Position paper

COVID-19 Crisis

Accelerating the digital transformation

For a more agile and less dependent France

The situation of confinement into which our country and a large part of the planet has been plunged has led to an acceleration in the use of digital techniques to compensate for the limitation of travelling. This acceleration has been accompanied by a remarkable appropriation of the available digital resources by citizens as well as by many private and public organisations. New uses and new applications have proliferated in many fields such as health, education or economic activities such as work organisation or mass distribution.

In these areas the initiatives that have emerged go far beyond palliative measures for the lack of mobility. They constitute indisputable advances in their respective fields and allow us to anticipate a systemic transformation of these activities. Containment has thus revealed, despite the dramatic nature of the epidemic, an opportunity for the virtuous " modernisation " of the country. This evolution is driven by the real-life measurement of concrete benefits that go beyond the reduction of travel: medical follow-up at home, the possibility of working or being educated at a distance, the development of short distribution channels for agricultural products, for example. At the same time, meeting these needs has highlighted the importance of infrastructures for a digital transformation that is shared by all and that meets the requirements of diversity, agility and creativity that the crisis has revealed, as well as criteria of confidentiality, independence and sovereignty.

Platforms are software infrastructures that facilitate or even automate the connection, exchange, design and deployment of online services, between different actors (individuals, machines, organisations). They accompany the transformation of organisations in their practices in order to take into account, in the accomplishment of their missions, a generalised context of digital communications and processing. They then become part of an ecosystem: e.g. patients/ caregivers/ healthcare facilities/ solution providers in healthcare, teachers/ students/ content providers in education as well as employees/customers/suppliers in commercial enterprises.

The implementation of these platforms is carried out within a so-called "cloud" architecture that consists of three levels. The first is the hardware resources (servers, data storage, communications) needed to support a platform and its applications. The second level is the platform itself, which manages the data, its collection, protection and exchanges[1]. The third level includes the applications that can be accessed remotely.

In 4 areas essential to the life of the country (Health, Education, Agriculture, Work Organisation) the Academy has noticed considerable limitations to the dynamics of adoption of new uses and creation of new services (2nd part of this notice). These limitations are partly related to the inadequacy of communication and processing infrastructures but are mainly the result of the lack of deployment of platforms adapted to each area.

In order to lift these limitations, while ensuring the conditions for our country's independence and sovereignty (see part 3 of this notice), the National Academy of Technologies of France recommends that:

[1] The Academy recalls that the value of data in France and in Europe and therefore the interest of the applications that use them must be based on the principles of virtuous circulation of these data (see opinion of the National Academy of Technologies of France) *https://www.academie-technologies.fr/blog/categories/publications-de-l-academie/posts/pour-une-circulation-vertueuse-des-donnees-numeriques*)

1. transformation policies of administrations and businesses based on the development of digital platforms be systematically initiated for those that have not yet started or accelerated when this transformation has started;
2. the platforms used in France and in Europe be based on the standards created by the Franco-German initiative of a federation of sovereign clouds called GAIA-X;
3. the use of systems vertically integrating the three tiers of cloud computing operated by the same supplier be avoided, in order to favour solutions based on different suppliers when independence and/or sovereignty criteria are paramount;
4. for organisations with multiple locations, a network structure of platforms be developed, allowing centralised processing to coexist with more local processing as close as possible to the production of data ("edge computing") in order to ensure the performance and resilience of the platforms;
5. the collection of data such as those provided for in the SMR (Shared Medical Record) be not a fixed and undersized description in relation to the need and the research work that can be carried out on the data collected, and that the development of a corresponding tool be supervised by a governance body;
6. the definition of the essential data of the educational world be also subject to supervision at the national level to ensure standardisation, accuracy, scalability and interoperability of these data;
7. the medium/long-term digital transformation needs of administrations or companies be identified and experiments be launched, led by French or European players, for a second generation of solutions based on needs already identified, and for a first generation on needs not yet met.

The crisis has favoured the appropriation of new uses and abundant initiatives

The four areas examined (Health, Education, Agriculture, Work Organisation) all have the same characteristics in terms of adopting new uses and developing new possibilities. The solutions that have emerged in each of these areas bear the hallmarks of a systemic transformation of the area concerned. In other sectors, such as the retail sale of manufactured products or Multimedia, the digital transformations were already well under way, and the crisis led to a real explosion of uses of electronic commerce and video on demand, also confirming the interest of similar digital transformations applied to other fields.

