Report

Public Innovation: the disruptive technologies that will transform Public Administration Agencies

minsait

An Indra company

At Minsait we are the mark we leave. And the mark we want to leave.

Minsait is the company that brings together all Indra's IT businesses and integrates the vertical markets and horizontal and support units to meet our customers' business transformation needs.

At Minsait, we create solutions with impact, prioritizing the value of the product, the culture and the transformational offering so as to drive the reinvention of our customers' businesses.

At Minsait, we seek the determination to put experience, talent and intelligence at the service of each customer, providing tangible solutions that can make a difference.

At Minsait, we are committed to discovering and opening up new ways to guarantee the generation of innovation-based transformation and impact.

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Contents

1 Introduction

> “The digital citizen wants an agile service, one that works on any device, that can work with the Public Administration in the same way as it can with other organizations.”

Raúl Ripio, Minsait’s Global Director of the Public Administration Agencies and Health Market.

New technologies have changed our way of life and the way in which we relate and communicate with one another. Their use is now not a matter of choice, we cannot set them aside, they are a key element, but rather a key element within organizations that enables companies and Public Administration Agencies to be at the forefront of a new era and improve their products and services.

Today’s society cannot do without a Public Administration that is able to manage this element effectively and transparently. The continuous change we are undergoing means that we expect more and more from the institutions that govern us. Citizens are used to experiencing and using technologies on a daily basis, and they demand that the Public Sector is also up to date in applying them, transforming itself into a digital and modern Public Administration.

This is why we have to tackle the need to modernize their structures, processes and services through new technologies.

“The Public Administration has to make use of disruptive technologies to provide better services that impact society positively and that also encourage their use by citizens and companies”

Antonio Ceño, Minsait’s Director of Public Administration Market Solutions.

An innovative Public Administration, one that is agile and efficient, is fundamental to achieve a welfare state and a society with the best possible quality of life. To achieve it, we need to innovate through services, implementing new ideas and practices in management, and increasing expenditure on R&D in technologies that make it possible to generate greater value for society.

Technological innovation is a crucial part of this innovative process in which the Public Administration must play a leading role and set an example in the use of new technologies. The analytical capabilities that *big data* offers us, the artificial intelligence revolution, the opportunities that digital reality offers, the indispensable cybersecurity and the promise of blockchain.

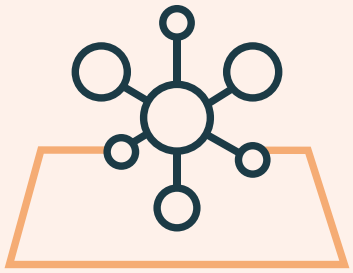
These are some of the most innovative technologies that are setting the course of society, and the Public Administration cannot allow itself to be left behind; in order to provide better services it needs to grasp the opportunities that these technologies offer it.

In this report, we analyze some of the **most innovative technological trends** for the coming years and how they can be used by Public Administration Agencies.

2 Big data

It is estimated that in 2020 there will be more than 16 zettabytes of bytes of useful data, which means they will grow by 236% per

As IT technology acquires more powerful processing capabilities and as access to data by multiple sectors increases, organizations worldwide are looking for more efficient ways to boost their productivity and extract more yield from the information they are generating day by day.



“Before, we saw only the tip of the iceberg, which was business intelligence, but big data is the massive block of ice below the water that keeps it afloat and makes it stronger.”

Natalia Clavero, Minsait’s Big Data and Business Analytics Manager.

In this current landscape, *big data* goes beyond business intelligence and data analysis and involves developing **data models that help organizations draw valuable insights from complex, advanced algorithms** capable of acquiring and processing a huge amount of records from all kinds of sources.

When we refer to *big data*, we are talking about datasets that, due to their volume, veracity, variability or speed of growth, are complex to process with the usual tools such as relational databases and conventional statistics or display packages.

Complications in data analysis and management are given by the so-called 4 “V’s”: Volume, Velocity, Variety and Veracity.

Volume

Big data collects, analyzes and processes a massive amount of data and information from different sources. IoT has been one of the phenomena that has contributed to the exponential growth of data in recent years.

Velocity

When we talk about velocity, we mean both the speed with which the data is generated, and the speed at which it is necessary to process and act on that information.

Variety

Not only is the volume of data generated enormous, but so is the variety of data, i.e. the multiple sources and formats from which they come. Information comes through images, videos, audio captures, email or social media interactions, etc.

Veracity

Reliability of the data used is also a key element. If the data are not truthful or reliable, their analysis is distorted and that is why it is necessary to invest time in ensuring the data have the right quality levels.

There are even trends that already speak of a fifth "V", namely **volatility**, which refers to the time during which the collected data is valid and must remain stored, since a lot of the data may be irrelevant after a certain time.

It is interesting to note that the evolution of big data is contingent on the evolution of algorithmic modeling. Whereas we used to talk about data processing that offered us an understanding of what had happened thanks to descriptive analytics, the new data science methodologies and work have been opened up to new models and new algorithmic methods such as predictive and and prescriptive analysis, which allow us to create

Predictive analytics

Predictive analytics uses historical data to identify patterns and trends that help to anticipate what may happen in the future.

That is, not only are the data analyzed that we already have, but **the predictive algorithm is able to generate patterns not diagnosed by the experts and it can thus establish probabilities, trends and predict irregularities** that help us in decision-making and focusing efforts and actions to be carried out.

One of the areas where big data plays a key role is in the development of smart cities. They allow management of the data that is generated through different sources and the improvement of its efficiency. The data can be obtained from sensors installed in cities (environmental, transport, energy), from traffic cameras or even from the use of different social networks by citizens.

An ideal Smart City, in technological terms, is one in which citizens, private sectors and public administration interrelate with each other.

Integrated infrastructure with real-time interoperability capabilities, big data, cloud deployment, and scalability are the foundation stake on which any IoT platform for end-to-end city management must be built to manage the vast majority of vertical services in cities. This allows the platform to function as a "holistic dashboard" of the city, based on data obtained from multiple sources and devices, integrating and managing them according to algorithmic rules and models making it possible to transform it into information relevant to both citizens and public managers, who will help to make better decisions that are more attuned to the city's needs.

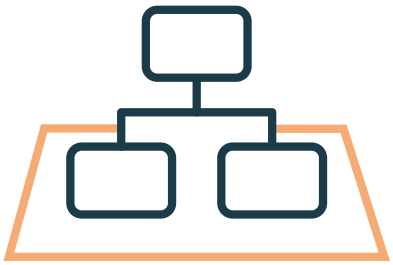
These 360-degree vision dashboards centralize all services and enable more accurate decision-making thanks to the real-time processing of all the information and the ability to simulate different scenarios.

For example, in the case of water consumption, predictive technology **helps identify patterns and trends in water consumption in order to predict demand**. Based on consumption history, demographic data or weather forecasting can be more correctly predicted and prepared to meet consumption levels more optimally. This type of solution can also be especially useful for saving water intended for agricultural irrigation in countries with problems of shortage of hydraulic resources.

