physical and material environments via 3D is a major step forward. The ability to study and model the impact of changes in materials or systems on overall structures but also on supply chains is a challenge for the future and being able to study more systematically and in-depth before building or investing.

But it is quantum computing that is going to take us into a new world! With increased real time computing power, the much heard slogan "at the same time" will take on its full meaning with quantum computing. This major technological breakthrough in a wide variety of fields of application will make it possible to perform calculations that used to be impossible in real time. As for road navigation apps, we will have other constrained maximisation apps with more parameters such as the fastest route with the least gradient, or the least kinetic energy, all of which is processed instantly. This will generate new ways of thinking in the search for optimum performance, from energy saving to the security of our internet encryption keys. This will open up our IT teams to new skills, not only in mathematics, physics and computer science, but also in literature and semantics, so that we can better analyse the world around us, better observe it, define it and reinvent ourselves."

Jean-Michel André,
CIO VP Information Systems, Groupe SEB

EMERGING TRENDS

Emerging technologies

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Some technologies are under development and have great potential to transform practices and services. However, there is not yet a consensus on when they will be released on the market, or even the real feasibility of some of them being rolled out on a large scale.

Some of the technologies most likely to bring about a major change include the following:

Edge computing

Edge computing enables **data to be processed as close as possible** to the data source, allowing real time management and in increase in processing performance. Edge computing promises to **reduce network bandwidth requirements and data traffic**, but could also lead to an increase in the number of computing and storage points and thus a reduction in the optimisation of data centres. Most of the data that will come from IoT, Industry 4.0, or connected vehicles, for example, will not be stored or processed in cloud. Current cases of use include real-time and local data management, notification management in order to optimise processing, maintenance and data sensitivity issues. Since data is used and analysed where it is generated, or as close to it as possible, it is not subject to the same regulations as data in cloud (e.g.: American CLOUD Act and the Chinese equivalent). Thus, Edge computing could make it possible to respond to the **growing challenge of data control**, especially for European companies. Some private, industrial or sovereign networks, and the intelligent infrastructure required for autonomous vehicles will demand network resilience that can only be guaranteed by local management, with **secure integration between connected objects, edge computing and cloud offers. Many players are seeking to position themselves on this very promising market**: players involved in cloud and industry, mobility facility operators, and equipment and telecommunication manufacturers.

The challenge for the coming years will be the scaling of edge computing, and the maintenance of connected objects and sensors. This transition could take place gradually over the next five years but will truly take off with the deployment of 5G.

Blockchain: convergence of data storage, distributed systems and cryptography

Blockchain is the **assembly of data storage technologies, distributed systems and cryptography** that gives rise to an innovative data exchange protocol. It is a transactional system in which tracking is distributed among all the players, with the creation of chains of tamper-proof transaction blocks. Blockchain can also be used to set up “smart contracts”, stand-alone programs that, once started, automatically execute the conditions defined in advance and entered in the Blockchain [7]. It is mainly used currency with bitcoin. Blockchain is also developed to improve the tracking of goods, foodstuffs or materials. For some sectors, Blockchain represents a threat (through the risk of disintermediation, or even the potential obsolescence of the business model), for others, it is an opportunity (with the simplification of exchanges, direct transactions). Professionals, depending on the sector, envisage other applications in banking, the medical field, energy, tourism or even the arts. Finally, it is potentially **thanks to Blockchain that true interoperability of connected objects (IoT) could be implemented**. This technology arouses interest but also doubts and distrust. Thus, the elimination of trusted third parties in transactions within five years still seems unlikely despite the growing interest in distributed systems shown even by some central banks (Central Bank Digital Currency). But complex institutional issues do not evolve as quickly as tools. Therefore, currently, Blockchain is mainly the subject of exploratory studies and will develop according to the success of its promises.

[7] Cigref Report: Blockchain, from theory to practice, 2018

3D/4D printing

3D printing is a technology that allows objects to be printed in three dimensions. **4D printing adds a mechanical dimension to the 3D object** such as physical impulses to certain materials (gravity, magnetism, movement, etc.). There are many potential applications, such as the adaptation of objects to the terrain, aerodynamic pressure, or living tissue (in the medical field in particular)[8]. These applications could be developed in the next 5 to 10 years.

3D printing has been around for forty years and is becoming increasingly widespread, yet it is still considered to be an emerging technology, **mainly for specific professional uses**[9]. The few cases of use in Europe during the COVID-19 pandemic reminded the general public about this technology, which made it possible to respond quickly and locally to medical equipment shortages. The use of 3D and 4D printing is truly innovative for the **production of very specific parts**, especially for maintenance and repairs.

The following new manifestations could be equally disruptive if they were successfully implemented:

Quantum computing

Controlling calculation and data at the level of particles, quantum computing should be able to solve all the problems that today's computers are unable to answer with a possible **"universal quantum computer", the promise of quantum supremacy**[10]. This computer will not replace conventional computers, which are much better at performing everyday office tasks, but it will excel in solving problems that require computing power. **This quantum revolution is likely to drastically modify programming and algorithms**, as well as data security. Quantum computing is still in the research phase and it is difficult to assess its real progress.

Nevertheless, the first applications will arrive within 5 to 10 years. The question is no longer whether there will be a quantum computer but who will build it and benefit from it in fields as varied as metrology, **resource optimisation, simulation, data analysis and artificial intelligence**. In recent years, many digital players in hardware, software, cloud, artificial intelligence, big data, or in other sectors (chemistry, finance, communication, transport, armament, etc.) have been progressively investing in it. Quantum computing has the **potential to modify the balance of power in industry,** but also in intelligence, military affairs and the strategic balance. In the world of security, quantum cryptography enables so-called "tamper-proof" communication, where significant advances have already been made. A key issue is **to ensure the evolution of the encryption techniques** used today to resist quantum computing. Therefore, companies must be prepared to invent new uses and new business models and to provide support for new ways of thinking, new working methods and new tools, as well as new skills, all of which are still unknown[11].

"Swarm intelligence"

According to a report by the European Commission[12], distributed intelligence, or "swarm intelligence", refers to the **"collective behaviour of various objects, each performing a number of simple functions and interacting with others in the process".** Like insects or a flock of birds, information systems designed on the basis of this principle manage processes in a decentralised manner through the self-organisation of all their elements. The prospects for the development of such systems relate to applications in **driverless cars, energy networks with distributed energy sources, and search and rescue robots**. There is already a high level of investment in this field. We can expect to see the growth of this field in the coming years depending on the progress of AI, the Internet of Things and 5G.

8 En quoi l'impression 4D influencera-t-elle les techniques de fabrication actuelles ? September 2019
9 L'impression 3D tirée par l'industrie, pas par les particuliers, June 2019
10 Vers la suprématie quantique, December 2019
11 Cigref Report: Quantum computing Understanding quantum computing to prepare the unexpected, 2020
12 100 Radical Innovation Breakthroughs for the future, 2019

Gradual adoption of new practices, uses and services that technologies offer

Virtual collaboration

During the lockdown of much of the developed world in the winter and spring of 2020, certain sectors of the economy, particularly in Asia, Europe and the United States, quickly adopted remote working and virtual technologies that favour remote collaborative work (via virtual reality). If they become a standard, these uses could favour the exponential improvement of revolutionary technologies, including in the industrial sector. Some projects even imagine combining **virtual reality, augmented reality, and intelligent sensors to generate immersive telepresence spaces** that allow users to physically feel the presence of people despite the distance. These technologies, which are still costly, could revolutionise remote working. They could also make it possible to develop new remote practices, particularly in the medical field.

Virtual reality

Virtual reality is a technology that allows an individual to be **immersed in a virtual, digitally created world**. This immersion is achieved with a mask or a room that depicts the desired environment via a 3D hologram. Used widely in the leisure field, virtual reality is increasingly becoming a professional tool. Thus, it could be used to improve remote collaboration. It is already useful for training certain employees, especially in maintenance or the simulation of risk situations.

Augmented reality

Augmented reality is a lighter version of virtual reality which shows virtual elements in the physical environment with the help of special glasses or screens. In addition to leisure, we have seen the development of medical uses (to treat phobias, simulate surgical procedures), industrial uses (to support the work of engineers for example), training (training of first-aiders, military personnel), etc. Although these tools are not yet completely accessible because of their cost, they may become increasingly so in the next few years in view of the many opportunities they offer. Their development will depend in part on 5G, because without it, connected glasses will be unable to simultaneously process voice and data (AI) for a smooth user experience.

Low-code: new applications programmed without a developer

Low-code tools are **development platforms** that do not require programming languages. With a shortage of developers, these tools are starting to be found in some companies. They enable the creation of an application without the need for any prior skills. Similarly, Microsoft's DeepCoder AI is able to write its own code. Such platforms should **facilitate the usual development, debugging and code review processes.** The reliability of data processed on this type of platform remains a major obstacle to its deployment. Another challenge: the high consumption of computing resources by this type of programme raises questions about its medium-term ecological impact. However, these types of tools or techniques could transform professions across the entire programming sector within 5 years. This would have major geopolitical repercussions, particularly in terms of the current use of programming companies based in low-cost countries (offshoring).

IT/OT convergence and digital twins

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IT/OT convergence: convergence of information technology (IT) and operating technology (OT)

Companies are seeking to exploit the full potential of their data and take advantage of the growing **optimisation and enhancement opportunities offered by data processing**, in particular that which can be obtained from their own industrial data. To meet these needs, platforms have been developed to collect, qualify, process, cross-reference and analyse this data. As a result, a company's procedures and the customer experience are improved. This convergence, which initially is technological, creates bridges between the two originally very separate worlds and increases the risk of cyberattacks. But it also brings together people with different skills. Therefore, in addition to safety, the main challenge for companies is to find the best organisation that allows teams to work together. Once this organisation has been found, convergence may accelerate within a few years.

Modelling of flows and digital twins

The creation of digital twins of objects represents a major technological breakthrough. It is now possible to simulate complex material and physical environments that are often long and costly to set up. The use of 3D now makes it possible to model a machine, a vehicle, a ship, a building prior to its construction, and more. **The digital twin makes it possible to create and simulate thousands of hypotheses before moving on to the real world**: simulating a change in a building's architecture, or a vehicle's interior for a professional driver. The twin makes it is possible to anticipate changes and their repercussions on the system, thus offering a large number of professional applications.

MAJOR **UNCERTAINTIES**

Towards hard law in the regulation of certain controversial technologies?

Hard law is different from soft law in that it imposes mandatory rules of law. Thus, the General Regulations for the Protection of Personal Data (RGPD) is a hard-law because of its binding nature for organisations. The European Commission is also working on **other binding laws on digital issues** such as e-privacy and the Digital Services Act (DSA). The DSA would be an upgrade of the 2001 e-commerce directive and would become a new European regulation to "establish responsibilities and security principles for digital platforms, services and products, and complete the Digital Single Market"[13].

However, it is also possible to **privilege self-regulation (or soft law).** This is how the cloud market works, in which data reversibility and portability is left to the discretion of providers. This strategy has its limits for end users, who rarely have their rights respected. Will the European Commission opt for self-regulation of the algorithm market and artificial intelligence (AI) stakeholders? Or will it introduce more restrictive laws for AI similar to the GDPR?

Many stakeholders and innovators are opposed to this, such as the Tech in France association[14], which has warned against the imposition of "disproportionate constraints" that would "stifle innovation", increase delays with competitor countries, and even undermine the sovereignty of the most restrictive nations. Thus, in the current health and social crisis, the choices made by States and/or Europe, especially on the development of a personal tracing application, could be decisive in that it would set a precedent for regulating the use of technologies. Several activists strongly criticise the **possible excesses of the uncontrolled commissioning of tracing technology** for the entire population.

13 Site of the European conference devoted to DSA
14 Régulation de l'intelligence artificielle : l'avertissement de l'industrie du logiciel, 2020

Towards a duty of explicability for algorithms?

The problem of explaining algorithms came to the forefront in recent years, in particular with the development of machine and deep learning. Whereas, up until now, it was possible to explain the results of calculations, calibrate them and justify prior (human) choices in the design of analysis algorithms, the emergence and development of such tools raise the **question of the "black box"**, this notorious box that produces results we can no longer explain. If artificial intelligence is improved, in particular with the development of quantum computing, what are the risks to the understanding of individuals who find themselves subject to the **machine's "decisions"**? This is the **"efficiency/explicability"** dilemma since a more powerful tool also threatens how its functioning can be understood.

These questions are being discussed by many consortiums that are seeking to develop ethical algorithms. Thus, on the occasion of the unveiling of Europe's AI strategy in February 2020 [15], the European Consumer Organisation (BEUC) demanded guarantees to mitigate the risks associated with AI, in particular by defining procedures to ensure that algorithms can be explained. However, these processes are currently **less technical provisions than good practices** by the engineers responsible for the development of algorithms. Therefore, these controversies and the search for technical solutions are expected to continue.

Towards a growing distrust of "all-digital"?

The switch to "all digital" is a manner of risk and concern. **Risk of cyberattacks,** of course, but also **risks of breaches of personal data** and **the freedom of individuals**. Debates are emerging on digital tools for the general population, such as tracing applications in the frame of the COVID-19 pandemic, which are undermining trust in the digital world. Concerns too with regard to the **dehumanisation of social relations**, which are increasingly filtered and governed by automatic and autonomous interfaces. Also, there are concerns about the increasing **disconnection** between those who have access to and understand digital technology and who are, therefore, able to make good use of it, and those who are deprived of it or who are subject to it without being able to defend themselves against potential abuses, thus **widening the digital divide**. However, one major and seriously underestimated risk is that **digital illiteracy** [16] may increase social stratification between the richest and the poorest, the most educated and the least digitally literate. This situation presents huge challenges in a context in which digital technology is emerging as the **preferred solution** in many institutions and administrations, especially at a time of crisis. This under-investment in training, particularly in France, will be more difficult to make up for than that in terms of infrastructure.