Health. This area has been marked by an unprecedented explosion of teleconsultation. Thus in April, at the peak of the epidemic, more than a quarter of consultations were made remotely and more than half of the private medical practitioners converted to this practice. In addition, several applications for home monitoring of patients affected by Covid-19 have been developed by many university hospitals. These applications (such as AP-HP's Covidom) allow patients to answer daily questionnaires via their mobile phones and thus prefigure more sophisticated telemedicine solutions that will allow the permanent monitoring of patients with chronic diseases and that are part of the answer to the problem of medical deserts. Such solutions are in gestation: they will integrate dedicated connected sensors but may also rely on other types of connected objects such as watches, which can provide diagnostic elements on the people who wear them. The use of automated exchanges between the most commonly used connected objects, mobile phones, has enabled the development of applications for digitally tracing people who are likely to be infected, such as StopCovid. Finally, it is also worth noting the sudden increase in the use of very high-powered supercomputers (most of which were designed and manufactured in France) by research teams that were not used to using them in the fields of epidemiology or the study of disease through molecular modelling.

Education. A very large number of primary and secondary school children have had recourse, often very intermittently, to tele-teaching practices that have made it possible to maintain a minimum of pedagogical continuity. In this context it is striking to note the great commitment of the teachers to maintain a link with the pupils during this period. Whether through software that is available at national or at school level but which often lacks user-friendliness or is rapidly saturating in terms of the number of users, or by improvising approaches combining e-mail, video-conferencing and telephone, many teachers have shown perseverance, imagination and creativity in seeking technical solutions while inventing new teaching methods that are more appropriate for the use of these tools. In fact, awareness of the contributions of digital education has been accelerated by this collective test. The interest of hybrid approaches (presential/distancional; synchronous/asynchronous; "normal"

class / inverted class...) is making its way into people's minds. The views of the teachers most resistant to digital education seem to be evolving positively.

Agriculture. According to Ipsos, the closure of urban markets has led more than one in ten farmers to look for ways to sell their products over the Internet. These sales methods have often been accompanied by the creation of "drive-in" sales at the farm, possibly involving several local producers, to enable customers to come and take their purchases with them easily and quickly. It is thus considered that while e-commerce activities doubled during the crisis, the sale of fresh produce over the Internet tripled during the same period, thus confirming the emergence of short sales channels in the territories.

Teleworking. According to *Les Echos*, almost one third of the employed workforce have experienced working from home, thus preventing their business or administration from coming to a complete halt. To do this, the major international groups have generally had integrated tools enabling each person to contribute in his or her usual role to the overall functioning of the company, regardless of location. For many SMEs or ISEs it was necessary to improvise by combining again often personal video or audio conferencing, e-mail, spreadsheets, text editors. Nevertheless, according to the same survey, 80% of working people who have had experience of working remotely would like to continue to do so, at least in part.

The limitations experienced: absence, under-dimensioning, restriction of the necessary digital infrastructures and social disparities

The containment provided exceptional conditions for full-scale experimentation of many digital solutions. Given the unprecedented scale of these experiments, digital hardware or software infrastructures and applications have often been stretched to their limits. It is essential to identify the main difficulties encountered in order to overcome them and benefit from the digital transformation process that has been set in motion.

Physical infrastructure: undersized communications, computing and archiving facilities, unjustified restrictions on the use of terminals.

- Insufficient coverage of the national territory by fixed or mobile broadband communications: the " Very High Speed Broadband for France " plan is still not sufficiently advanced for each individual or organisation to be in a position to use or create the various uses mentioned above, regardless of their geographical location.
- Insufficient local bandwidth for access to the information systems of companies or public services, as well as inadequate processing and archiving power of these systems: for several SMEs or ISEs, it has not been possible to accommodate simultaneously all their employees in telework. Regarding tele-education, public structures such as the CNED have been rapidly saturated. Hospitals suffer from a chronic weakness of their digital infrastructures. It should also be noted that in the fields considered here, few use external hosting structures that allow the sharing of communication, processing and archiving equipment within the framework of services offered by the so-called "Cloud computing" architectures.
- The crisis has considerably increased the use of mobile phones, revealing unjustifiable restrictions on their use by some of their manufacturers. This lack of neutrality undermines consumers' freedom of choice and free competition. In the case of digital tracing applications, it has led to arbitrary limitations on application developers and the deployment of democratically agreed public policies[2].

Software infrastructures: absence of secure software architectures based on the notion of an integrative platform

- In most cases, the applications that were called upon during the crisis period are stand-alone applications that do not communicate with other applications or reuse data that may have been otherwise generated or captured. For example, a teleconsultation application does not communicate with a patient's home monitoring application, and a care pathway monitoring function can prove difficult to be developed given the non-interoperability of data from various monitoring applications. Similarly, an application for teaching

[2] Apple in particular has imposed a privacy policy on its phones that is in keeping with its commercial interests and disrespectful of a national health policy.

a given subject will not necessarily be compatible with the application for teaching another subject, making it difficult to set up generic applications for monitoring students, measuring their real commitment, evaluating their personal knowledge and their progress. All the ancillary functions useful for the rapid and customisable development of applications that will implement the uses of the various players in the platform ecosystem will have to be grouped together within an integrative platform. Thus, it will enable data to be collected, archived, structured, shared and exchanged and protected. It will also provide generic data analysis and prediction processing as well as management tools for connected objects. With regard to the applications themselves, the platform will, for example, provide mechanisms for configuring and running the applications, as well as functions to ensure the scalability and possibility of evolution of these applications.