Nowadays, data on the state of traffic in cities can be obtained thanks to the existence of multiple road safety cameras equipped with Artificial Intelligence or sensors installed in traffic lights or on public buses. This information along with other available sources of data such as weather forecasts, or information about scheduled events that displace a large number of people (concerts, football matches or public demonstrations), allows us to predict the places where traffic jams or incidents are liable to occur, for example, informing citizens of alternative routes, regulating the network of traffic lights, extending the frequency of trains, subways or buses or even redirecting the route of the buses to improve urban mobility.

Currently, sensors installed on public buses even make it possible to analyze braking and speeding patterns that together with other sources of information can help to identify unsafe driver behaviors and can predict the probability that a specific driver may have an accident. In this way, targeted preventive measures can be taken before an accident occurs.

In the **healthcare sector**, *big data* applications focus on the use of heterogeneous data sets such as patient behavior data, population data, medical device data, and other health data to perform both real-time retrospective and predictive analyses.



Hospitals are mobilizing to adopt *big data* technologies to provide better and more efficient services to patients and even help detect potential threats to their health up to 24 hours in advance, improving care for patients and reducing their infant mortality.

In the field of **justice**, the first proofs of concept are beginning to be seen regarding tools capable of calculating the years of conviction of a sentence or the likelihood of re-offending. Using specific software capable of analyzing hundreds of data can obtain patterns of behavior and estimate crimes or assaults before they happen. Such systems allow the use of not only historical crime record data but also other data such as individual behaviors or images, where by applying effective algorithms it is possible to calculate the probabilities of a crime occurring in certain locations and also suggesting the best possible way to fight this possible crime.

Perhaps the best-known example in this field is the pilot developed by University College London and the University of Sheffield, which has been shown to be 79% accurate in predicting court rulings in the Court of Human Rights of the European Parliament.

Similarly, Washington State University, using a tool known as SAFER, is able to perform the calculation of sentences and also determine the likelihood that a subject will or will not be a repeat offender for a number of crimes. In this way the tool is able to categorize profiles according to risk categories and can support judges in decision-making.

Another area where predictive analytics is starting to be used is in **social services**. These are models that help create dependency policies and primary care services for the elderly, disabled or their families, while analyzing data to create employment policies that are better suited to social and geographic needs at any given time.

The application of these models is also of particular importance in the **detection of fraud**. Today, according to a report by the United Nations World Institute of Development Economics researchers, a total of USD$500 billion is evaded worldwide, and one of the biggest challenges of state agencies is to prevent this from happening. **Public Administration Agencies need to increase research work for the detection of and action against fraud**, effectively selecting possible fraudulent cases and maximizing the productivity of inspectorates.

This is where we need to be able to use unified predictive technologies to extract unstructured data using text mining to combat tax fraud. Predictive analytics can help us find patterns that lead to the generation of future scenarios and detect possible irregularities in the collection of public administrations. Algorithmic models analyze and cross-reference multiple and mass information, thus allowing us to diagnose which companies are most likely to evade paying taxes, based on their records, activity or billing. In addition, systems can more efficiently recommend the planning of inspections.

These fraud detection models can also be used to detect fraudulent receipt of subsidies, grants, social benefits or fraudulent claims for training funds.

All these analyses make it possible to encourage voluntary collection from taxpayers, create mechanisms for citizens to interact with tax systems and detect and prevent fraud where it is most likely to arise.

Prescriptive analytics

If we go one step further than predictive analysis and modeling, we can move ahead and be able to change future scenarios by analyzing them beforehand. This is where prescriptive modeling comes in. This field of study must be understood as one that analyzes and inserts actions as variables within algorithms, so that a particular goal can be achieved.

Prescriptive analytics takes predictive analytics as its starting point and includes mathematical and statistical techniques, operations research, as well as requiring a system that tracks the consequences of suggested actions. In this way, it **is able to predict consequences, but also recommend the best path for any pre-established outcome**.

Prescriptive analysis suggests decision-making options on how to grasp a future opportunity or mitigate an upcoming risk and shows the implication of each decision choice. By continuously incorporating new information and data, it improves the accuracy of predictions and recommends the best options to make.

In the private sector, these models are already being used in a variety of areas, which leads us to believe that analytics of this kind are also of interest for the public sector: they can be used to assist in decision-making and improve services offered to society.

In the **education sector**, better policies can be implemented once the different future scenarios that prescriptive analytics provides us are envisaged. Questions such as what to do to reduce a country's future unemployment can be answered with modeling that allows us to know future job needs and thus create policies to adapt, provide incentives and train students in skills that such jobs will require.

With these solutions, educators are also enabled to identify variables that influence student behavior in order to detect learning difficulties or school dropout and are thus able to take measures, such as improving tutoring, that can minimize dropout rates and improve academic outcomes.

Another application may be in the field of **tourism**, where by segmenting the market and defining the objectives set, it is possible to identify the optimal actions and the precise way to promote a country's brand and contribute to increasing a country's GDP.

In a sensitive area such as **healthcare**, this type of algorithmic modeling may suggest which therapy will deliver the best outcome in a patient based on their clinical and genetic conditions, ev en indicating to a patient what physical activity to perform, or which foods the patient should eat or avoid

The social sphere is a major challenge today

Helping us with *big data* analytics and anticipating the needs of the elderly. **Combining demographic, socio-cultural, economic and health data, the well-being of citizens can be improved** by creating social policies for dependency that are best suited to meeting the needs of our elderly dependents.

They can also be used to help channel public benefits and aid efficiently by focusing on decisions that have a positive impact on these groups. If we know that in 10 years we will have more dependent people, the data can be processed in algorithmic models to show us which scenarios are best suited to minimizing the unwanted impacts in a society that prioritizes the well-being of its individuals.

In relation to **resource management and budgeting,** prescriptive analytics is a great opportunity to change the way agencies determine their public policies and implement their budgets. Prescriptive analytics is able to obtain models in which, from a given budget, the different possible scenarios of expenditure are estimated, thus obtaining a more global vision and a more efficient distribution of public expenditure.

These models are clearly a step forward from the current watertight budgeting formulas, in which the budget of each department is always estimated based on the previous year's expenditure and without taking into account overall aspects and impacts.

In the same way, data can also be modeled with the aim of making the most appropriate decisions on investment policies in a country's new infrastructure such as roads, hospitals, schools or public transport.

Being able to develop a different and intelligent **agriculture**, allowing diverse scenarios to be generated that strike the right balance between supply and demand. Generating policies that direct aid and grants to the environmental, agricultural or livestock sectors or safeguard certain species of fauna and flora due to possible future environmental situations.

Myriad possibilities are open to us, with which governments can improve their management and policy-making through the use of these new analytics.

3 Artificial Intelligence

Artificial Intelligence (AI) is one of the main technological trends that will have the greatest impact in the coming years, as advances in the field leap forward, opening doors to a new world of automation as machines match or even surpass certain human skills.

AI encompasses a series of software, logic, and computing disciplines that are intended to make machines perform functions that until now were thought to be exclusively human. Its technology is based on algorithms that learn from data input and pattern learning, making it possible to take decisions that could seem human in origin. It also includes technologies such as deep learning and Natural Language Processing (NLP), to encompass more advanced systems that can understand, learn, predict, adapt and operate autonomously.