There may also be some level of resistance, even disputes, against the imposition of digital technology by companies and public authorities (surveillance practices, health issues). It is necessary to take these warning signs into account so as to work towards developing **strong trust between users, beneficiaries, and providers**.

[15] Europe's digital future must benefit consumers, February 2020
[16] Livre blanc contre l'Illectronisme, October 2019

What are the impacts of the environmental challenges on the digital sector?

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Environmental challenges may play a major role in the development of new technologies in the future. Indeed, environmental issues may increase **distrust in digital technology by certain members of society**, as seen by the strong opposition to the development of 5G. These issues may also lead to the introduction of restrictive laws designed to reduce the negative effects of digital technology, in particular through the implementation of a "green tax" [17], for example, or an **"environmental tax"** [18].

Furthermore, and precisely because digital technology is highly dependent on natural resources and rare materials, the exponential growth of technologies in recent years may be **significantly reduced by increasingly restricted or costly access to the materials required** for their proper functioning and/or by higher energy costs (see Field 2 "Digital technology and environment").

[17] Can a "green tax" be an incentive to reduce pollution in your country?
[18] OECD's environmental taxation website

WILD CARDS

Collapse of all or part of the Internet as a result of infrastructure vulnerability

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Submarine cables, particularly in Africa, have suffered a number of failures in recent weeks and the question of their maintenance, already difficult in normal times because of access and the heavy investments to be made, has become all the problematic in the context of a global crisis that is paralysing part of the workforce and travel [19]. Furthermore, the malicious acts seen during the crisis are very revealing of the network's weaknesses. These weaknesses do not concern its capacity but its physical and software integrity, and the physical security of mobile and network infrastructure.

Moreover, the deployment of the Elon Musk Starlink network[20] raises questions about the future risks associated with the use of satellites for ensuring the planet's network coverage.

Rapid availability of operational quantum computing

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Quantum computing may be operational earlier than expected (within 5-10 years rather than 20 years). An expected early arrival should encourage global organisations to start studying the challenges of the international governance of quantum computing, taking into account the consequences that are already known (deciphering of security algorithms, etc.) and anticipating the possible risks for information technology.

The significant impact of quantum computing on security and encryption issues is already being anticipated with quantum cryptography. The security of digital exchanges and sometimes even the vital infrastructure that relies on digital technology could be seriously jeopardised. The emergence of this communication algorithm decryption technology may disrupt all encryption systems and pose serious risks for companies and States. The post-quantum encryption market is already working to respond to what today is still a *wild card*.

This wild card can also be found in Field 3 "Cyber risks and geopolitical challenges".

[19] Opérations de maintenance des câbles sous-marins compliquées par le COVID-19, 2020
[20] Encombrement spatial et risques liés aux ambitions, 2020

Low cost revolution in electronic components of equivalent performance

If researchers managed to find a way to make low-energy components with everyday materials (especially organic materials), electronics could overcome its dependency on rare earth minerals. Economical in terms of production costs and energy consumption, this revolution would transform the electronic components market and challenge current well-established suppliers (Intel, Qualcom, AMD, Nvidia, etc.).

This wild card can also be found in Field 2 "Technology and environment".

Development of a brain/machine interface

Going beyond science fiction, several initiatives by stakeholders in Silicon Valley are seeking to create a possible human/machine connection. Ray Kurzweil, the author of several books on the future of machines, suggested as early on as 2015, two years after his arrival at Google, that we would be close to creating a connection between the brain and artificial intelligence by the 2030s[21]. More recently, Elon Musk's Neuralink project involves building brain implants to help people communicate with machines[22]. To date, only a few experts support this project. However, if it succeeds, it would represent a genuine revolution in neuroscience, professional practices, and everyday life. That said, it appears to be a prospect much further down the line than 2030[23].

21 Artificial intelligence, human brain to merge in 2030s, says futurist Kurzweil, 2015
22 Neuralink présente ses prototypes d'implants, 2019
23 Neuralink, rêve ou réalité ?, September 2017

Point of view

"My vision of the Digital technology of the future can be summed up in three key words: agility, frugality and responsibility.

I'm convinced that the current unprecedented crisis marks a turning point in the management of IT investment: IT is now a rare resource for the Bank. We are now moving towards the simplification of our operational models: agile methods targeting short development cycles that enable a better understanding of needs, will become more commonplace and taken to their very highest level.

At the same time, CIOs will have to be more disciplined about norms, standards, architecture and security rules, and their ability to reuse and avoid duplication in the application base, all of which will help to ensure technological foundations in companies that ensure interoperability and frugality "by design".

Finally, this transformation will be accompanied by a shift towards more responsible Digital technology and awareness of our environmental (energy consumption, waste management) and social (inclusion, ethics) footprint. To that end, I am proud to have signed the INR's "Charte Numérique Responsable" (Responsible Digital Charter) last November on behalf of the Société Générale."

Christophe Leblanc,
Group Head of Corporate Resources and Digital Transformation,
Société Générale Group

Technology and environment

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Digital transformation and ecological transition are closely linked:

- The digital sector relies on the consumption of natural resources and energy and is responsible for externalities (CO2 emissions, pollution, etc.). Therefore, it is directly concerned by the objective of ecological transition.

- On the other hand, digital technology can also be a source of innovation and technologies that can speed up or delay the ecological transition.

- The objective of technological progress as we largely understand it today is to improve performance, thus extending opportunities for use, which necessarily increases energy consumption. Overall, the volume of digital activities and uses is increasing faster than progress on energy efficiency in technologies.

Point of view

"Progressing from being an enabling technology to become an additional dimension in our lives and our systems of thought over the space of twenty or so years, seen as being the central element of the 4th industrial revolution that will allow us to relaunch growth, a catalyst for globalisation, and a promise of emancipation as well as a threat of hypercontrol, Digital technology is naturally at the centre of our thinking at times of major upheaval. The most important aspect in the short term is the obligation to halve our greenhouse gas emissions by 2030 if we want to limit global warming to 2 °C.

To ensure Digital technology's continued ability to create lifestyles that are compatible with this constraint, it is essential to prioritise digital uses and limit the direct environmental impact of digital technology, namely a complete departure from the (very recent) habits we have adopted. This new way of thinking, even of challenging, concerns consumers, businesses, regulators and, ultimately, providers. With this new dynamic getting underway in France, it will be crucial to extend it throughout Europe as of this year."

Hugues Ferreboeuf,
Project Manager, The Shift Project

STRUCTURAL TRENDS

Global context: growing tensions on climate, natural resources and ecosystems

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Global average temperature increase

The latest forecasts by the IPCC (Intergovernmental Panel on Climate Change) suggest that the global average surface temperature could rise by **1.1 to 6.4 °C** by the end of the 21st century[24]. The most recent models (by the IPSL for example) show that 2 °C will be reached before 2050. This phenomenon is directly linked to the rise in greenhouse gas emissions, especially CO2, which have almost doubled in 30 years and continue to increase, whereas the target of not exceeding 2 °C requires a reduction by half within the next 10 years.

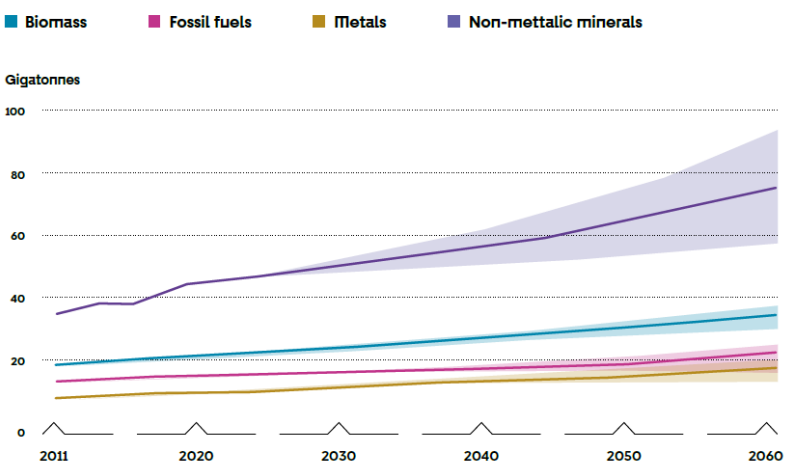
Explosion in the global consumption of natural resources

In parallel, over the past 50 years, the global consumption of resources has tripled while, over the same period, the population has doubled and the GDP has quadrupled. For example, since 1970, extraction of metal-bearing minerals (necessary for industry and ICT in particular) has more than doubled.

Decline in global biodiversity

Finally, all scientific publications record an acceleration in the **decline of biodiversity** on a global scale, going hand-in-hand with a **large-scale deterioration** of ecosystems.

GROWTH IN MATERIALS USE DEPENDS ON POPULATION AND ECONOMIC GROWTH ASSUMPTIONS



Source : Global Material Resources Outlook to 2060 - Economic Drivers and Environmental Consequences[25]

[24] Les deux modèles de climat français s'accordent pour simuler un réchauffement prononcé, September 2019
[25] Global Material Resources Outlook to 2060, OCDE, 2019

Digital technology: a tool for responding to environmental challenges and risks of negative impacts

Digital, a green transition tool

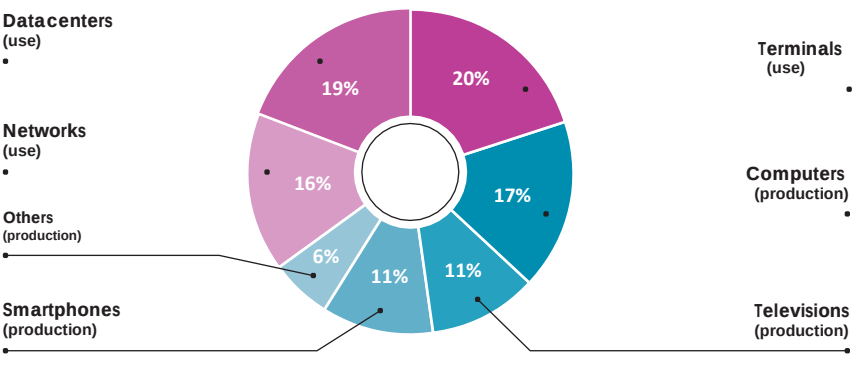
Digital technology, via **sensors and the modelling** of past, present and future phenomena, offers a better **understanding of the environmental situation** and the state of the planet. Data collection and models were developed in the 1960s to create the first models of the atmosphere. Today, they integrate more parameters, more computing power, and make it possible to produce predictive models.

It is also possible to use digital technology to help **rationalise, monitor and optimise energy** and thus reduce the carbon footprint. IoT sensors, for example, can be valuable for managing and optimising resources in many areas (agricultural, thermal, mobility, etc.). The COVID-19 crisis has shown how remote working and collaborative tools can be alternatives to travel
which consumes high levels of CO2 locally (car) and globally (plane). The paperless office, made possible by digital technology, has also accelerated during this crisis. Finally, many analysis tools (AI, Big Data, geolocation system, highly-professional call centres) have helped improve decision-making, thus optimising the consumption of resources.

Growing environmental impact of digital technology

However, the impact of digital technology on the environment is just starting to be taken into account. **The supply of resources, whether rare materials or water, is a problem.** By nature, rare materials, currently essential for producing certain components in digital devices, are not available in unlimited quantities. Yet, digital technology requires more and more resources to manufacture equipment, infrastructure and data centres. Furthermore, **the issue of high-water consumption and end-of-life recycling are not taken into account.** Just 15% of Waste Electrical and Electronic Equipment (WEEE) is recycled worldwide. Finally, **the very use of digital tools consumes energy and generates greenhouse gases (GHG).** The Internet alone is said to account for 10% to 13% of global electricity consumption and 3% to 4% of global GHG emissions, more than civil aviation. In France, digital technology
accounted for 2% of greenhouse gas emissions in 2019[26]. By 2030, up to 100 billion smart objects could be in operation around the world, meaning that nearly half of the world's electricity would be consumed by digital technology[27]. According to the French Senate's information mission on the environmental footprint of digital technology, digital terminals already accounted for 70% of the carbon footprint in 2019.

Breakdown of digital energy consumption by terminal for production (45%) and use (55%) in 2017



Source: The Shift Project 2018

There is therefore a tension between the **two digital and energy transformations,** which is in some way contradictory. Up until now, the leading digital players appear to be refusing to tackle it. Forecasts by hyperscalers do not include the issue of the sustainability of their models and services, especially because end consumers continue to be relatively unaware of the impact of these dematerialised services on their physical environment.

[26] Rapport du Sénat français pour une transition numérique et écologique, June 2020
[27] *Pour une écologie numérique*, Eric Vidalenc, Les Petits Matins / Institut Veblen, 2019

Worsening of the environmental situation as a result of planned new technologies

At present, as a result of more intensive use, we generate 30% more data each year, technological progress absorbs part of the growth at a constant rate of energy.

Concerning the Internet of Things (IoT), The Shift Project[28] estimates that the energy needed to make smart objects work is, at an individual level, relatively low. However, owing to the number of objects deployed, current consumption could increase by 25% by 2025. The additional energy consumption from the IoT in 2025 could, therefore, be about 200 TWh, not counting the indirect impact on network and datacenter consumption. In the same way, AI results in higher consumption.

In terms of network, more sites will be needed for 5G to achieve cover similar to 4G (about a factor of 3). Furthermore, a site's energy consumption would increase by a factor of 2 to 3 after a few years. Therefore, there will be an increase in electricity consumption from radio cover for mobile equipment. Edge computing is also at the heart of the debate: with a reduction in throughput on the one hand and the multiplication of small, energy-intensive data centres on the other hand.