- The "système D" ('make do system') that has prevailed in many cases has opened gaping security holes in many information systems. Teleworking in particular has been a privileged field for attacks of all kinds. In the field of Healthcare, some hospitals have had to suffer denial of service attacks. Others have found themselves exposed to ransom demands or to the unavailability of their data. Once again, the failure to use a properly constituted and secure platform infrastructure to host applications and data is largely the cause of these security breaches.

Social disparities: the crisis has accentuated the impact of the digital divide.
Clearly, the use of digital solutions has been very uneven across the population. Residents in areas with poor broadband coverage have been effectively excluded from continued use of certain digital services such as videoconferencing. The same is true for those who cannot afford a personal computer or mobile phone or to buy an Internet subscription. In other cases, the lack of training in the use of the WEB or the lack of personal space for teleworking or telelearning were also grounds for exclusion. Moreover, the permanent use of digital technology in the home has led to worrying situations of dependency or stress.

Accelerating the digital transformation

The speed with which a significant part of the population has taken up the use of new digital services underlines the spirit of initiative that has animated many of our fellow citizens to create new services and invent new solutions. This creativity and entrepreneurial spirit are exemplary and must be made visible to the general public.

Public authorities and economic leaders must take advantage of this momentum to accelerate the digital transformation of essential functions of the State as well as that of businesses, while mastering the key elements of their independence, by ensuring the participation of user communities in the development of digital services and applications.

As far as users are concerned, "illectronics" (computer-, smartphone-, etc. technology illiteracy) and the difficulties of access to equipment for part of the population must, of course, be taken into account in this transformation. Furthermore, it should be noted that the widespread use of digital technology is increasing users' daily dependence on non-European terminals, mobile phones or connected objects, which is a matter for vigilance.

With regard to communication networks, which are essential for a digital transformation accessible throughout the country, the completion of the "Very High Speed Broadband for France" plan must be hastened, both in terms of fibre and fixed and mobile radio, which are less costly for sparsely populated areas.

European efforts to develop new supercomputers and processors must be continued in order to create the conditions for an open and independent single European digital market. In the same vein, the presence in Europe of integrated circuit foundries at the world state of the art must be guaranteed.

Beyond this, the ongoing digital transformation is fundamentally based on the development of integrative platforms specific to an ecosystem. On this basis, administrations and businesses must, for those who have not yet done so, rapidly define and communicate a strategic vision of their activity based on the use of combined and shared digital data and services and draw up the corresponding investment plans. In the field of Health, the "My Health 2022" law has paved the way for such a vision.

As far as Education is concerned, it is desirable that the Estates general of Digital Education contribute significantly to the elaboration of such a vision for this domain. Without prejudging their conclusions, they can contribute to

accelerating a policy of experimentation by applying it to advanced educational technologies that allow, for example, the personalisation of a pupil's educational path, his/her use of various types of connected objects for learning, or the use of virtual or augmented reality systems. These experiments must be exploited and promoted on a large scale in the framework of a trusting cooperation between the State and local authorities.

In these and other areas, the state must guarantee the independence of users from cloud computing solution providers. Indeed, this market reveals several types of players: those who offer hardware hosting (servers, storage) for platforms and applications, those who provide software for the platforms themselves and finally the application producers. It is important to point out that major global companies, especially those referred to as GAFAM, offer fully integrated solutions and operate them. In the latter case it can become difficult for a user to distance himself when necessary from his supplier and guarantee the protection and confidentiality of data and applications that are of a strategic or sovereign nature. In this context it is fundamental to underline the importance of the initiative taken by Germany and France to organise in Europe the federation of sovereign clouds. This initiative, known as GAIA-X and supported by 22 major industrialists[3] located on both sides of the Rhine, aims to guarantee confidence in Europe in the collection, archiving, processing, sharing and circulation of digital data.

When designing a platform for a given ecosystem, it is also necessary to ensure that the architecture and the data collected meet the immediate and future needs of the user community concerned over time. The solutions implemented should allow for the rapid development of new, innovative and varied applications at any time. The extent, depth and continuity over time of a digital transformation will depend to a large extent on the accuracy and scalability of data collections such as, in health, patient medical data.

The investments required for the digitisation of state services or those necessary for the transformation of enterprises are considerable. They must combine a short-term vision, which aims to make up for lost ground and can only be achieved in some cases with limited recourse to non-European economic players, with a longer-term vision which must be prepared and should provide an opportunity for the development of European technology companies.

[3] Among these companies: Atos, BMW, Bosch, Deutsche Telekom, DocaPoste, EDF, Orange, 3DS Outscale, OVH, Safran, SAP, Scaleway, Siemens, ….