> “We are living in a new era in which robots and computers not only perform routine work activities better than some humans and at lower cost, but increasingly possess better capacities to perform activities that require cognitive, emotional and comprehension competencies.”
>
> Mariano Ortega. Senior Practice Manager at Minsait.

Economically, this aspect is very attractive because, if it is well-programmed, an effective AI solution can think faster and process more information than any human brain. As in the different process or technological transformations throughout history, AI also contributes to increasing productivity and achieving greater profits, both at the process and business level, as well as at the level of entire economies.

Today, the most tech-savvy companies use it to boost the efficiency of their operations, increase their sales, improve their customer loyalty and retention programs and generate business intelligence. This means a general revolution in society that clearly affects the Public Administration as well. Although we think that the Public Sector is a more conservative sector, it is gradually undergoing a digital transformation by understanding the benefits that this type of technology can have for the quality of life of citizens, businesses and civil servants.

Within the Public Sector, areas of action are already being generated where Artificial Intelligence addresses tasks that free up civil servants from routine activities and allow them to dedicate their time to areas that improve the service provided and generate greater added value.

This combination of work between humans and machines will produce better results by complementing each other, making it unlikely that one day machines will replace humans, as their role will be to help us expand our capacity to contribute to progress in different areas.

Conversational platforms

Conversational platforms will drive the next big change in the way we communicate in the digital world. Everything indicates that this will be the technology that will revolutionize 2019, a year in which most sectors will make the leap to chatbots in automated tasks such as attention to citizenship.

Today we are no longer surprised to see people talking directly to their cell phones. "Siri, what's the weather going to be today?" or "Siri, find me the fastest route to get home" are some of the prompts that have made a voice assistant a critical tool on any Apple device, such as Alexa in the Amazon environment or Microsoft's Cortana.

A chatbot is Artificial Intelligence software that mimics human behavior, allowing you to interact with it naturally and comfortably.
This technology becomes a knowledge management tool that evolves from a model in which people adapt to machines to a model in which it is the machine that adapts to the result desired by a human.

To achieve this interaction, its **software has been specially designed, programmed and trained to be able to interpret the purpose or aim of the conversation, understand a human's replies and, based on them, decide how to respond or what action to take next**. This ability to naturally understand and process a dialog is made possible by *machine-learning* technologies.

> “Until now empathetic personalization was achieved only in interaction with agents, but it is already shifting to robotic interactions thanks to the evolution of chatbots, whose objective is to understand interlocutors and express themselves according to the person with whom they are communicating”

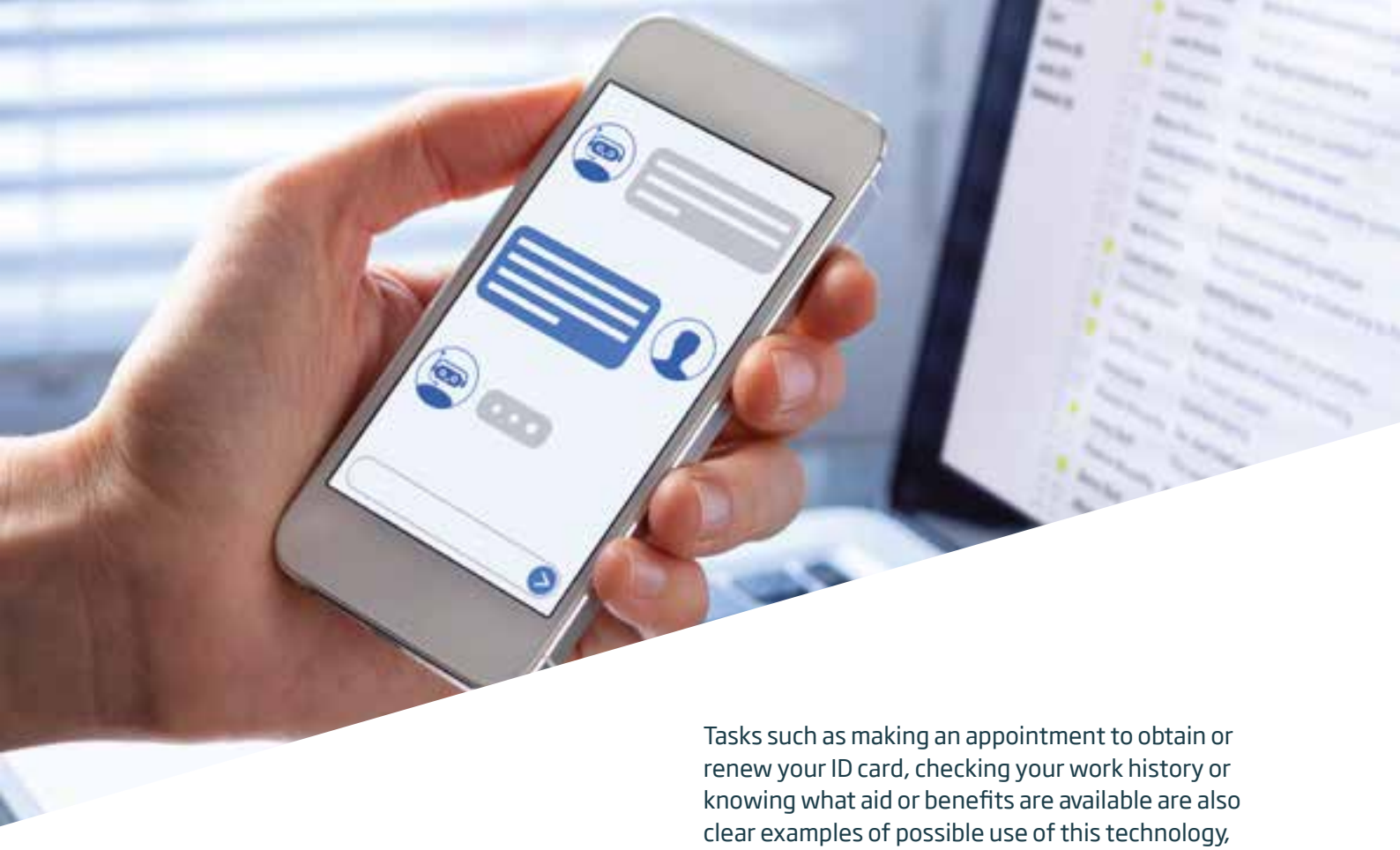
Roberto Arias, Minsait’s Director of Advanced Technologies.

Machine learning detects patterns within a dataset and adjusts actions accordingly and Natural Language Processing (which studies the interactions between computers and human language).

Today, conversational platforms have enormous potential for use in areas such as education, in which, in addition to using traditional communication tools such as email, forums or instant messaging, more interactive and efficient mechanisms can also operate with some autonomy and with a wide availability of access, such as chatbots, enriching communication and bringing enormous benefits to their users.

In universities, for example, with a *chatbot* solution, students can make any inquiries about the books and documentation available in the library; it can also be used as a tool to support educators, resolving any queries about the classes taught, and reducing requests for tutoring and face-to-face consultations. It is not a matter of replacing traditional communication, but rather enriching and enabling it.