In response to these challenges, regulatory frameworks are increasing and becoming more stringent

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Climate policies

In response to the acceleration of climate change, strategies are being introduced by States and local authorities to reduce their greenhouse gas (GHG) emissions. France, which, **in 2007 committed to cutting its greenhouse gas emissions by four**, is now aiming to achieve a balance, "carbon neutrality", between GHG emissions and the reduction or absorption of these GHG by 2050[29]. The government integrated this objective in the "Energy and Climate" law, promulgated on 8 November 2019. Regional authorities, for their part, are setting up strategies to adapt to climate change, while inter-municipal authorities are all required to have a climate, air and energy plan. On an international level, climate negotiations were marked by the signature of the **Paris Agreement in 2015.** However, it has only been ratified by 55 countries. Therefore, public climate policies are progressing at unequal rates in different countries and regions and are not yet sufficient to curb the rise in greenhouse gas emissions. These policies could be confirmed as part of the relaunch of European autonomy in response to the COVID-19 crisis, or, conversely, be delayed if the economic and social upheaval of current events takes precedence over energy priorities.

Growing importance of the evaluation of the environmental impact of companies by their directors as well as in investors' decisions

More and more companies are paying close attention to climate change and their impact on the environment and are seeking to regularly assess and offset their negative externalities. Some, at their own level, are even committing to "carbon neutral" strategies[30].

At the same time, in the financial sector, investors are increasingly taking these aspects into account. They include them in their investment models, thus showing their awareness of the role they can play in **transforming** the most polluting activities even going so far as to **completely eliminating them**. The bank JP Morgan Chase announced in February 2020 that it would withdraw from all financing of oil and gas projects in the Arctic [31]. This phenomenon could even become more pronounced if the price of raw materials continues to fall in a climate of global economic crisis. The decline in the price of oil during the COVID-19 crisis is one example of this leading us to rethink the structuring of financial assets, heavily dependent on the oil sector up until now.

[28] Déployer la sobriété numérique, The Shift Project, January 2020
[29] Stratégie nationale bas carbone, October 2020
[30] Neutralité carbone, Novethic, October 2019
[31] Quand les banquiers se désengagent du pétrole, Agence Science Presse, February 2020

EMERGING TRENDS

Increased public awareness of the impact of technologies on the environment

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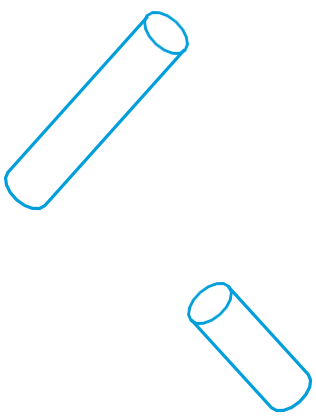
The growing number of studies and statistics (The Shift Project, Fing, Green IT) highlighting the negative impact of digital technology on the environment is encouraging a **growing awareness** among the general public. More and more associations and collectives are taking up the subject in order to raise awareness of these issues and make the population and leaders aware of their responsibilities.

In response to these citizens' demands, several major French business leaders organised a forum at the peak of the COVID-19 crisis, explaining the need to make economic recovery an accelerator for the ecological transition[32]. Thus, in July 2020, the National Digital Council published a roadmap for a national and European agenda on responsible digital technologies and the convergence of digital and ecological transitions[33].



Growing wish among workers to join more sustainable companies

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In recent years, workers' expectations with regard to their employers appear to be changing, especially among young people. In France, in 2018, nearly 30,000 students and young graduates signed the ***"Manifeste étudiant pour un réveil écologique"***[34]**,** in which they undertook not to work for companies that are not environmentally-friendly. Companies in Silicon Valley, including Google, also face **criticism from their employees** when they make decisions that they feel go against the principles of CSR (Corporate Social Responsibility). These wishes are gradually being taken into account by some companies, which try to respond to them and promote ecological values in particular.

Emerging interest for low tech in particular in developing countries

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In response to increasing dependency on digital technology and its environmental impacts, players now want to promote "low tech". These are technologies that are practical, cheap and easy to use. They also contribute to **reducing the consumption of resources** because they are based on second-hand or recycled materials, and **promote the use of renewable energies.** Low tech is traditionally developed in the poorest countries and in developing countries. But, in recent years, there has been a renewed interest in them in rich countries. In France, they were launched into the mainstream in 2014 by the engineer Philippe Bihouix in his book, *L'Âge des low tech* [35].

32 Entreprises de l'industrie (Thales, Airbus, Renault, Michelin), de banques et d'assurance (Axa, Société générale), des transports (SNCF, RATP), du luxe (Kering, Chanel), de l'énergie (EDF), de l'agroalimentaire (Danone). "Mettons l'environnement au cœur de la reprise économique", May 2020

33 Feuille de route du Conseil National du Numérique sur le numérique et l'environnement, July 2020

34 Taking action for an ecological awakening !

35 L'Âge des low tech, Philippe Bihouix, Seuil, 2014

Point of view

"Like any new discipline filled with hope and risk ("science without conscience is only ruin of the soul" declared Rabelais), Digital technology brings its own cohort and does not escape assessment and repositioning. In an even more holistic approach, the current health crisis, the impending environmental catastrophe and the increasing sensitivity of people to subjects such as freedom and responsibility must encourage us to constantly review the overall value of our digital investments and uses.

It is possible to draw up a simple inventory of good digital practices to disseminate in our companies. Some of them should become systematic: measurement of the code's environmental performance, rise in the rate of reuse of IT and digital assets, extension of the lifespan of assets based on their simplicity, systematic and detailed measurement of the rate of use of these assets, the real contribution of a new solution to protecting the environment. In more industrial terms, the optimal performance of datacentres, networks, components and workstations.

However, I am also convinced that digital technology is a fundamental lever for environmental protection and that it is in these projects that the true value of future investments will be seen. Take for example: optimal management tools for resources that take advantage of AI, multiple data and support for instant decision-making; real-time monitoring and optimisation of our energy consumption; monitoring of processing chains (logistics, food, industrial, health, etc.) with a view to reducing energy consumption.

And if the lesser of two evils has to be chosen, it is highly likely that environmental supporters will realise that Digital technology, despite its undeniable negative impact on the environment, remains an excellent alternative and a major ally in their struggle for the future of the planet. It's up to us to prove them right by showing maturity and reason."

Jean-Christophe Lalanne,
EVP IT, Air France-KLM

MAJOR UNCERTAINTIES

Towards a better use of digital products, towards greater digital simplicity?

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Today, consumers are unable to really visualise the **true environmental cost** of digital technology. It is difficult, for example, to realise the impact on available resources and ecosystems of storing an e-mail or sending an SMS, an impact which is much more perceptible for air traffic, for example. In the future, could this awareness be increased with communication campaigns, or **tracking tools on the real GHG consumption of a digital product?** Who could be behind such educational actions?

Moreover, the extensive use of digital tools, whether in remote or face-to-face work situations, does not appear to be going in the direction of digital simplicity, unless it is strongly compensated for by a reduction in other consumption. If certain practices were required to persist in companies and in society as a whole in the longer term, especially when it is a question of maintaining social distancing rules, it is clear that they will have to be accompanied by an analysis of an ecological and reasoned adaptation of tools and uses.

Towards restrictive standards or taxes for businesses when it comes to digital technology?

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The rise in energy consumption and GHG emissions generated by digital technology has been particularly rapid, but it is also very recent.

Moreover, the benefits brought about by digital technology are used by businesses, consumers and public authorities alike. As a result, they have not yet attempted to reduce the environmental impact of digital technology. However, in the future, the situation may change in view of the expected rise in the negative externalities of digital technology and the acceleration of climate and environmental issues. Therefore, French public authorities and the European Union may gradually impose **new standards on network operators and/or digital equipment and service users.**

Towards new technological tools that help effectively reduce energy consumption?

Today, there are no satisfactory solutions for reducing the consumption of natural resources for digital technology. Fairphone, for example, works to develop more sustainable and environmentally-friendly tools, but it is unable to fully restrict the negative externalities of its products.

Technologies could also help produce or exploit other energy sources. For example, **lithium-ion batteries** would, in time, make it possible to store solar energy on a large scale with ever more autonomy[36]. Other avenues being explored include **the use of cells as calculating organs** with a very efficient energy balance, or the **storage of electronic data in DNA**[37]. Indeed, data storage, as it exists today, is not sustainable in that it is energy-intensive and will soon be limited in terms of storage space. The density of data that can be stored on one gram of DNA is huge (215 petabytes) and would enable almost unlimited storage. However, the commercialisation of this technology is still a long way off (development requirements and high cost) and in any case, it is not in line with the target of halving GHG emissions within 10 years.

Towards an international consortium of digital companies for the environment?

Today's digital players **lack a common culture on ecology** and tend to approach environmental issues as a series of challenges, targets, and problems to be solved, without adopting a **more ecosystemic approach**[38].

However, digital technology cannot offer a universal solution to all environmental issues. It should be considered as a tool that is part of a collective approach, in which governance is shared, in particular with civil society. In the future, digital companies, because they have the tools to organise a joint reflection, may decide to offer the frameworks and resources to think collectively and holistically about environmental issues.

36 Will climate change derail the Asian Century, 2020
37 100 Radical Innovation Breakthroughs for the future, 2019
38 Réconcilier transition écologique et numérique, 2019

WILD CARDS

Unavailability of strategic natural resources

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The digital sector has been able to develop thanks to the **low cost of non-renewable resources.** The rise in the global consumption of some of them (in particular rare earth minerals), also driven by other sectors (such as renewable energies) may generate **tensions concerning access to them in the medium-term**. Some of these tensions may be temporary (time to adjust supply necessary for the exploitation of new deposits), but others may be more long-term as a result of the depletion of certain resources or geopolitical tensions. There is expected to be a sharp decrease in natural resources, especially rare earth minerals, for several reasons. **The impossibility of extracting** strategic natural resources due to tools that are not very powerful or not powerful enough, **the decline in investment**, or **the impossibility of continuing the activity** of certain strategic sectors in the case of a global economic recession for example, are all potential reasons for a sudden difficulty in accessing strategic resources.

Moreover, China, for example, may abruptly decide to withhold rare earth minerals, (it owns 90% of them[39]), effectively causing a **major geopolitical disruption.** At the very least, this would result in soaring prices and also probably in shortages. Such a situation would encourage stakeholders to increase the recycling capacity for the materials in question, extend the lifetime of components and/or look for replacements.

Development of frugal, bio-inspired artificial intelligence

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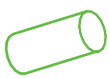
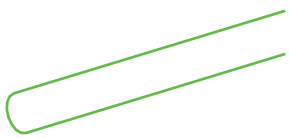
Artificial intelligence, especially deep learning algorithms, require a **very large amount of data** in order to be trained and become relevant for the task they have been given. **The energy consumption** needed for machines to learn AI is also very high: indeed, the AlphaGo machine consumes dozens of kilowatts compared to a Go player whose (organic) brain only uses a few dozen watts. Researchers at DeepMind, the designer of AlphaGo, regularly work on the continuous improvement of their machine's energy performance, but with the same types of algorithms[40]. In several fields, such as armament and aeronautics, developers are already designing their embedded IT systems to consume as little as possible, via miniaturisation, an old version of frugality. Some stakeholders aim to develop alternative algorithms that are much more frugal and bio-inspired**.**





39 Les terres rares sont rares, March 2016
40 AlphaGo Zero: Starting from scratch, 2017

Violent rejection of digital technology driven by environmental issues

While digital products are still widely consumed and coveted, the multiplication of strongly committed militant movements for the environmental cause (such as Extinction Rebellion[41]), especially among young people (see the climate strikes initiated by Greta Thunberg) could be the first sign of a radical rejection of digital technology. Faced with the inaction of public authorities on the regulation of the digital sector, and the inability of digital companies to offer greener solutions, a growing section of the population, in Europe for example, may severely restrict their use or ownership of digital tools (smartphones, computers, and also cloud, drives, etc.) and turn to more low-tech technologies. This violent rejection of digital technology could lead to drastic regulatory constraints on the environmental impact of digital technology.

Drastic regulatory constraints on the use of digital technology for environmental reasons

Because of the strong annual growth in its energy consumption, the digital sector may need to be much more regulated by means of coercive measures designed to reduce its carbon footprint. Such measures currently apply to the automotive sector, which is forced to adopt a gradual decrease in its carbon footprint with very demanding laws. With the consistently pessimistic announcements by the IPCC, the European Green Deal[42] may decide to greatly restrict the entire digital technology sector. If this were the case, 5G may not even deployed or it may be necessary to remove the previous 2G/3G layers before deploying it, there may be a strong limitation on mobile phone use, and a strong decrease in the energy consumption of datacentres and digital uses.

Towards a society of digital control for the ecological transition

Furthermore, the use of digital technology for the ecological transition may involve using digital technology as a means of controlling non-responsible behaviour. Thus, the emergence of a more ecological civilisation may be based on tools developed by the leading digital players in order to make citizens aware of their responsibilities and penalise consumption deemed to be harmful to the environment. Chinese social scoring I planned to integrate health data collected during the COVID-19 crisis. It may be applied to environmental issues and directly involve citizens in reducing the environmental impact.

41 Nos revendications, Extinction Rebellion
42 A European Green Deal: Striving to be the first climate-neutral continent

Cyber risks and geopolitical challenges

3.

Although the increasing use of digital technology by businesses is a source of opportunities, it also reinforces risks of all kinds, especially cyber risks. Whether for criminal or geopolitical purposes, companies are subject to many attacks and their number increases as the scope of digital technology grows. In the midst of the COVID-19 crisis, the sometimes-unsecured posting of a certain number of critical activities, the increase in data collection from the high-speed switch to the digital management of numerous procedures and services raised the issue of the resulting new cyber risks. Moreover, the strong involvement of companies in geopolitical issues is a potentially destabilising factor, as illustrated by the commercial strategies of China, the United States and the EU. Companies are becoming increasingly involved in the political ambitions of these States. The capacity of organisations to protect themselves against these threats, and ultimately to work in degraded conditions if necessary, is a great challenge. Here again, a company's resilience is crucial and requires it to improve its ability to anticipate these risks and its adaptation protocols.

In this document, cybersecurity will be understood as the technical, legal and human activities required to tackle the risk of fraud and hacking that are harmful to the interests of others. It is designed to protect against state cyber conflict, cybercrime, cyber activism, cyber-terrorism and computer fraud. Offensive capabilities remain the responsibility of national services.

Point of view

"With the health crisis, companies have faced a huge shock that will affect their economic balance in the coming months and years, with the likelihood of a decrease in IT budgets and those devoted to cybersecurity. Yet, in this difficult economic context, diplomatic tensions are on the increase against the backdrop of the Sino-American trade war, and consequently a growing inter-state cyber threat. Specialist national services are currently reinforcing their offensive cyber capacities. Moreover, the COVID-19 crisis itself is being used in an intensive manner by cyber attackers and follows a period of a steady rise in the number of attacks. Since December 2019, there has been an explosion in the number of cyberattacks on large groups and public organisations.

At the same time, the mass recourse to remote working has led to the opening up of information systems, which is endangering company systems. This period has shown that remote working may become common practice in the future. For organisations, this requires the ability to secure access to business applications and provide secure collaborative tools and adequate supervision and control systems, especially for the remote management of workstations. With the use of the cloud set to increase, cybersecurity issues involving cloud will also probably change. Organisations will have to prepare themselves to manage a multi-faceted health and cyber crisis. In view of the above, organisations will be required to devote part of their recovery effort to cybersecurity, because it has now become of critical importance for them."

Jean-Claude Laroche,
CIO Enedis

STRUCTURAL TRENDS

Exponential growth of the cyber threat

The development of new tools and new practices generates vulnerabilities as **networks** (Internet of things, 5G) and **contact and exchange points** (data collection and storage) **grow and become increasingly complex**. These vulnerabilities are sometimes overlooked by stakeholders and, therefore, may be poorly anticipated.

For example, the large-scale move to remote working during the lockdown brought on by the COVID-19 pandemic and the subsequent explosion in the number of connections, data exchanges and online practices were immediately exploited by many cyber-attackers with mainly criminal intentions (phishing campaigns, identity theft, strong development of mafia networks, etc.). However, this exceptional situation is typical of the many threats to businesses and individuals in cyberspace. We have seen attempts at industrial espionage (theft of login details and even company secrets) and political destabilisation (WHO, laboratories and hospitals have been particularly hard-hit).

This variety of incidents, condensed over a short period of time, demonstrates **the complexity and long-term nature of cyber threats** which may come from players with a variety of intentions and with more or less serious consequences. ANSSI has identified the main digital threats weighing on citizens, businesses and States as:

- The exfiltration of strategic data for the purpose of espionage
- Destabilisation or influence operations designed to paralyse or sabotage the activities of the entity concerned
- The illegal generation of cryptocurrency for profit-making purposes
- Online fraud, including ransomware is one good example
- Indirect attacks that take advantage of relationships of trust in order to circumvent security measures and access sensitive data.

In 2019, more than half of data leaks in France were of malicious origin (54%)[43]. In the first half of 2019, nearly 812,000 people had their data leaked but only 1,035 notifications of data breaches were submitted to the CNIL. In France, there were 69 large-scale attacks in 2019.

[43] En 2019, plus de la moitié des fuites de données ont été d'origine malveillante, January 2020

Structuring of the darkweb

Some of these threats seem to be getting worse due to the strong involvement of certain criminal interests. According to an analysis firm specialising in Blockchain, it is believed that illegal bitcoin transactions on the darkweb represented $283 billion in 2019, after peaking at $875.5 billion in 2018. Another interesting fact, ransomware is believed to have made at least $6.6 billion in 2019[44]. The development of this underground market on the darkweb is a matter of great concern. All types of players can be found there, all types of information are sold there, there is even a blockchain of databases being developed there, and future attacks are being prepared there. This space is organised around protection schemes reminiscent of Mafia organisations. **Knowledge of these networks is becoming one of the priorities** adopted by companies through partner companies or freelance experts with a view to anticipating attacks, keeping abreast of new types of attacks, and identifying new behaviour by cyber attackers.

The cyber risk and darkweb economy[45] are growing because it is a highly lucrative and relatively accessible business. Criminal organisations in Italy, some Eastern European and West African countries, and also drug trafficking networks in Latin America are turning their hand to this profitable market that presents fewer risks for them. There are also strong ties between those behind these networks and political regimes or regulations in some countries. **No-one can escape the risks which, by definition, are just as international as the Internet is**. Thus, during the COVID-19 crisis, the diversion of Internet traffic by State players alarmed companies. Furthermore, all countries, even those with the most developed cyber infrastructure, and even those accused of carrying out attacks themselves, are being attacked by other players.

Businesses and States with little legal baggage to manage cyber threats

The lack of legal, technical, educational, predictive and reactive tools, as well as the lack of awareness among the populations, companies and States concerned partly explains the difficulties encountered by players subject to cyber risks. The failures of multilateral negotiations, highlighted by the impossibility of reaching a consensus document for the United Nations Group of Governmental Experts (UN GGE) on information and telecommunications, illustrate the difficulty of regulating cyberspace with international law. States, torn between divergent interests, do not agree with the objectives and means to be implemented. For the time being, international economic competition does not make security a genuinely differentiating subject for States. Admittedly, EU policies are gradually starting to help States manage threats (*EU Cybersecurity Act*) and are developing security measures for European businesses, such as the Network and Information Security Directive. However, this does not necessarily give them the means to fight cyberattacks. SMEs and VSEs are particularly vulnerable. SMEs and VSEs are particularly vulnerable, “not least because of a lack of skills, increased by a growing shortage of cyber security experts”.

Growing inequalities between countries in terms of cyber security

Although all players are subject to cyber risks, including those most ahead in research and protection, or even attacks, some countries and entire regions have particularly vulnerable digital infrastructures. Several African states are in such a case, but there are also some European countries, such as Georgia[46] or Ukraine, often attacked on a massive scale in a manner that is extremely debilitating. **The presence of “weak links” in the Internet has a strong impact** on the defence capacities of all interconnected entities. This aspect is fundamental to understanding the critical need to establish certain common international security rules.

44 2019, une année record pour les cyberattaques sur les cryptomonnaies, February 2020
45 Welcome to the darknet, Thomas Frey, January 2019
46 La Russie accusée par les Etats-Unis et le Royaume Uni d’une cyberattaque en Géorgie, February 2020

Need to improve the cyber security capacities of the entire ecosystem, particularly among SMEs and VSEs

In the same vein, and in view of the exponential growth of the scope of the threat, one of the major challenges in the fight against cyberattacks, and a means of defending oneself against them, is also to secure all the links in the chain at the level of private stakeholders. Large companies are strengthening their systems' defence capabilities, but still remain dependent on openings and interconnections with other systems; from their subcontractors to their customers. Subcontractors sometimes have less means to protect themselves. These vulnerabilities need to be taken into account.

Dependency on the solutions offered by digital giants

The sudden massive over-consumption of services provided by Google, Amazon and Microsoft following the successive lockdowns decreed in March 2020, has brought to light the **near-monopoly position** which these companies have **on the infrastructure, operating systems, and collaborative systems** in North America and Europe. Furthermore, it appears that these suppliers' strategy is focused on a gradual takeover of the systems that are made available to companies for storing data, and processing and analysing it, thus taking the place of organisations when it comes to their information systems.

This situation of dependency on an outside player, which may fail in its duties or decide to use its position of strength (price increases, new conditions for accessing data, etc.) raises many questions about the future use of these services and the possible development of alternative solutions that help to ensure national or European digital sovereignty.

Disparity between American, Chinese and European policies in terms of personal data protection

Europeans were the first to highlight **the poor practices** of American players with regard to ends users **in terms of personal data**. The many negative reactions of American companies to the General Data Protection Regulation illustrate the difference in how privacy is viewed by the two different cultures. Thus, the adoption of the CLOUD Act in the wake of the Patriot Act requires American service providers to divulge the personal data in their possession when they are requested to do so by the American authorities.

Nevertheless, the subject of personal data protection is starting to be taken into account on the other side of the Atlantic. In July 2019, the US Federal Trade Commission fined Facebook €5 billion following the Cambridge Analytica affair, which represented about 9% of Facebook's turnover in 2018 (despite the GDPR only authorising up to 4% of turnover). The use of facial recognition at airports in the United States has also led the US Privacy and Civil Liberties Oversight Board to launch an inquiry into these practices[47].

In parallel, China is also developing its own data policies with the Cybersecurity Law[48], which makes it possible to impose the storage of data in its territory and control the data of its citizens and its businesses, in particular through data filtering by means of the Great Firewall set up two years ago already.

47 Examine Use of Facial Recognition and Other Biometric Technologies in Aviation Security, June 2019
48 China's Cybersecurity Law: What You Need to Know, June 2017

EMERGING TRENDS

Internet balkanization
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Today, national, regional and international laws overlap and compete with each other because the Internet is a **cross-border space, even a "borderless" space**. Tomorrow, States may decide to close their borders permanently to foreign interference. This is already partly the case: Russia and China impose their own IT technologies in their territory. We are seeing an increase in the power of some countries and groups of countries organised around the same digital regulations. This situation may have **major long-term economic and regulatory consequences.**

In Europe, the General Data Protection Regulation (GDPR), through its application via the Privacy Shield, is a European attempt to **extend data privacy law beyond its borders**. Nevertheless, although the Privacy Shield provides for the application of European privacy law on American soil when the data concerned belongs to European citizens, the different American national security laws actually apply before the Privacy Shield. The Patriot Act of 2001, and the CLOUD Act of 2018 offer the US government a means to circumvent the GDPR according to national needs.

According to the advocates of a "free" Internet[49], the world is gradually moving towards a "splinternet". Whereas the world wide web aimed to globalise access to the web and its content, and thus to knowledge, transcending national borders, the rules that are gradually being put in place to limit abuse (or in other cases to introduce censorship) appear to be causing **splintering**.

In the future, international groups may be required to operate in an increasingly balkanised world, which raises particularly complex issues for multinationals.

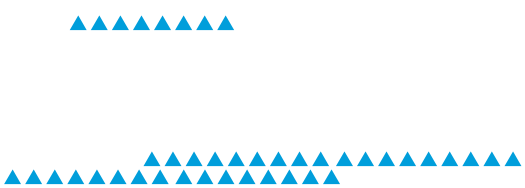
DIFFERENCES BETWEEN THE INTERNET AND THE "SPLINTERNET" ACCORDING TO FORRESTER[50]

PLATFORM CHARACTERISTICS	INTERNET	SPLINTERNET
Technology standards	Controlled by open standards bodies (e.g. W3C)	Controlled by platform vendors (e.g. Apple, Facebook)
Screen format	PC-screen sized	Varies from large to small, landscape or portrait
Interactive applications	Based on Flash, Java, etc.	Based on proprietary platform kit
Permitted applications	Any	Only those permitted by platforms
Searchability	All sites	Only site elements not behind a password; applications not included in searches

[49] Défenseur d'un Internet libre, vers la balkanisation d'Internet, April 2019
[50] The Splinternet and Travel Distribution, June 2020

Use of cyberspace as a means of political pressure

Cyber space is increasingly being used as an arena for conflict and political pressure between States. The many espionage actions and cyberattacks are endangering countries' critical systems. Some are even being used as levers for negotiation. Consequently, the United States, China and Russia, as well as France, are investing in offensive cyber tools to structure their deterrent capabilities. One clear development in the military doctrines of some countries (particularly the United States[51]) also deems that a military attack could follow a cyberattack Thus, there is a gradual militarisation of cyberspace.



Growing need for appropriate cyber security skills

To meet the challenges of cyber security, companies must act on several levels, each of which requires specific skills. It is, of course, essential to have a team able to react to a cyber threat. But companies must also develop solutions that integrate by design cyber security devices, in particular by setting up multi-factor authentication or VPNs. Finally, they must provide education for their employees, since individual errors and malware or phishing are responsible for more than half of the data breaches identified.

As far as human resources are concerned, in France, "anti-hacker" expertise was already the most sought-after digital talent in companies in 2018. 68% of them stress their need to recruit a cyber specialist. According to CESIN, in 2020, 6 out of 10 companies declared that they would be unable to manage a large-scale attack[52]. However, for 79% of the companies surveyed by CESIN, security only accounts for 5% of the IT budget, which places a limit on the opportunities for new recruitments. In fact, only one company in two is seeking to increase the number of security staff, with many explaining this by the difficulty in finding qualified profiles.

Therefore, for companies, this means hiring engineer profiles but also participating in the training of (future) employees who will then be able to manage all these challenges.

51 Aux États-Unis, un groupe d'experts fait 80 propositions sur les cyberrisques, March 2020
52 Cybersécurité : comment les entreprises françaises gèrent le risque, January 2020

MAJOR UNCERTAINTIES

Towards the creation of an international cyber space law?

The difficulty of dealing with **the rise in and professionalisation of cyber security attacks** raises questions about the role of regulatory bodies in securing the digital space whilst also ensuring individual freedom. The lack of an international digital law means that it is impossible to set up a dedicated digital police force.