Administrative procedures are another clear area of application. Let’s imagine that a citizen needs to know what options they have to pay a fine, how to register with the social security agency, or when their vehicle has to undergo a technical inspection. All these queries that may require multiple phone calls or looking things up on different websites can be solved with an immediate query to a chatbot that is also available 24/7.



“In a very short time, chatbots have gone from being just one more channel of access to state agency services, to incorporating artificial intelligence making them a lever of universal availability of such services and efficiency of the Public Administration”

F ernando Cuenca, Director of Digital Practices at Minsait.

Tasks such as making an appointment to obtain or renew your ID card, checking your work history or knowing what aid or benefits are available are also clear examples of possible use of this technology, which is able to find the requested information more quickly and effectively, freeing up time for citizen’s advice bureau officers to resolve other, more complex issues.

Proactivity and learning are two fundamental features of these platforms that anticipate and interact with the user. Linking these tools to a citizen’s social networks can offer us educational, cultural activities or news of interest and remind us of pending procedures. They are also able to notify us when there are traffic restrictions or demonstrations that would block traffic, and at the same time propose suitable and optimal alternatives for travel or just getting around.

Some of the world’s first government *chatbot* experiences are already under way. Australia has developed a virtual assistant that resolves citizens’ tax questions and Singapore is also in the process of implementing this technology as part of its Smart Nation strategy. **Minsait has technology solutions and knowledge bases** that allow us to undertake the development of conversational platforms to cater for state agencies in a fast and effective way.

Machine vision

Machine vision, through information analysis and processing, **helps us understand the environment around us**. Just as humans use sight to know what is going on around them, machine vision reproduces the same effect so that computers understand the images they process and can act in a pre-set manner. While human vision is best for qualitative interpretation of complex unstructured scenes, machine vision excels in quantitative measurement of structured scenes through its speed and accuracy.

To achieve accurate, reliable and replicable results, machine vision tools include the intelligence needed to quickly and accurately compare patterns of objects of interest. For example, on a production line, a machine vision system can inspect hundreds or even thousands of parts per minute and is able to easily perceive those details of an object that are too small to be detected by the human eye.

If we analyze its application to **smart city management,** machine vision solutions can facilitate and speed up the maintenance of public transport and waste collection. By providing artificial intelligence to urban cameras you can also detect the poor condition of a roadway, optimize public lighting on low-traffic roads or manage traffic by monitoring traffic time. All this has an impact on a better quality of life, allowing the intelligent rezoning of the space, as well as reducing costs, optimizing public services, and contributing to the reduction of energy consumption.

In 2017, the European R&D&i Project BeCamGreen, in which Indra participated, developed a solution based on vision and artificial intelligence to reduce city traffic and drive new sustainable mobility policies. The solution allows traffic managers to know mobility patterns and establish policies that encourage the use of public transport, high-occupancy and low-emission vehicles, applying discounts, penalties or restrictions on access to cities.

Document artificial intelligence

Document artificial intelligence is another step on the path towards the digitalization of public administration. Within any office, department, or agency, there are thousands of papers whose reading increases and consumes much of staff's time. Thanks to AI, some of the tasks they perform can be automated to increase productivity.

Automatic recognition and intelligent reading of documents are two disciplines with many applications and different use cases depending on the type of documentation to be analyzed.

If we focus on more structured documentation, we can also talk about clustering to automate the logical grouping of similar documents, thus allowing a group of documents to be automatically analyzed and treated in the same way.

Faced with the challenge of extracting the semantics of the documents and of having systems that are able to analyze them, we need to take into account the concept of *machine learning*, in which systems learn using algorithms, in order to be able to make classifications of future documents, recommendations within large documents, etc.

Let's think about the documents of evidence that are submitted in different procedures within the Public Administration, that is, documents such as certificates, whose purpose is to attest to some fact or circumstance.

This could be a certificate confirming that a person is living, a criminal record certificate, home ownership title deed, or driver's license. Such documents require an official to verify their validity and authenticity by observing them, but what if the AI is able to structure all relevant data to subsequently apply business rules and in this way confirm the validity or otherwise of the document submitted and thus facilitate the task of civil servants?

With solutions of this kind, it is possible to **increase the added value of civil servants** by freeing them up from routine and monotonous tasks, and replacing them with more complex activities that generate a better service and also achieve a reduction in the times to resolution of processing them.

Document artificial intelligence can **help facilitate decision-making and the analysis of complex files or large amounts of documentation.**

One example is the documentation involved in court proceedings. The incorporation of such solutions will help judges issue judgments by allowing systems to highlight the fundamental parts of documents in a case file in an automated manner and thus help decision-making become more agile. The Government Justice product created specifically for courts and tribunals applies knowledge and learning models and proposes to judges the pages or paragraphs of interest on a particular issue and detects possible inconsistencies in the same document or file.

If we go beyond the mere analysis of documents, we can find a third aspect that is associated with *machine learning* and that enables several functionalities such as: the search for similar documents, the listing of documentation in a case file or the viewing of past rulings or decisions on a given topic or facts.

Drones

Unmanned Aerial Vehicles (UAVs), popularly known as drones, are one of the most promising high-tech devices if we equip them with artificial intelligence solutions. While it is true that the use of drones is widespread in the military field, it is in the civilian field where their applications present the greatest challenges today. Examples include firefighting, rescue, agricultural uses, or even crowd control, for example at a sporting event or a large concert.

Aircraft also use artificial intelligence to fly on auto pilot. One of the most outstanding applications that has emerged is aerial recording for fire prevention and mitigation. For example, with a drone flying over a fire, key information can be collected, such as the direction of the fire, the proximity to populated centers or the location of people who are in danger due to the presence of the flames.

This results in increased speed and responsiveness for firefighting professionals. Indeed, Minsait, together with Babcock, has developed an unmanned vehicle that performs night-time fire detection flights that has already been used in Galicia (Spain), and which contributes to the improvement of the safety and effectiveness of fire-fighting teams.

Other tasks such as **surveillance and control** are also significantly enhanced with the use of drones. Security at strategic points in many countries is really important, and more and more drones are responsible for complementing and strengthening the work already done by traditional surveillance systems.

Infrastructure maintenance is also another clear case of use. Inspecting rail lines for example is much simpler and cheaper with drones. Operatives will no longer need access to the railway corridor to carry out the tasks of monitoring the state of the tracks, because thanks to Artificial Intelligence, the drone is able to locate any modification or incident. This results in cost savings and increased safety for both users and workers. In some Spanish cities they are being used to manage and inspect water and sanitation networks.

Drones can also be used in areas such as **tax inspection**. In 2016 the Spanish Tax Agency was helped by drones to discover 1.7 million buildings and annexes that were not paying Property Tax achieving the collection of more than €1,200 million.

4 Digital Reality

Digital reality is a generic term that encompasses augmented reality, virtual reality and mixed reality. While it may seem that these concepts have been used more frequently by fiction or film writers, the truth is that they are making headway and are increasingly finding practical applications in different sectors, revolutionizing aspects of our daily lives.

These platforms offer new ways to frame and deliver content, experiences, and interactions. Virtual reality allows us to replace our environment with one generated in a completely digital way. Augmented reality complements the real world with objects, animations or digital data and mixed reality is the combination of both "virtual and augmented" reality that allows spaces to be created in which both real and virtual objects and/or people interact.

Virtual reality (VR) is a technology that allows the user to fully immerse themselves in a virtual world, replacing the environment around them with one generated digitally. It allows simulation of a complete sensory experience within an artificial environment without displaying any of what lies outside.

"Digital reality will undergo enormous development in the coming years, especially when devices become more affordable and access to these technologies is widely available"

Francisco Cañamares Martínez, Head of Digital Channels at Minsait.

Meanwhile, **augmented reality (AR)** allows the overlapping of information about the real world, by means of images, markers or indicators. In this way reality is combined with the digital world, achieving a new perception of our environment.

By combining the interactivity of virtual reality with the visual power of augmented reality, mixed reality is born. **Mixed reality (MR)** represents a slightly more complex concept since it no longer overlays information about the real world, but merges the physical world with the digital world. Users navigate through real and virtual environments where digital objects are anchored in the user's real space, making virtual interactions look "real" and mimicking our natural behavior, for example, that as you get closer to the digital object, this will cause a change in perspective or size.

Education

It is a well-known fact that in the last two decades technology has revolutionized education. In recent years, classrooms have been progressively filled with computers and electronic whiteboards, and even notebooks or textbooks have been replaced by digital tablets. However, a very common mistake is to think that digitalizing or using new technologies is to pick up a book and transfer it to digital format, but this is not the case. There are new mechanisms that can be exploited in technology to generate another type of learning that is more effective, more efficient, faster and more enriching.

The idea is that traditional methods are renewed with new tools and new assistance. It is not just about acquiring knowledge, it is about acquiring competencies, skills, capabilities to do and solve things. Skills must be acquired through experiences and in this field Digital Reality offers many opportunities that will enrich students' learning.

One of the main attractions of this technology is its interactivity, which makes it a powerful tool **to capture students' attention, and also to explore a wide range of possibilities** that traditional means are not able to achieve. The possibility of seeing constellations in detail just by pointing our mobile devices at the sky, immersing ourselves in the wonders of the human body or doing simple mathematical operations as if it were a game are just some of the infinite possibilities that this type of technology can provide to improve and make educational practice more attractive.

Schools and colleges, universities and other institutions can encourage their users to interact with their programs, thus better attracting their interest. It is a perfect complement for both *e-learning* processes and traditional training instances, as you can visualize and interact with three-dimensional objects.

Laboratories, for example, have learning instruments that provide a great deal of information and possibilities for experimentation. All the elements that make up it can also be associated with instructions for use, applications or audio files that with just the use of a mobile device allows access to all that information with a single click. Studying physics, chemistry or biology with virtual reality solutions allows users to interact with the elements of the periodic table or with different molecules and even create their own models that are then visualized through glasses virtual reality that allows them to handle the created object.

This technology is already being applied for the training of professionals in different fields, such as **health workers.** It can be helpful for a surgeon to have a three-dimensional view of the organs and bones around the area where they have to operate or be able to observe overlapping information or even images of similar previous operations.

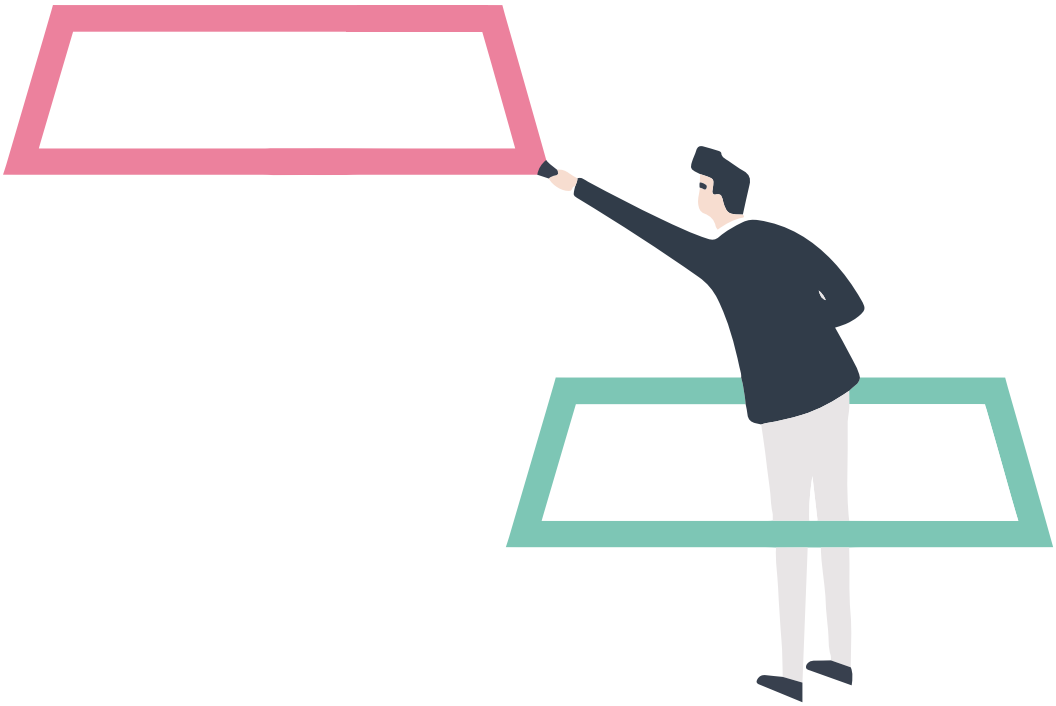
“Books and e-whiteboards are the same format as usual, using the Internet to reach more students. They are not innovative, virtual reality is”

Michael Bodekaer (technology entrepreneur and creator of Labster)

Vocational Training is another area with many applications. Training in welding, mechanics or the handling of industrial machinery can be expensive due to the consumption of materials and consumables, **the use of simulation and augmented reality scenarios can eliminate physical risks** associated with this activity such as burns or cuts, and save on the consumption of materials for the practical training. The use of these solutions is also attractive for young people at a time when there is a need for qualified professionals.

Workers in public services such as firefighters, forest rangers and police officers can also take advantage of these technologies for their training as scenarios that could hardly be replicated in real environments can be simulated, such as fires, major nuclear catastrophes or terrorist threats. Currently, these services have to perform drills that are expensive to carry out and that cannot be performed very often. With these simulation tools you could train both large groups of personnel and a single individual, since there is no need to wait for a larger volume of colleagues for a training action to be run.

The possibility of **virtual excursions** or tours to different places that are being studied is also a very useful use case. In this line there are solutions that allow students to go hiking and discover the underwater world through 360o and 3D images of the world’s reefs, tour the National Museum of Natural Sciences or take a guided tour of Cervantes’s House Students of the natural sciences can even explore a volcano without leaving the classroom.



Another perfect application for this technology is **gamification.** When we talk about gamification, we basically mean using game dynamics to shape a training or educational process, either at a very basic level and more oriented to a juvenile audience, or even within complicated dynamics in areas much further away than in principle we might expect from a game. Learning by playing is proven to be a very effective educational activity, and for this, various channels, methodologies or dynamics are tested; allow different companies to include these processes in their operations.