The Paris Call[53], signed by a large number of organisations and countries, attempts to set limits but it is a very long-term process. This question of international cyberspace law is necessary to regulate the sector. In the absence of forthcoming regulations, this situation leaves each public and private stakeholder free to deliver its own justice by means of "hack-back" practices, which are extremely dangerous for international relations. Thus, it appears that the regulation of cyberspace is gradually being handed over to large private players, called hyperscalers, or States that are working to develop a strategic approach to this space (China, United States, Russia, etc.). Thus, those that are struggling to contribute to such ideas (in particular the European Union) run the serious risk of seeing the creation of a cyberspace that is completely beyond their control and their desire to protect their citizens.

How should regulatory competences be distributed?

Regulation by the private sector? The leading Internet players confirm their readiness to assume certain aspects of State sovereignty or to accept responsibilities of a sovereign nature. Led by Microsoft, a "Digital Geneva Convention" is seeking signatures from all State players. The idea is simple and attractive, but difficult to apply to cyberspace. In this scenario, States would be responsible and would have to commit to putting an end to all conflictual activity in cyberspace outside the context of armed conflict. In the same way as the various Geneva Conventions, it would rely on the goodwill of States to limit and eradicate state-sponsored attacks.

Regulation by the public sector? In a way, the Appel de Paris launched by France in November 2018, takes the opposite view of the Digital Geneva Convention since it aims to make the main economic stakeholders responsible, in particular for the maturity of the security of their products and the fight against cybercrime.

With the subject becoming increasingly sensitive, public authorities will gradually seize it and also impose regulatory constraints at a national level. However, depending on the context, it is necessary to remain vigilant in order to ensure that these rules respond correctly to the challenges faced by companies and, conversely, do not lead companies forced to comply with them to waste their energy.

[53] Cybersécurité : Appel de Paris du 12 novembre 2018 pour la confiance et la sécurité dans le cyberespace

What are the excepted developments for cyber culture in companies? in civil society?

Businesses need to **make their users, both customers and employees, aware of cyber risks.** The creation of a true corporate culture is essential but difficult to put in place. During the widespread development of remote working, it has been necessary to recall cyber "barrier" gestures for avoiding attacks and intrusions in company systems. This cyber communication has often been included in group communication relating to the health situation in order to ensure maximum visibility. Will the COVID-19 crisis raise awareness of cyber risks or, on the contrary, will it push this concern into the background?

Some countries are already starting to teach young people about digital issues and concepts (from artificial intelligence to the risks of cybersecurity) at primary and secondary schools, such as in Israel[54]. France has just modified certain high school curricula to follow a similar direction and has launched a teaching diploma devoted to computer science. However, these approaches take a very long time to produce effects on a large scale. The matter of who will be responsible for educating citizens about cyber risks remains unresolved.

[54] Comment Israël forme à la cybersécurité des adolescents de milieux défavorisés, September 2016

WILD CARDS

Exploitation of a major and systemic security breach in a system or application that is extensively used

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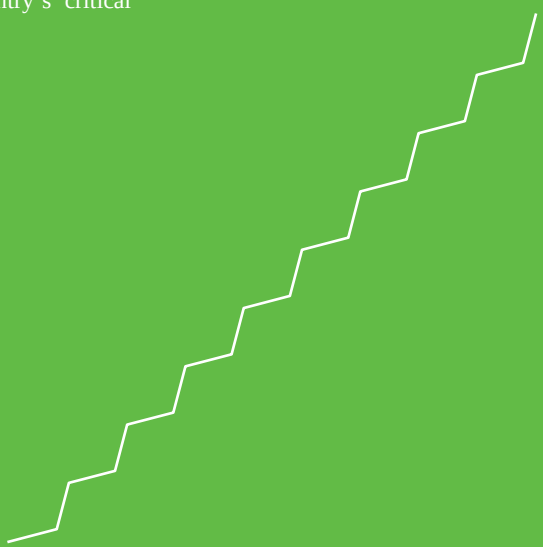
The number of security breaches discovered is gradually increasing. The vulnerabilities of businesses and public administrations are increasingly obvious. During the COVID-19 crisis, some companies are relying heavily on a limited number of solutions and suppliers to run their minimum services and ensure team collaboration. If a major and systemic flaw were to be used, the situation could potentially be catastrophic and endanger not only the company and its users but also, in some cases, a country's' critical infrastructure.



Collapse of the financial system following a large-scale cyber-attack

To illustrate this threat, Christine Lagarde used the example of a cyberattack that might destroy or encrypt bank accounts[55]. The best-organised cyber criminals are able to deploy this type of malware in corporate networks. They then take data "hostage" and demand a ransom. If account balances were inaccessible, it would be impossible to know where the money was. This situation could generate a liquidity crisis, with customers rushing to banks to withdraw money from their accounts for fear that it will disappear into a digital void.

Collapse of the Chinese Great Firewall

Today, the Chinese "Great Firewall" can be compared to a digital Berlin Wall. It is a control mechanism that offers the right to inspect all data circulating between the global Internet and the Chinese internal Internet. This system removes or prevents access by a country to content, services and companies that are contrary to the policy of the Chinese government. As a result, it generates major constraints for globalised companies. It is also a powerful commercial tool for China that helps to ensure the sovereignty of leading Chinese firms.

[55] Pourquoi Christine Lagarde dit que la prochaine crise économique pourrait venir d'une cyberattaque, February 2020

Digital providers and services

4.

Digital technology has a global impact on companies' business models, but also on the relationships between players in the digital ecosystem: between service providers and users, and between traditional players and newcomers. New data-related services, combined with the development of technologies such as the cloud, artificial intelligence and 5G, are leading to the appearance of new international players, especially in Asia. These providers deploy their tools and offers at all levels of society, from governments to companies, as well as services offered directly to private individuals, including within the European Union which is known for its strong regulatory ambitions.

The American hyperscalers such as Google, Amazon, Facebook,, which are particularly powerful, have acquired great influence over companies and users even going so far as to call into question the capacity of States to limit or control their operations. The Chinese BATX are gradually establishing themselves as new leaders likely to generate major changes in European infrastructure, particularly with regard to the development of 5G. It is essential to question the changes in the interplay between these players because they will have deep-seated impacts on tools and services, as well as on future risks.

Point of view

"Originating from political philosophy, the concept of sovereignty played a central role in the establishment of constitutional states in the 18th century. Contemporary developments following the global deployment of digital technology are endangering the sovereignty of States, whether sovereignty over digital technology, i.e. sovereignty over infrastructure, sovereignty over data, sovereignty over terminals (telephones or chatbots), etc., or sovereignty in the traditional sense of the term. On this last point, the COVID-19 crisis has served to reveal the changes underway: remember the Apple-Google consortium's stonewalling of the European States' request to open up Bluetooth functionalities in order to set up a tracking application. Unilaterally decreed by Amazon, whatever its motives for doing so, the one-year moratorium on facial recognition services provided to the US police also appears to be a challenge pitching a private company against the police and, more generally, against the homeland security of the United States.

Everywhere, the exercise of sovereignty by States is contested by today's American web giants who propose to assume its prerogatives, and it is highly likely that it will be the same for Chinese companies in the future. The European community is proving to be extremely weak. For example, when it opens each of its tenders to all stakeholders, regardless of where they come from, especially the web giants who wield great financial power that increases their lobbying power.

Should we, in France and in Europe, accept being dominated by foreign players without any democratic control? After the domination of Nation-States, are we entering a new form of feudalism influenced by industrial powers? This is the question we should be asking ourselves today."

Jean-Gabriel Ganascia,
Sorbonne University, Comets (CNRS), CERNA

STRUCTURAL TRENDS

Merging of digital service providers

The major providers, particularly in cloud, are enjoying **organic internal growth** as well as external growth based on the acquisition of competitors and start-ups. This strategy helps to drain the market and **reduces the number of small providers**. The large number of mergers and acquisitions in the sector is leading to **a concentration of the market and dominating positions.**

Each of the "Big Five" American companies (sometimes called GAFAM) has made at least **one very significant acquisition in the past 10 years representing billions of dollars**. The acquisition of Motorola by Google for $12.5 billion in 2011, the acquisition of WhatsApp by Facebook for $19 billion in 2014, and the acquisition of LinkedIn ($26.2 billion) and GitHub ($7.5 billion) in 2017 and 2018 by Microsoft are some of the most revealing examples. On the other hand, some players do not hesitate to look beyond their traditional field. For example, Amazon bought Whole Foods for $13.7 billion in 2017 creating a major upset in the world of volume retailing[56].

Depending on the economic impact of the COVID-19 crisis, it is possible that this trend may gain ground if certain small players find themselves in difficulty or found themselves forced to accept takeover bids by the "giants". Inversely, **the need for national autonomy and resilience**, brutally recalled by the partial breakdown of physical production and supply chains, may force States to support **the development of "local champions"** able to provide solutions as effective as those of the existing giants.

A software market dominated by a few players

The oligopoly of the software market has gradually changed. IBM's monopoly was initially broken by Microsoft, and the ERP market was divided up between SAP and Oracle. The development of attractive environments has allowed Microsoft to dominate the public cloud market. Currently, Google and Amazon are investing in this segment. It is unlikely that we will see the emergence of other players in the software world. Google and Amazon are deploying extensive financial and human resources to catch up with the competition in this field. The fact remains that the **logic of buying out innovative companies may end up stifling the market** and, therefore, the dominant players themselves. Despite the difficulty of finding a niche for themselves, today's dominant players may find themselves in competition in the future. Smaller players, that are still not very visible, are increasingly managing to position themselves particularly in niche "as a service" solutions (Slack, Zoom, ServiceNow), even if, at present, they are quickly being bought up.

At the same time, governments' political games are also starting to have a strong influence on companies' technological choices. The Internet is becoming increasingly regulated. This is a risk for the large internet platforms, which, in this case, would be greatly affected by relocation and digital sovereignty policies.

This idea of the "nationalisation" of technological choices or providers would also lead to a gradual decentralisation of architecture. This phenomenon may be increased by the shortcomings highlighted by the COVID-19 crisis outlined above.

[56] Wikipedia data on the different players' pages

Tensions on the skills market for the integration of editor solutions

Service providers rely on a large ecosystem to implement their solutions in organisations. Integrators in particular are key in the setting up and management of solutions. However, the shortage of digital skills also affects these players as it does companies that need to integrate these solutions into their information systems, something that makes their implementation all the more difficult. This tension hampers the deployment of solution providers such as Salesforce and SAP.

Strong lobbying by American digital giants

The digital market's concentration around a few American players allows them to impose themselves on this market and act as **key players in the global technological landscape**. They are at the **forefront of European**[57] **and international negotiations** as a result of the very high spending on lobbying which increases each year[58]. In the United States, the major manufacturers have organised themselves and finance their presence among institutions' representatives. This financial power allows them to participate actively in the writing of laws and standards or the development of future projects. In this way, they are able to impose their own vision and serve their own interests.

According to figures from the NGO the Centre for Responsive Politics [59], in 2019, Facebook and Amazon spent approximately $16.7 million on lobbying in the United States, while Facebook spent $12.6 million the previous year, and $9.85 million in 2015. Google reduced its $21.7 million 2018 budget to just $12.5 million. In the "Electronics & Equipment" category, Microsoft slightly exceeds $10 million. Apple increased its budget from $6.7 million to $7.4 million. These figures show the great influence of these player in political decisions and the definition of technological standards.

Growing imbalance in relations with major suppliers

With the opportunities offered by cloud, digital service providers are burdening their customers excessively with **the cost of converting to** cloud**.** Their strategy leads them to adopt the commercial behaviour of "**bounty hunters**" who are encouraged by a remuneration model that emphasises "selling more" rather than "selling better" (i.e. advice and added value for the customer).

The voluntary lack of clarity in contractual clauses and certain guidelines allows them to be interpreted to the providers' advantage. User companies are asking[60] providers to return to a balanced business model based on the real value. This business model is also being questioned in view of the economic and socio-environmental challenges to be met (massive use of cloud, extreme archiving, etc.).

The COVID-19 crisis has shown Europe's dependency on digital technology providers mostly based in the United States. Microsoft has had to balance the load between its environments to give more power to Office 365 and less power to Azure uses. At the level of the country, this might have meant the redirection of connections from one country to another. Such preferential strategies ultimately pose a threat to Europe's digital independence.

57 Petit guide de lobbying dans les arènes de l'Union européenne, May 2019
58 Several indicators available: https://lobbyfacts.eu/ and https://www.integritywatch.eu/
59 Internet Lobbying profile, OpenSecrets.org - Center for Responsive Politics
60 Cigref press release, October 2020

Regular increase in the adoption of open source

Red Hat has revealed that **more than half of the software in the companies surveyed** in 2019[61] **was still proprietary**. This year, proprietary software is expected to have fallen to 42%. In two years', time, the survey estimated that the share of proprietary software will fall to 32%. However, respondents indicated that 36% of their organisation's software is open source enterprise software and that they expect this percentage to increase to 44% in two years' time.

There is, however, a major difference in adoption between **infrastructure open source** and open source tools for business or office applications. The digital giants themselves, such as Amazon, Google and Microsoft, are active contributors to the open source community for the development of infrastructure, but also offer proprietary turnkey solutions to their customers.

More and more user companies are **reducing the footprint of major suppliers in their information systems** and are devising exit strategies by looking for alternatives that use open source in particular. Due to the strategies of suppliers, which has led to an explosion in the cost of licences and their support services, these exit strategies are gradually becoming more attractive and economically viable, even if the process is long and the efforts to be made by companies are very substantial.