In this sphere, Minsait has developed TGo Games, a mobile application that makes it possible to configure different challenges in a geo-located and enriched space with augmented reality giving access to a range of prizes, awards and promotions that can encourage knowledge acquisition, carry out philanthropic actions or encourage teamwork.

Tourism

Tourism is a very important sector that drives the economy of many countries and digital reality is one of the technologies that is starting to be exploited the most by companies in the sector. The characteristics of today's tourist have changed: whereas before we were used to traveling with a guidebook in hand, today we demand more information about the places we visit; without giving up the independence of organizing our own routes we use different devices and gadgets and demand new services that meet our needs.

Travel agencies, hotels, restaurants and attractions managed by private companies have been offering digital reality solutions to their customers for some time now, and public administration agencies (at the national, regional and local levels) are key players that must support tourism in their different spheres of action.

The most obvious and at the same time most high-profile application is the **rebuilding of ruined or historic spaces**. To be able to admire any work of Roman engineering in its entirety as it would have looked in the first century BC, or even witness a simulation of a classic performance on this same recreation as you stroll through the city. It is fascinating to be able to contemplate the reality that surrounds you, a monument that no longer exists, historical characters, traditional scenes, parks, gardens etc.

With these technologies it is possible to add levels of knowledge and increase the possibilities of dissemination in galleries and museums, superimposing photos, videos and supporting texts on the real image, and even being able to share it on social networks. Although the main contribution is visual, it is also possible to add sounds to the actual image that will be "silent" to the other users and that allow a specific visitor to listen to a piece of music or a detailed explanation about a certain work.

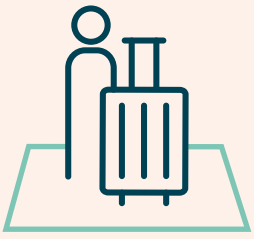
In addition to offering the opportunity to learn about **points of interest** of an area, whether of tourist, cultural or commercial interest, these technologies also offer very useful information to improve urban mobility: locating the nearest bus stops, which buses pass by each stop, how far we have to go to take the bus we want, the location of bike rental points, car parks, etc.

The combination of different visual and sound formulas is also an incredible advance to improve accessibility. For example, an interactive map showing points of interest, store opening times, contact phone numbers or the distance from our position to a specific point. A city can even set up programs to incentivize its local business, such as restaurants: if by using digital reality a user visits certain spaces, follows predetermined routes or solves simple questions to score points, the user can obtain discounts or benefits that they can then use in the affiliated establishments.

We will cite some practical examples that have already started to be implemented, such as the case of the Xunta de Galicia (Regional Government of Galicia, Spain) that has a mobile app within its Smart Camino solution that incorporates augmented reality, so that by using the cellphone camera one can view all the points of interest located near the point where the traveler is making the journey.

In January 2018, FITUR presented its Augmented Fair solution and a series of prototypes that have included elements of customization, planning and guidance with a smart virtual assistant, holograms that allowed one to interact with other people who were attending or were connected to the fair or the possibility to view the content through 360º videos.

What is certain is that digital reality opens up a lot of new possibilities **to attract visitors to physical spaces, to get them involved, to have more fulfilling experiences that will contribute to the growth of quality tourism**, which is why not only companies in the sector but also state agencies must encourage their adoption in the coming years.



Social integration of functional diversity

Digital reality solutions can also be of great help to differently abled people, with a disability or dependence, being able to help them in different ways and contributing to their full social and labor integration. **Through virtual reality, people with reduced mobility can overcome their physical limitations** and experience unique sensations and experiences. They can visit places that, because of their physical characteristics, were impractical for people with motor disabilities until now.

Not only that; this type of technology makes it possible to design **solutions that contribute to improving these people's rehabilitation treatments.** In Israel, the network of centers for children with disabilities has developed a program based on virtual reality and a video game with the aim of stimulating social, motor, psychological, and cognitive abilities. Young people can learn to express their emotions, practice social skills, and gain autonomy with virtual actions they could not otherwise perform.

Thanks to its immersive ability, virtual reality is used for the rehabilitation of different types of phobias, disorders or conditions, such as Asperger's syndrome, a neurobiological disorder of the autism spectrum, which causes difficulties in sufferers' social, behavioral and communication skills.

“The main objective of the CicerOn project is to help people with Asperger’s syndrome cope with their social, behavioral or communication skills through virtual reality training techniques”

Natalia Gómez Esteban, Minsait’s Head of Social Action.

In Spain, Indra, in collaboration with the Universia Foundation and U-tad, has created the CicerOn project, **which uses an application that through immersive virtual reality techniques** allows people with Asperger’s Syndrome to work on their interaction with other people through public exposure to different subjects through interaction with virtual avatars and gamification techniques and game dynamics.

In the case of visual impairment, Indra through its Indra-Adecco Foundation of Accessible Technologies and together with the Polytechnic University of Madrid has developed e-Glance - a solution that seeks to contribute to the social and labor integration of the visually impaired. The solution makes it possible to offer users relevant information about their environment through vibrations and sounds on a Smartphone with the aim of improving their perception and spatial orientation and therefore facilitating their adaptation to work, as they are able to perform tasks with ease, such as planning a route in the middle of numerous obstacles, or obtaining information about the location and identification of people and objects remotely. Although the app works through a *smartphone*, it is planned to use the cane used by visually impaired people to send and receive instructions from their cell phone, making slight movements with the hand and thus facilitating its use.

The Public Administration, as a guarantor of the rights of differently abled people, can adopt inclusive measures of these groups in their public services, and also promote the use of such solutions in institutions that work and are relate to differently abled people.

5 Cybersecurity

“Cybercrime has a global impact on the economy of €350 billion a year, about 1% of global GDP”

Report by McAfee, December 2017.

2017 was the year of cyber threats and will be remembered especially for the Wannacry or Petya attacks, which simultaneously targeted both private entities and public bodies, and hacked more than 300,000 computers in 150 countries. Wannacry was one of the most damaging attacks with different repercussions in different countries and affected not only companies, but also the public sector. It is estimated that the consequences of global cyberattack could exceed €200 million.

While in the 1990s computer attacks were carried out by individuals in search of notoriety, known as “cybervandals”, who created viruses that were annoying simply for the personal satisfaction of being able to do so or to harm the image of certain organizations or institutions, over the past decade, cybercrime has appeared on the scene through organized groups that create complex programs in order to steal large sums of money or influence countries’ policies.

In a couple of decades we have gone from computer vandalism to cybercrime, and everything suggests that in the coming years **we must ready our infrastructures and our security professionals to confront cyberterrorism and cyberwarfare**.

Cybersecurity is a key and paramount trend in this environment.

The main threats faced by state agencies around the world in terms of cybersecurity are **cyberespionage and the theft of sensitive information**. That is why public administrations require comprehensive cybersecurity-based security solutions that contribute to the protection of local, regional and national public bodies. In addition, it is essential that there be an exchange of information between the different public administration agencies on the incidents that occur in each one, since it is much easier to act effectively when faced with an incident that another entity has already experienced to prevent it from happening if this type of information is shared between agencies and public bodies.