Strengthening of "platform" enterprises through user retention

"Platform" companies have the capacity to **strengthen their position on the market and to become indispensable** by taking advantage of the "network effect". For example, the Uber taxi service needs to have enough drivers to meet the demand of customers who, in turn, will be satisfied with the service if there waiting time is as low as possible. Therefore, the more drivers there are, the more customers there are and therefore the more journeys Uber is paid through commission from each transaction. Thus, the more users there are on the platform, the better it performs, its good performance makes it harder to leave it or do without it, meaning that the platform attracts even more users. These companies offer networking between at least two types of population, each one attracted by the growth of the other. The largest American and Chinese platforms represent a huge number of users, with approximately more than one billion users each. This "network effect" explains **the emergence of dominant players** such as Uber and Didi (drivers and customers), Amazon and Alibaba (merchants and customers), Facebook, Google, Baidu (advertisers and users), Spotify (producers and subscribers), Airbnb and Booking (hosts and travellers). Since users are reluctant to switch to a less intuitive and efficient service, it is difficult to attract newcomers to the market. These platforms are well on their way to becoming indispensable, both in BtoB and BtoC. Another practice along these lines is that the diversification of their activities allows them to cover an ever-wider spectrum of consumers' daily lives. Their coverage of value chains is increasing. For example, the Chinese firm WeChat and now Facebook offer the possibility of using email to pay, reimburse, etc. their friends and family, or access e-commerce sites[62].

61 Red Hat finds enterprise users are adopting open-source software at a rapid pace, February 2020
62 Les secrets de la messagerie chinoise Wechat décryptés par Fabernovel, January 2019

EMERGING TREND

Platformisation of the economy

Therefore, with what is known as "**uberisation" or "platformisation"**, entire sections of the economy may be disrupted by new digital players. For example, Booking.com acts as an intermediary between customers and hoteliers, thus capturing a growing share of the turnover of traditional hoteliers. Although, initially, the platform service offered by Booking was seen as a means to enjoy greater visibility, many hoteliers report a growing dependency on them for accessing their clientele that sometimes even goes so far as enslaving them. In other fields too, companies may become completely separated from their end customers, often with negative consequences on their business model, know-how or identity.

After personal data, the race is on to exploit industrial data

"We are entering a new phase, with the development of a new type of data that is **no longer personal but industrial**[63]", declared Thierry Breton, European Commissioner for Internal Market in an interview in Les Échos on 17 February 2020. According to him, while "large platforms based on data exploitation have developed in the United States and China", industrial data will "redefine the game". **Europe will be the "main battlefield" of the "industrial data war"**, and must "be the first continent to take full advantage of this wave". Already platforms targeting the B2B market, such as Schneider Electric and Dassault Systems, are positioning themselves to process industrial data. The new platforms, which should enable "the exploitation of this data as close as possible to its place of production, are of a very different nature to those of the hyperscalers, the largest internet platforms. Therefore, Thierry Breton is hoping that the emergence of European industrial platforms will be driven by "European projects of common interest associating large companies and SMEs in order to build critical data management platforms".

63 Thierry Breton : « La guerre des données industrielles débute maintenant et l'Europe sera son principal champ de bataille », February 2020

Willingness of France and Europe to tax digital giants and more particularly digital giants

France and Europe want to **regulate digital giants** such as Google, Apple, Facebook, Amazon (GAFA), particularly by means of national taxes. Often based in Ireland, a country that encourages foreign investment, these companies benefit from reduced taxes due to the non-territoriality of their digital services (little physical infrastructure). These companies, in a dominant position, enjoy a significant turnover in France resulting from the development of Internet users' activities. At a European level, there is a growing number of projects that aim to regulate and tax the activities of the GAFA, in particular on the initiative of Margrethe Vestager and Thierry Breton[64]. France announced its intention to introduce a "GAFA Tax" in 2018[65]. Many European countries are involved in international discussions at the OECD in order to find a global agreement for the taxation of digital giants, along with the United States. However, the United States is very reluctant and the Trump administration has launched a formal investigation[66] into national taxes for digital services adopted or proposed in nine countries, threatening to tighten US tariffs on imports from these countries.

Furthermore, the taxation of companies may be based on turnover but also on their "behaviour", similar to what is done in China by means of company rating.

Willingness (but difficulty) shown by public authorities in better regulating content hosted by the digital giants

In the wake of particularly memorable events (such as the Christchurch Massacre in New Zealand in March 2019), many States have taken steps to regulate hateful content on social networking sites. The Australian government reacted quickly with an action plan[67] followed by legislation to deal with the spread of violent content. The G20 has declared itself in favour of raising the level of expectation on the role of platforms in the fight against terrorist content. Gradually, several countries are setting up measures. These are often extremely controversial, such as in France or the United States. In France, the Avia Law aimed at fighting hate on the Internet has generated many heated debates, particularly among libertarian activists.

64 L'Union européenne créera une taxe GAFA si l'OCDE n'y parvient pas, January 2020
65 Projet de loi n° 1737 portant création d'une taxe sur les services numériques et modification de la trajectoire de baisse de l'impôt sur les sociétés, Assemblée nationale, March 2019
66 USTR Initiates Section 301 Investigations of Digital Services Taxes, February 2020
67 Report of the Australian Taskforce to Combat Terrorist And Extreme Violent Material Online, June 2019

Gradual emergence of Chinese players in the Western infrastructure market

The arrival of Chinese players (equipment manufacturers and service providers) on the Western market (Europe/North America) - such as Alibaba with its cloud offers, and Huawei with its hardware equipment (especially for 5G) - introduces competition against the dominance of American players. China's capacity to invest in innovation is considerable. In 2019, Huawei planned to at least **double its annual R&D spending** to $15 billion while Alibaba also announced that it would invest a similar amount, in particular in artificial intelligence. **China's ambitions for its international development** have become even stronger with the crisis, whether in terms of international bodies, bilateral relations, and technology (and in particular concerning 5G infrastructure[68]). The extreme tension prior to and exacerbated by the crisis, may have a decisive impact on the real role that Chinese players will have in Europe and North America in the future.

International tension around Chinese and American providers

Tension between the US government and Chinese players, in particular the equipment manufacturer Huawei, followed tensions in trade between the two countries. **The integration of Chinese equipment into the critical infrastructure of the American 5G network** is seriously challenged. The United States accuses Huawei of complicity and espionage on behalf of the Chinese government via "backdoors", vulnerabilities intentionally created to allow covert actions designed to extract information. These players' links with the Chinese government are alarming and raise questions about the impacts of their expansion. On 1 May 2020, President Trump signed a presidential decree forbidding players in the electricity production and transmission network from buying equipment made abroad[69]. In the same vein, a similar decree may concern digital infrastructure players. The United States was not alone in adopting this approach during the COVID-19 crisis. Britain declared it wanted to form a club of 10 nations in order to develop their own 5G technology and reduce their **dependency on the controversial Chinese giant**. Nevertheless, the Chinese footprint is already very large meaning that autonomy could be difficult[70].

These tensions concerning security are accompanied by **a trade war** between the two great Sino-American powers. Chinese authorities are reacting to this by speeding up their plan for their own technological autonomy. The government is also strengthening its diplomatic policy and warning countries, something that might keep their players out of the markets.

68 Beijing May Score Its Biggest 5G Win at Home, August 2020
69 US presidential decree prohibiting foreign equipment for the power network, May 2020
70 Win For Trump? Britain Backs Away From Huawei 5G Plans, May 2020

Wish to encourage the emergence of European leaders, especially in cloud

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Encouraging the emergence of European cloud players to ensure their **sovereignty** and protect European cyberspace is a **wish shared by many stakeholders** but one that is difficult to implement. The French Gauvain Report on the protection of companies against extraterritorial laws and measures, dating from June 2019, states that "*French companies today do not have any effective legal tools to defend themselves against extraterritorial legal action*[71] *against them*." The extraterritoriality of American law and its alignment with European law raises many questions.

Nevertheless, the European Union, which is eclectic, appears to have difficulty proposing a competitive offer against the Chinese and American ones. This raises the question of France's and Europe's ability to create **true strategic autonomy**. Nevertheless, the COVID-19 crisis has put this topic back on the agenda in view of the sector's obvious dependence. The stated ambition of certain European countries to set up a trusted industrialised cloud offer represents a unique opportunity to respond to this problem. Gaia-X, the French-German alliance aims to design a technical architecture that guarantees secure data exchanges. This architecture could then be used as a basis for a complete data management ecosystem. In addition to improving the economic conditions for access to cloud service resources, such an initiative would send a clear signal concerning the ambition to restore Europe's strategic autonomy in a key sector of the digital industry.

[71] Rapport Gauvain sur la protection des entreprises contre les lois et mesures à portée extraterritoriale, June 2019

MAJOR UNCERTAINTIES

Towards the disappearance of long-standing IT service players?

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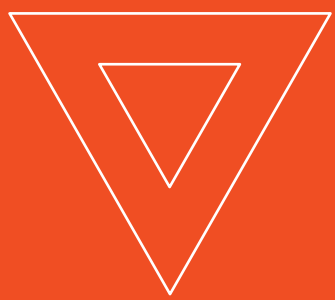
While **a large number of long-standing players have been overtaken by newcomers** and new technologies, it is possible to challenge the existence of the present-day dominant players. The successful and rapid transformation of some of them illustrates their resilience. At different stages of their development, IBM or Microsoft managed their customers' loss of interest and bounced back by offering new services. Others lost a significant market share or even disappeared completely. Some traditional players, such as Oracle and SAP, appear to have reached the end of their model and need to reinvent themselves in order to remain competitive.



The renewal of players according to the technologies and means granted is a recognised phenomenon, nevertheless the current situation and the importance of data holding (both industrial and personal) raise questions about the changes to come. If these players were to disappear, **the replacement strategy** would be very arduous for companies, requiring considerable investment to the detriment of more innovative projects. The following two uncertainties are potential drivers for the gradual disappearance or disintegration of these long-standing players.

Towards a questioning of sovereign functions by digital giants

The emergence of projects such as Libra, **Facebook's crypto-currency**, is worrying governments which fear **a supremacy of digital giants,** as they extend their sovereign functions[72]. Ambitions by these digital giants in the fields of health, finance and cyber, are forcing governments to deploy legal mechanisms designed to limit them.

American Democrat representatives have drawn up a draft text prohibiting large digital companies from issuing crypto-currencies and acting as financial institutions, the "Keep Big Tech Out Of Finance Act". The European Central Bank also communicated about the working group set up with the banks of England, Canada, Japan, Sweden and Switzerland. They intend to study concrete design choices (economic, functional and technical), "including cross-border interoperability". China, for its part, has announced that it is working on a Yen crypto-currency at the state level in order to maintain control over the currency.

Towards a regulatory dismantling of the digital giants?

In 2018, American congressmen expressed a wish to **dismantle major tech companies**, including Amazon, Alphabet and Facebook, calling them "anti-competitive behemoths that are crowding out competition[73]." Nevertheless, this position is not shared by all as it is not considered to be a sufficient response to the "large number of truly essential questions". Even once dismantled, it is likely that the platforms will continue to hold strong positions in their respective markets as European platforms struggle to establish themselves. Thus, dismantling is not necessarily "the best remedy for restoring competition in markets and protecting innovators, consumers and workers"[74].

72 La fin de l'État-nation ? Les méta-plateformes au service du bien commun, November 2018
73 Warren wants to split tech companies, March 2019
74 Break up big tech? Some say not so fast, July 2019

Towards a breakdown in trust in the digital giants?

In the face of numerous recent leaks of personal data, some observers are seeing **a breakdown in trust in the digital giants**, which may lead to a decrease in the use of their services. However, some analysts claim that **this trend is not proven**. So far, the scandal involving Facebook and Cambridge Analytica, for example, has had no effect on Facebook's performance. Amazon appears to be increasingly criticised in Europe in recent months, particularly with regard to its managerial practices. But during the COVID-19 crisis and the national lockdowns, the use of their services exploded. Might the public turn their backs on such companies or, on the contrary, will it continue to use them for the added value they provide, regardless of the individual and collective consequences? **The major role played by social networks** and digital services during several exceptional events of this decade (Arab Spring, American Presidential election and Brexit, natural disasters, the COVID-19, etc.) shows the extent to which these tools appear to be mostly adopted, used and valued regardless of their data use policy.

Towards ultra-regulation of digital services, hindering or limiting their use?

As the space occupied by digital technology in our societies grows, regulatory institutions are taking on the subject and developing principles for it. In 2018, the European Union adopted the General Data Protection Regulation to force digital service companies to inform their users and limit the use of such data. But already, some users are experiencing **difficulties in their user experience**, such as the number of clicks needed to accept website cookies. Another regulation aimed at protecting the very youngest from the dangers of video sites is currently being drawn up. Critics of these laws believe that they reduce the freedom to use services, especially for certain populations.

WILD CARDS

Consolidation of many sovereign services in the hands of a few major players

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The constant diversification of digital giants in many fields of activity and their gradual stranglehold on the systems of most companies and public administrations raise questions about how able they are to *intrude* in the economy of countries. It is possible to imagine that their knowledge of the markets and know-how of many similar companies around the world **offer them an extreme competitive advantage for becoming the undisputed leader** in certain services, including sovereign services. Their power would allow them to respond to issues usually managed by States, such as health, cyber security, financial services, etc. and, States would have to rely on these private players which benefit from more resources and skills.

Collapse of the system of economic speculation allowing financial investment by digital giants

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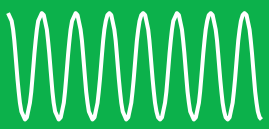
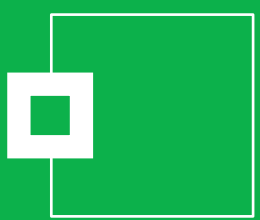
In recent years, the listing of new players on the stock market and the amazing valuation of digital players with business models based on exploiting data has raised many questions about the **system's sustainability**. Without a need for immediate economic profitability, an ecosystem being kept alive relies on **economic speculation about the future value of data**. Nevertheless, this enthusiasm might be undermined by increasing regulation and disappointment in the promised results of profitability. A **major change in investors' reasoning** would have a much greater impact on the financial capacities of these players.

New ways of working and employees commitment





5.

Digital is now at the heart of the organisation of work within companies and administrations, but also a part of the working world that is increasingly distributed, managed remotely and networked. Certain tasks, previously managed internally, are now carried out “in project mode”, over a short period of time, bringing in stakeholders from outside the company and using “platformisation” to recruit or exchange, etc.

At the same time, digital uses are blurring the boundaries between private, professional and public life. Individuals use it as workers as well as in their role of consumers and citizens. Permanent connections, and certain tools such as smartphones, sometimes make it impossible to distinguish between what falls under one or other of these spheres. Thus, the continuum between these three dimensions can be beneficial as well as harmful. We are seeing a diversification in employees’ expectations and changes in behaviour according to periods of life (e.g. demand for remote working) which creates new challenges for organisations. These tools and digital uses may also bring new health risks (isolation, depression, burn-out, etc.) that need to be taken into account.

Remote working practices deployed massively during the COVID-19 crisis in spring 2020 were a vast social experiment in the relationship to work and its organisation in the digital age, the consequences of which will be studied in detail. We can already imagine the new connections between companies and their employees, as well as between employees and their activity, with some concerns regarding human resource management, if the criteria of profitability and productivity were to take precedence over the economic and social stability of all.

Point of view

"The health crisis is highlighting the importance of the virtual world and France's delay in providing digital support for those in greatest difficulty. The digitalisation of the economy and social life is creating digital divides that cause a great deal of anxiety for many. Not having a broadband internet connection or a computer has become a major social handicap. It is expected that the digitalisation of work, combined with globalisation, will eliminate many unskilled or low-skilled jobs and generate pressure to constantly adapt and train in new techniques or trades.

During the lockdown, the extensive use of remote working changed how employees relate to their companies and has offer them more freedom in how they organise their work and life. For companies, it is a twofold saving: a saving in terms of productivity and a saving in terms of premises. The environment also benefits. However, many employees have found remote working to be a challenge and have developed psychological disorders. The three trade unions, the CFDT, UNSA and CFTC, recommend the creation of a right to remote working, that favours voluntary, non-permanent remote working that is subject to social dialogue within organisations.

Nevertheless, remote working is not possible for all positions. In companies, there is great inequality in how managerial staff, who work remotely and are protected, are treated compared to the others, who either have no work or in workplaces (shops, factories or building sites) where there are health risks. It is the return of the divide between white-collar and blue-collar workers."

Jacky Bontems,
President of the Qualified Personalities Group, CESE

STRUCTURAL TRENDS

Older, more urban and more varied workers

The profile of the workforce is set to **evolve in the coming decades** in line with demographic and geographic changes among populations. The **ageing** of the global is a proven trend that will have an impact on a country's available workforce. At the same time, people are tending to settle in big cities, generating new opportunities as well as new challenges for maintaining an activity in more neglected rural areas.

Furthermore, workers in the future will probably have **more varied profiles**, caused, in particular by transnational migration, which is on the increase, especially in response to climate risks. This trend is expected to continue despite the current border closures at the time of writing, especially since many people may flee areas that have been hard hit, not by the virus, but by the interruption of food supplies and humanitarian aid.

Restructuring of sectors, evolution of trade and skill requirements

The importance of the primary and secondary sectors[75] has continued to decline in favour of the tertiary sector. In France, **the drastic reduction in the agricultural workers** (75% fewer farmers between 1980 and 2014) and, since the 1970s, **the country's deindustrialisation** are the result of the mechanisation of trades and the relocation of activities to countries with low wage costs.

In certain sectors, the profile of workers in demand is evolving greatly towards highly-qualified, multi-tasked workers who are comfortable with digital tools that too are constantly changing.

[75] Prospective. Quel travail demain ?, INRS, 2016

Marked change in ways of working

How people work is changing in three ways:

Time devoted to work

With digital technology, it is no longer possible to define working hours as before, since digital tools mean that it is possible to work outside official office hours and take personal breaks during this official time. In 2014 already, about 7 out of 10 executives worked in the evening, and half of the weekend[76]. The right to disconnect, which came into force in companies in 2017, has not yet had a notable impact on this phenomenon. At the same time, according to another study, French employees spend more than one hour a day on the Internet for non-work-related activities.[77] These phenomena should be a matter of concern for companies that have required their employees to work remotely 17 March 2020. The aim will be to understand the extent to which the constraint of working from home all the time might affect actual working time and employee productivity, and also identify potential health risks arising from such practices.

Places devoted to work

Just before the national lockdown that forced part of the French population to work from home, remote working was not very widespread but was starting to gain ground. 29% of the French employees surveyed declared that they worked remotely on a regular basis in 2019. Most of them work remotely from home, but some of them also use coworking spaces. With places devoted to work already becoming more varied before the lockdown in spring 2020, the boundaries between private and professional life are becoming increasingly blurred[78].

The aim here will be to assess the extent to which the practice of remote working over a long period of time that has been imposed on all, including the most reluctant employees or companies, will have an impact on the relationship to remote working. Will employees continue or stop this method of working once the restrictive measures have been lifted? Furthermore, the continued constraints on travel and meetings, which may last until a vaccine is found in 2021, also raises questions about the inequalities that have been highlighted by home working. These include inequalities in housing, relationships with family, relatives, and loneliness. Not all remote workers are equal when working from home.

Management and relationships at work

The changes in tools and workplaces, as well as the contributions of social and behavioural sciences on the psychology of individuals and on the strategies to be deployed to maximise worker efficiency have had a strong impact on how relationships between employees are structured. New forms of spontaneous collaboration, without any leader or for a limited time, are being seen and are being structured through digital networks. In more traditional companies, the horizontal relationship between employees is increasingly being defended and hierarchical systems are starting to evolve. This trend may be confirmed in a context where remote working and solely virtual exchanges are forcing managers to trust their employees more. Conversely, it is possible to imagine the development of new tools for measuring and monitoring working time and employee productivity, which may prove to be restrictive or abusive.

76 Cadreo étude le travail des cadres en vacances, 2014
77 Olfeo étudie la réalité de l'utilisation d'internet au bureau, 2016
78 Le télétravail se diffuse enfin, April 2019

Diversification of forms of work

Although in France, the permanent contract continues to be the main employment contract still concerning nearly 9 out of 10 employees, its framework has changed considerably. Offering less and less protection over the course of the reforms, it is also used less and less often by companies, since in 2017, 87% of new recruitments were fixed-term contracts, an increase of 10 points in 10 years [79].

Jobs offering very little insecurity appear to be multiplying, with more than one in five employees working part-time and almost one in ten French people holding down at least two jobs[80]. Self-employment has also increased[81] (+25% since 2003), driven among other things by contractual work favoured by digital technologies, **the growth of the so-called gig economy**. However, this development is relatively insignificant in France with very little change in the number of self-employed workers compared to other countries (such as the United States).

More generally, career paths are becoming increasingly fragmented, with workers often alternating periods of employment with periods of unemployment or the resumption of studies. Such **job insecurity could become much more pronounced** if France enters a major economic recession as a consequence of the spring 2020 epidemic, failing a strong social support decision at the level of the State and Europe, and initiatives by the private sector.

Dualisation of work: an increasingly pronounced social divide

According to several studies conducted in Germany and the United States, on statistics collected between the 1990s and the 2010s, **there is an increasingly clear discontinuity** between the best qualified and best paid professions on the one hand and the least qualified and low paid ones on the other hand. Thus, there appears to be a strong divide between a group of minority privileged workers in the tertiary sector and a low-skilled and less well-paid workforce.

This phenomenon can be seen in the digital economy, where more and more of the world's workforce finds itself in a highly insecure position[82], while, at the opposite end of the spectrum, those at the head of the world's largest fortunes are mainly CEOs of digital companies.

This divide is highlighted by the COVID-19 pandemic, which obliges key first- and second-line professions to go "to the front", and partially or fully lays off employees in sectors that have been shut down by the crisis without any possibility of being able to work remotely. Thus, **it is likely that economic divides will worsen** (it is easier for intellectual socio-professional categories to work remotely than manual workers) as well as health inequalities (e.g. the particularly difficult working conditions of healthcare workers), with some sectors taking major risks while others are more protected.

79 Étude de la DARES sur l'évolution du recrutement au cours des 25 dernières années, June 2018
80 Main changes in the labour market over the past ten years, 2017
81 L'emploi non salarié ne progresse plus en France, January 2018
82 Tribune du CNNum sur les travailleurs des plateformes, April 2019

EMERGING TREND

Growing distrust of large companies by the French and young people

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According to the barometer of political confidence by Opinion Way for Sciences Po Cevipof[83], **43% of respondents say that they trust large private companies.** This rate has declined significantly since 2015, returning to its lowest levels recorded in 2011 and 2009. However, it increased again (+4) for the last wave of the survey wave in February 2020.

The positioning of large companies during and after the COVID-19 crisis may be decisive in how this trust evolves. Indeed, it may be a strong *momentum* fort for a number of private players who can seize the opportunities for renewal and restructuring arising from the crisis by reinventing their activities, their offers, and also their relationships with their employees.

Transformation of aspirations and the vision of work

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Alongside this phenomenon, the aspirations of employees and the very vision of work among the working population may also change. A 2018 survey by the BVA Institute[84] shows that well-being has become the main topic of interest for employees when it comes to their working life (59%). According to an Ifop survey for Philonomist in 2020[85], among 970 employees, 82% consider that the company is responsible for its employees' happiness. But remuneration remains central in motivations (for 60% of those surveyed). Thus, **work is seen less and less as an end in itself and more as a means to an end**, even if feeling good about being there appears to be particularly important. This ratio may change greatly depending on the evolution of the current crisis. Indeed, the need to work to meet your needs may be accentuated in the context of a major economic crisis, but at the same time, the sudden shock of a catastrophic event and an unprecedented lockdown may change people's priorities, at least for those who have that privilege. Thus, some may decide to focus on their families and loved ones, rather than on their careers. Finally, some professions may come out stronger from the crisis, especially personal care services. This might lead to a move away from digital professions.

83 Baromètre de la confiance politique, Sciences Po-Cevipof, January 2019
84 Etude de 2018 par le BVA Institute, March 2018
85 Etude Ifop pour Philonomist, January 2020

Changing demands of workers… and the balance of power between employees and employers

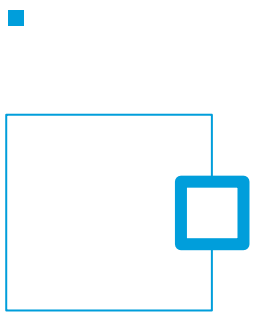
Both the cause and consequence of workers' growing distrust of enterprises, and the transformation of their aspirations, **the demands of individuals are also changing greatly.** Environmental causes, gender equality, and also the links between companies and the State's security systems may all be new decisive criteria in an employee's decision to work for a specific player. According to a survey in 2019[86], one French person in two would be prepared to resign from his or her company if it discriminated against them in terms of pay. However, this highlights a discrepancy between what is said and what is done since the Ifop/ Philonomist survey shows that 58% of the employees surveyed believe that companies must work to balance the situation between men and women.

The Manifesto signed by French students[87] to **defend the environment** also underlines a change employees' demands, capable of transforming the balance of power between them and employers, forcing company managers to adapt their activities to new expectations. Thus, Google was recently forced to abandon a planned partnership with the American Department of Defence.

New tools are also available to job seekers, such as *Moralscore*, a site that ranks brands most in line with the user's values which are provided in a two-minute questionnaire on their moral beliefs.

For this emerging trend too, the situation caused by the pandemic may have a decisive impact in the medium and long term. As outlined above, **the balance of power may again be reversed in favour of employers,** in a context of economic crisis and a health emergency that could change the labour law and during which environmental issues could be briefly forgotten by individuals concerned about their economic future.

However, inequalities between socio-professional sectors, strongly highlighted by the epidemic but which already existed before it, could also fuel vast social protest movements in an insurrectional climate, if the State does not keep its promises and/or if companies try to take advantage of the situation.



86 Enquête annuelle ADP "The Workforce View in Europe 2019", March 2019
87 Les étudiants de grandes écoles lancent un manifeste pour le climat, October 2018

Employee training and support needs

Faced with the constant evolution of digital tools and the new possibilities they offer, **the initial and ongoing training needs** of employees in the digital sector are constantly increasing. In order to ensure that a worker's skills do not become obsolete, it is becoming increasingly important to support them throughout their career and constantly help them to develop their skill set. More and more companies are becoming aware of this need but the "bootcamp" phenomenon, or short and adapted training courses, is still emerging.

Furthermore, supporting employee during lockdowns, or in cases where social distancing measures have to be maintained over the medium and long term, is a real challenge for managers and human resources. Many companies have sent out questionnaires to gauge their employees' state of mind and are thinking about renewing their employee support services.

Increasing health problems relating to digital and digitised work

The new forms of employment and new tools available to organisations are a source of opportunity but also generate new risks for workers. WHO has already raised the issue of the emergence of psychological disorders directly related to work, such as burn-out. The organisation of work guided by the demand for immediacy, the difficulty in disconnecting, lower wages and job insecurity are all factors that could have a significant impact on the health of individuals. The French National Institute for Research and Security (INRS) even suggest the risk of increased mortality as a result of stress. Certain neuroscience research is also concerned about the damage to the brain caused by **long-term exposure to digital tools** (lack of concentration, new memory-related problems, analytical skills, etc.[88]). There is also cause for concern about the long-term effects of **reduced physical contact and the virtualisation of exchanges**. Finally, the specific case of content moderators on platforms is just as worrying and reveals the possible excesses of digital technology. For example, many Facebook or YouTube employees, who are paid to filter violent videos and content, report suffering from serious psychological disorders, to the point that their mental health is deeply affected, without benefiting from adequate support from their employer[89].