With the rise of *big data, blockchain* and the IoT, **cybercrime prevention is becoming one of the main concerns of governments**, which are already taking action to address it and which require diverse solutions that include specialized training of their professionals, the security of digital identification and the security of the Internet of Things.

Evaluation and simulation platforms for staff training

According to several studies, there are currently not enough qualified cybersecurity professionals for all the work that will have to be carried out in the coming years in this area. A survey by the Center for Cybersecurity and Education (ISC) estimates that more than 350,000 qualified professionals in this field will be needed in 2022 in the European Union alone. Globally, the number expands to a figure of around 2 million professionals.

Training of its professionals is a fundamental element that not only companies but also public administrations have to take themselves very seriously. This training in cybersecurity cannot be only theoretical, but rather it is **essential to practice and experiment in controlled environments in order to be prepared and know how to act in the event of a possible cyberattack.** That is why in recent years computer platforms have been created with simulation exercises that allow computer experts to safely learn and practice programs such as the Minsait solution.

Cyber Range is a solution that allows intensive and continuous training at the individual and group level in techniques and tactics of forensic analysis, response to cyberattacks and secure programming techniques.

“Training and education form one of the key pillars for cybersecurity in any organization and country”

Jorge García Carnicero, Head of Cybersecurity Business Development at Minsait.

These types of solutions allow replication of the systems of a public body and then propose exercises to the user and monitor their actions before them, comparing their actions with the theoretical solution of the exercise so that it can go easily checking their progress. This type of simulation platform also uses artificial intelligence to be able to react and anticipate the user’s actions and this, together with an important gamification component, enriches the professional’s learning process.

Platforms can reproduce an organization’s systems, but by not impacting users or the processes of the organization, they allow not only better training and preparation of the security professionals in organizations but also to assess whether the security solutions that are being implemented are sufficient or new measures need to be taken.

Companies, as well as also public institutions and critical and strategic operators are improving their responses to security incidents through such platforms and their use will increase exponentially in the coming years.

Identification through biometric platforms

Biometrics is an **identification technology based on the study and automatic recognition of a person** based on one or more intrinsic and non-transferable physical traits such as fingerprints, facial or iris recognition and/or voice recognition. Being a convenient and secure system, for a few years the biometric passwords have become popular as a method of authentication on mobile devices and computers, displacing the use of more traditional alphanumeric passwords. Nowadays they allow not only unlocking of the mobile but also make payments with it without having to take the credit card out of the wallet or have to press the PIN of the wallet. The popularization of this technology in *smart phones* has meant that many citizens are now familiar with it and are becoming increasingly comfortable with its use.

It is obvious that biometric identification is destined to become the most used method of identification in the future since it can be associated with a particular individual, it is convenient to use because it is not necessary to remember passwords or carry cards or certificates that can be forgotten or lost, and it is highly resistant to fraud. Depending on the use you want, you can combine different technologies and ensure different levels of safety or authentication.

Its applications have so far focused on the control of physical access (buildings, restricted spaces, laboratories etc.) or logical (access to computer equipment, mobile and tablets), but they have enormous potential for areas such as homeland security and reliable identity accreditation.

Homeland security is streamlined and made more secure with solutions that enable automatic reading of the travel document and automatic validation of passenger eligibility criteria, identity verification based on biometric algorithms from facial recognition and fingerprint verification and consultation of police databases to check whether there are any exceptional circumstances requiring police intervention.

Signing documents or even official files also benefits from solutions that allow one's voice to be used as a digital signature.

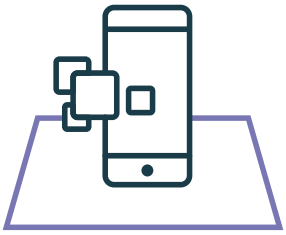
Fight against fraud is another of the use cases in which the use of these types of technologies will become most extensive. State agencies are already installing biometric systems to try to reduce fraud and prevent the misuse of public funds and they can also be of great use for the more efficient management of public aid and benefits since biometric identification ensures that the same person cannot claim the same aid or benefit more than once. Solutions that allow the reliable proof of identity through an individual's biometric features and enable the detection of possible document fraud, also enabling context-based multi-factor

Cybersecurity on the Internet of Things

IoT, or the Internet of Things, is here to stay and is revolutionizing people's lives. Today millions of people wear smart watches or bracelets every day that measure the number of steps they take, the steps they go up, record their heart rate or even smarter devices that can detect that a user is having an epileptic fit or has experienced a sharp increase in body temperature and sends an alert to a family member's or caregiver's cell phone, which includes geo-location of the person carrying the device. In our homes we install temperature sensors and smoke detectors that allow smart regulation of the heating of our homes, or receive alerts on our cell phone in case we leave a pan on a lit cooktop.

Many of the companies that design and market these smart devices, or rather connected devices, do not consider the large volumes of data stored in them to pose a security threat or risk and therefore not enough security measures are being taken to safeguard them.

Recently, international news has been that smart bracelets, which the United States Government had distributed among its soldiers in order to encourage sports practice and combat obesity in their troops, allowed the location of secret US Army bases to be revealed. The soldiers who wore these wristbands when they went for a run reported by GPS positioning the exact path and the distance traveled by each user on a map published on the Internet by a public application that many sports users use to share their sporting practice.



The main problem is that the technology used by most of these devices is so new that security has not always been considered in product design, and therefore become easy-to-attack devices being able to steal our data personal and even spy on us.

Most users who use these devices, more than 27 million users globally, are in Europe and the United States, so the map of these places represents millions of yellow dots representing the routes of millions of users. However, if you zoomed in on remote conflict zones such as the Middle East or Africa, where the use of these devices is a minority, the much lower presence of such points on the map coincided with the existence of military bases from which the exact location and the journeys the soldiers made when they used them could be deduced.

But not only is there a danger to military security, **concern about IoT security also grows when the data that is vulnerable to theft or hacking is sensitive**, such as health data. In the case of health applications, there is concern not only about the possible theft of sensitive information, but also the possibility that such devices could may be virtually hijacked, for example making them inoperable, and demanding a ransom for their release.

This can also happen with our smart vehicles, home automation systems, and other commonly used devices that can become targets for cybercriminals for easy revenue.

“Digital transformation and cybersecurity go hand in hand. In a hyper-connected environment, any device with access to a network can be used for a criminal purpose. Companies and institutions need to invest in effective protection measures and training of their professionals”

Manuel Escalante, Head of Defense & Security at Minsait.

In IoT security, which some have already called SoT (*Security of Things*), challenges are emerging, ranging from product design and upgrade, the security of the network they connect to, and the security of the databases where they are filed. Not just companies that manufacture and market these devices but also users who use them have to take security very seriously, and in this respect **there is a need to invest in social awareness so that users have enough information and use such devices in the safest way.**

From the Mobility Studies Center (CEM) and IoT of ISMS Forum Spain, of which Indra has been a member since its foundation, two coordinated lines are being worked on to minimize the risks of the IoT. On the one hand, with the definition of a catalog of good practices for the design and secure implementation of IoT products, and on the other hand in the possibility of providing the Industry with a mechanism for the recognition and certification of the security measures implemented. The IoT Cybersecurity warranty mark has been designed a specific badge that can be incorporated into the products after the evaluation and prior validation of the product by ISMS of a series of mandatory and other recommended controls. This type of identifier will help users become more informed and purchase more secure devices.