88 Les écrans détruisent-ils le cerveau de nos enfants ?, November 2019
89 Life as a Facebook moderator, February 2020

New working organisations

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Thanks to digital tools, but also in reaction to workers' new expectations, **new ways of organising work** are emerging. "Flash organisation", for example, is a term for the industrialisation of participative production (crowdsourcing). The aim is, to involve a certain number of workers in the performance of a given task for a limited period of time. Digital technology makes it possible to attract the best profiles by means of remote selection and cooperation systems. These "employees" are actually self-employed workers. In contrast to these solutions, which are still very much marked by a "productivist logic" targeting efficiency, **a multitude of more informal collectives** (of artists, architects, dancers, etc.) are appearing, brought together by common values, producing a ways of working that does not respond to traditional solutions (sometimes without a contract or commission, and therefore without pay, for example).

The solidarity movement set up during the COVID-19 crisis helped many collectives to join forces on various subjects (cybersecurity, remote working, open source, etc.). It is possible that these collectives will survive the crisis and continue to help communities outside companies, autonomous communities or communities that could offer their services to companies.

MAJOR UNCERTAINTIES

Towards health regulations at work?

The current health crisis and the anticipated successive waves of this disease, or even new epidemics in the longer term, could force companies **to review the way in which they manage the employees' health**. This will involve anticipating new physical risks (disinfection of workplaces, relating to work at home), and developing much more psychological support: development of addictions, maintenance of motivation, but also fighting isolation and guaranteeing **the continuity of human exchanges, key factors for personal well-being,** etc. Moreover, while managers have to respect a certain discretion with regard to their employees' sick leave, the different nature and deadly dangers of COVID-19 have changed this attitude and these same managers are required to follow up on infected persons in order to protect their other employees. Therefore, the manager's position with regard to the health of employees could help to develop greater attention to the individual.

What new recommendations concerning occupational health rules might result **from alarming findings relating to the use of digital technology, remote working, the isolation of employees and the merging of professional and personal spaces?**

Towards a redesign of work spaces?

Two phenomena linked to the health crisis will probably lead to a **complete overhaul of work spaces**. Indeed, in the context of increased sanitary procedures designed to limit the spread of a virus, the layout of *open space* and *flex office* spaces is unsatisfactory and will have **to be adapted to comply with health rules**: for example, with a reallocation of offices either individually or by entity. Also, the hybridisation of work between remote and face-to-face will generate a need to fit out meeting rooms that are currently not equipped with video-conferencing equipment and collaborative tools for remote use.

Towards new living spaces conducive to remote working?

In France, **the trend to become a city dweller could be reversed**, if large cities were gradually abandoned by people reluctant to live in urban areas where the health risk is high and social distancing measures are too restrictive. Indeed, inhabitants of large cities, and in particular the inhabitants of the Greater Paris area **want to move** (38% compared to an average of 11% in France) as a result of the lockdown experience[90]. Furthermore, with the impact of the economic upheaval, several city centres may see their businesses **affected in the long-term** (shop closures, business parks in financial difficulty), which would make them even less attractive. Other elements that existed before the COVID-19 crisis might also accentuate this trend: search for a better living environment (less air and noise pollution etc.), cost of real estate, etc.

90 Survey on the impact of lockdown on the mobility and the French way of life, April 2020

Towards fewer and more insecure jobs?

In view of the major trends identified, a number of uncertainties remain regarding how the number and types of jobs will evolve. Will technological pressure increase to the point of drastically reducing the number of jobs available? What workforce restructuring can we expect?[91] More generally, how will the status of workers, their rights, social protection systems and even remuneration systems evolve?

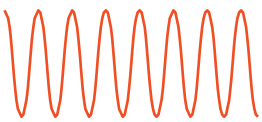
As already mentioned, the economic consequences of the pandemic and the associated measures will probably have a very strong impact on this phenomenon in that it will **expose individuals to greater insecurity**.

Towards increasingly decentralised and distributed companies?

Although the **hierarchical business model**, where everyone occupies a clearly defined position and answers to superior, is still very present, especially in large groups, it is becoming highly disputed. Indeed, management research has underlined the importance of giving everyone the same role and responsibility in a company in order to maximise investment and productivity. This **horizontal evolution** in industrial relations could have an impact on internal power games, orientation and decision-making as well as on the very structure of companies, even traditional ones.

Furthermore, the emergence of new, smaller, more agile players, such as the many start-ups comprising of just a few employees who come together in coworking spaces and use innovative collaborative tools, goes against the traditional image of the centralised company. Reduced models of work organisation, focusing on innovation, where everyone can play different roles, compete with the administrative machinery of large companies, which is heavier, less scalable and less adaptable to new challenges.

Finally, companies might decide to refocus on a small core group of employees and call on experts only for specific tasks. The extreme form of this model would be that of “Distributed Autonomous Organizations”, coordinated by a digital programme and managed by shareholders.



91 Arntz Melanie, Gregory Terry and Zierahn Ulrich, “The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis”, OECD Social Employment and Migration Working Papers, n° 189, 2016, OECD (Organisation for Economic Co-operation and Development)

WILD CARDS

Wide-scale replacement of tertiary jobs by machines

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Some of the most pessimistic scenarios for the future of work herald a major, multi-sectoral upheaval in employment as a result of **advances in artificial intelligence and robotisation** (the McKinsey reports[92], in particular, often paint this picture of wide-scale automation). In this way, human beings would be largely replaced by machines in all areas, including among white-collar workers. The consequences of the automation of work would be huge as it would mean **reinventing the activities of an entire population** forced into inactivity. This wild card might be more likely in a context of economic crisis and budget cuts, in which companies decide to develop automation or remove non-essential tasks. It would mainly concern specific professions, such as call centres and logistics centres, cashiers and audit/inspection professions. However, society will continue to require workers in other sectors, such as personal services, which are less easy to automate. In this case, we may see a phenomenon of transfer.

Setting up of a universal basic income in Europe and the United States

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In view of the various developments in employment and social protection systems, Europe and North America might decide to set up a **universal basic income system for all**, without any conditions, as soon as a person becomes an adult. This income would allow a person to cover their basic needs [93] and would make it possible for everyone to pursue the activities of their choosing without having to work. This hypothesis was raised by many countries during the COVID-19 pandemic and its **and its disastrous effects on households most in difficulty and on employment**. Therefore, it appears less and less likely to be a wild card. On 7 April 2020, Spain declared that it wanted to introduce a basic universal income of at least €500 for all[94].

Deglobalisation and return of activities as a result of economic, strategic and/or environmental pressure

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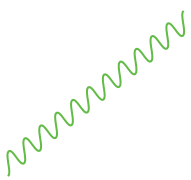
In response to national economic and environmental challenges (the need to relocate certain crucial production or reduce negative externalities) and also in order to cope with the risk of **disrupting the value chain** as a result of pandemics such as COVID-19, several States might commit to a strategy of relocating their activities, giving rise to a massive wave of deglobalisation and national or regional withdrawals.



92 Future of Work reports, McKinsey, September 2020
93 Revenu universel : que retenir des expérimentations déjà menées ?, September 2018
94 L'Espagne paiera 500 euros de revenu minimum "de quarantaine", April 2020

Major real estate crisis for office property in major urban centres

If lockdown leads to the widespread adoption of remote working and the relocation of white-collar workers to areas outside cities, the **real estate market for office premises could see a huge drop in prices**. Indeed, even before the crisis, the pressure on companies caused by a reduction of their real estate assets, led them to widely use open space and flex office to reduce the surface area occupied. The move to remote working for the majority of employees and the continuity of business ensured during national lockdowns might lead companies to reconsider their need for office space. Already in 2017, the American firm WordPress offered all its employees the opportunity to work remotely, thus closing its offices in San Francisco[95]. If a large majority of French companies were to adopt the same approach, it would generate a **genuine real estate crisis and upturn the entire sector and its ecosystem** (cleaning, catering, furniture companies, etc.). In such a case, the development of telecommunication resources to reduce the number of uncovered zones would also be essential to meet demand for connections.

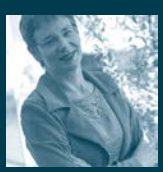
95 Wordpress ferme ses locaux de San Francisco, June 2017

Point of view

"The crisis has created a shock wave, the effects of which are not yet fully known. We only know that some of them will be devastating, while others may be salutary in the sense that they contribute to accelerating the need to transform companies' business models with an even greater sense of acuity and urgency.

In companies where there the crisis has had a huge impact on employment (activities at sites that have closed or been deserted, for example), we are seeing the divide between connected employees (with a digital existence in the company) and non-connected employees, with or without a digital existence, whose activity is carried out solely at company sites (of the employer or its customers). This situation places an even greater responsibility on companies. This is visible in their communication over the last few months which has highlighted their number one priority, that of taking care of their employees.

This should also lead us to give more substance to how inequalities resulting from the conditions of how we carry out our work are treated. Being able to work from anywhere - thanks to being connected and equipped with the full range of devices - is a real asset (even a comfort), as long as the connection (real, not virtual) with your employer isn't lost. However, this is only a very small step towards the true digital transformation of our companies."



Agnès Mauffrey,
Global CIO, Sodexo

Members of the Strategic Orientation Council

Bernard DUVERNEUIL,
CDIO, Elior Group,
Chairman of Cigref

Hugues FERREBOEUF,
Project Manager,
The Shift Project

Jean-Claude LAROCHE,
CIO,
Enedis

Jean-Michel ANDRE,
CIO VP Information
Systems, Groupe SEB

Jean-Gabriel GANASCIA,
Sorbonne Université, Comets
(CNRS), CERNA

Jean-Christophe LALANNE,
EVP IT,
Air France-KLM

Yves BERNAERT,
Europe CEO,
Accenture Technology

Henri ISAAC,
Paris-Dauphine University,
Renaissance Numérique

Agnès MAUFFREY,
Global CIO,
SODEXO

JackyBONTEMS,
President of the qualified
personalities group,
CESE

Christophe LEBLANC,
Group Head of Corporate
Resources and Digital
Transformation,
Groupe Société Générale

Françoise
MERCADAL-DELASALLES,
Chief Executive Officer,
Groupe Crédit du Nord

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Publication team

Rédaction

Cigref

Henri d'Agrain, General Manager
Clara Morlière, Mission Officer

En collaboration avec **Futuribles**

François de Jouvenel, General Manager
Marie Ségur, Research Officer
Cécile Désaunay, Research Director

Contributions Cigref Team: **Vanessa Dewaele**, **Flora Fischer**, **Frédéric Lau**, **Marine de Sury**
Proofreading: **Marie-Pierre Lacroix**, Content Director, Cigref
Communication: **Thibault Luret**, Communication officer, Cigref

Art direction and graphic design: **Studio Dame Yucca** (www.dameyucca.com)

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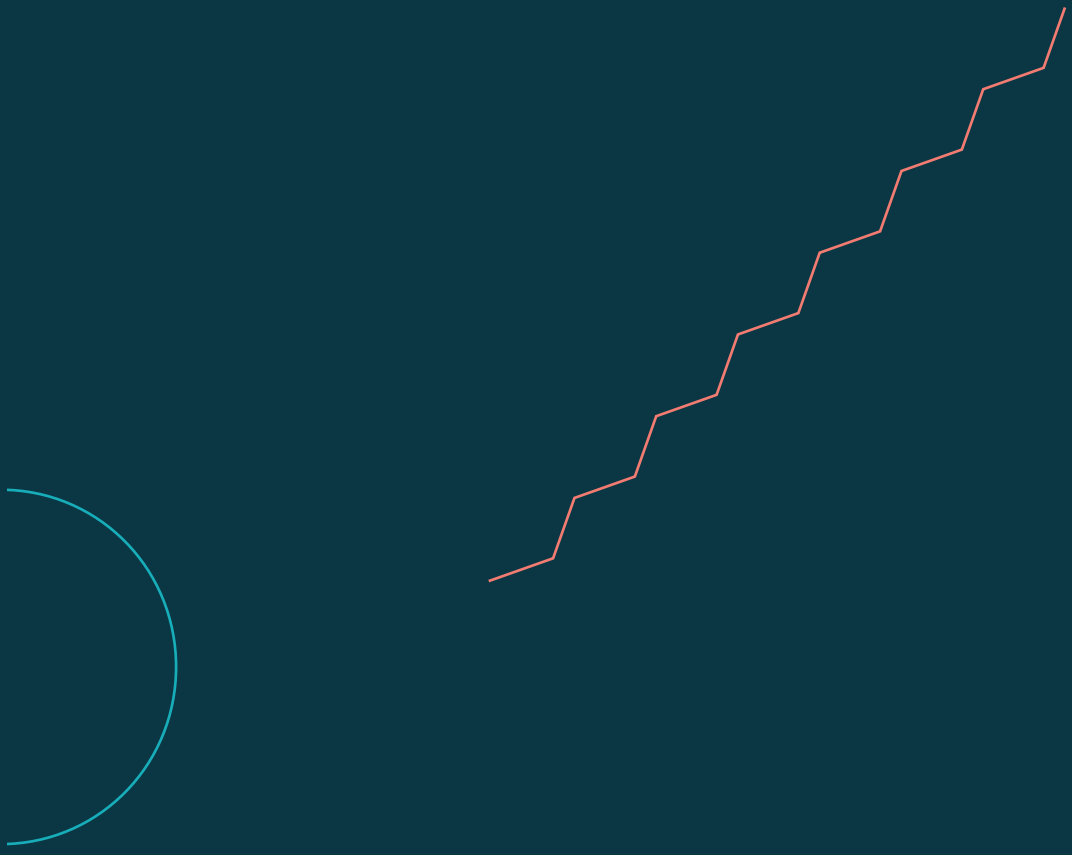

Cigref
RÉUSSIR
LE NUMÉRIQUE

21, avenue de Messine
75008 Paris
www.cigref.fr