In conclusion, we can say that **cybersecurity needs to be able to provide a comprehensive response to global threats**. Cyber-secure companies and state agencies will have to implement a 360-degree security model that focuses on prevention to curb the constant attacks to which they may be exposed, the detection of possible security compromises identifying anomalous patterns of behavior in the network, in systems, and even in employees, and response by using rapid intervention methodologies that minimize the impact of incidents that the organization may experience.

In an increasingly connected world, cybersecurity is not an option and state agencies must act with a dual role: as drivers of cybersecurity measures, encouraging, raising awareness and legislating as they have done up to now, and on the other hand ensuring that they themselves take all of the cybersecurity measures at their disposal, **continually updating themselves in a world where new attacks appear every day.**

6 Blockchain

Blockchain is a new paradigm for sharing digital information safely and transparently. It was initially defined as an ideal system to allow for greater efficiency of processes such as bank transfers or clearing and settlement systems in the financial sector, but its special characteristics have made it quickly at the center of interest for many other sectors.

The operation of *blockchain* is based on the **decentralization of data and its equal distribution to all members of a network**, ensuring its legitimacy since there is no central element with the power to tamper with records, and in which each transaction is verified by the consensus of the majority of participants in the system.

> "Although digitally it is a technology still in the process of maturing, it is developing very fast and investment in technology assets is high"
>
> Fernando Cuenca, Director of Digital Practices at Minsait.

The union of the blocks in which the generated information is grouped is what is known as blockchain and these blocks are only registered in the ledger by the consensus of at least 51% of the nodes. Once each transaction is entered, it is encrypted using asymmetric cryptography techniques, which intrinsically ensures network security by generating a peer-to-peer trust environment that eliminates the need for intermediaries that allows the exchange of assets of any kind.

Blockchain affords users three main advantages:

Decentralization: Everyone has the same privileges and transactions are executed uniformly anywhere on the network.

Security: If a node is compromised, it will not affect the overall performance of the network, because the blockchain has redundancy on all nodes in the network.

Transparency: every transaction is recorded and registered on the blockchain by consensus between the nodes of the network, so that every user has access to all the recorded information that in turn is permanent, which means that once a transaction has been registered, it cannot be altered without the consensus of 51% of the network.

Flow chart of a blockchain transaction:

1. Ciphering and encryption

The transaction is encrypted and digitally **added to the distributed ledger**

2. Decentralized validation

The transaction is **validated** by a network of nodes that confirms the legitimacy of the transaction.

3. Distribution and confirmation

Once confirmed, it is **recorded definitively** in the ledger distributed as an immutable record.

4. Execution

Finally, **the transaction is completed** and the recipient receives his/her assets.

Although originally this technology was defined as public, open, decentralized and pseudo-anonymous, currently and depending on the type of network one wants to define, we distinguish between public *blockchains* (such as Ethereum) and private *blockchains.* The main difference between a public and a private *blockchain* is basically that in the public one anyone can become part of the network, whereas in a private blockchain (owned by an organization) it can only be accessed by invitation.

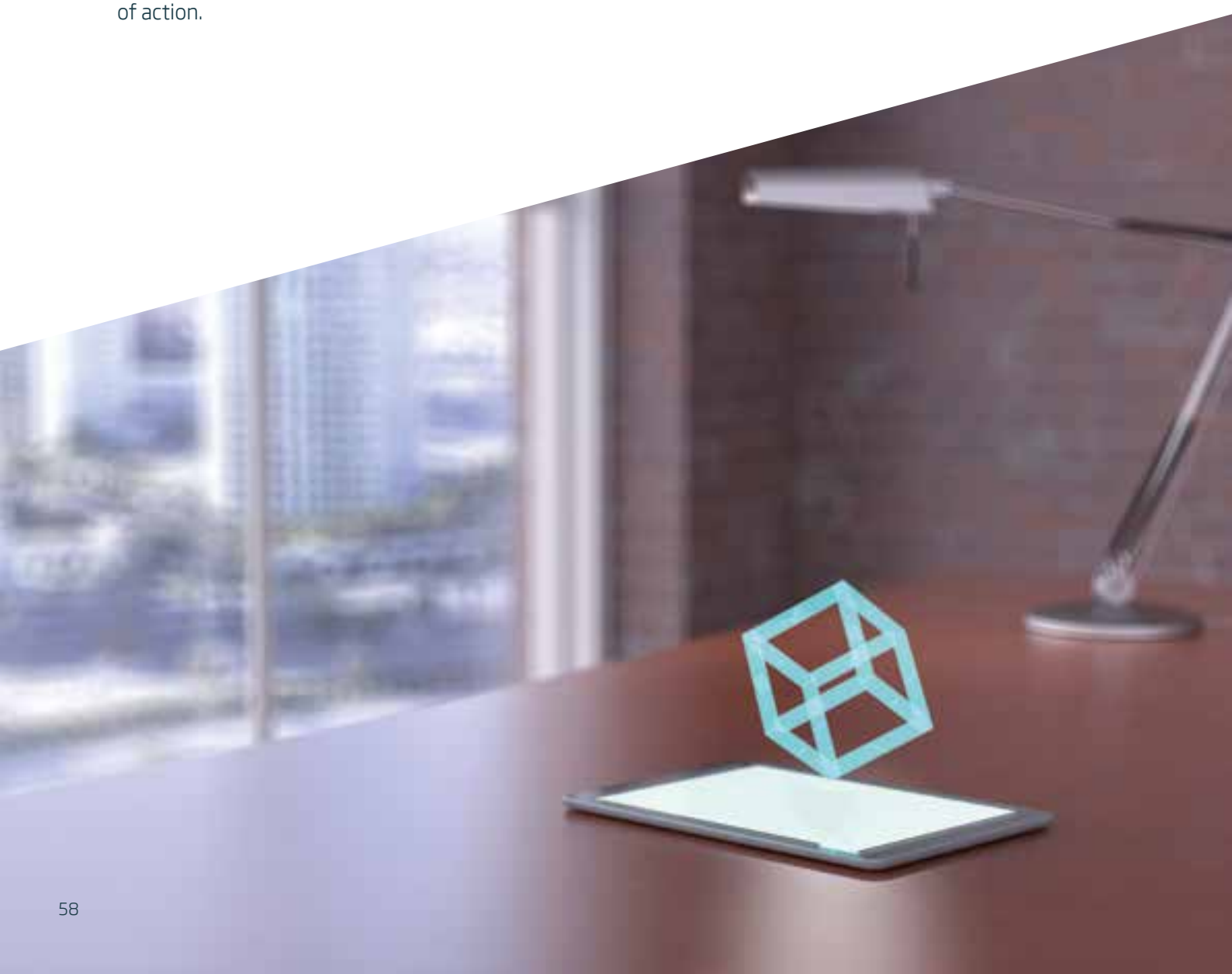
Bitcoin is the most successful public *blockchain* on the market, but since 2008 many other important networks have emerged such as *Alastria*, recently created in Spain as a multi-sectoral consortium involving many of Spain's large companies and institutions, including Indra; it seeks to establish a semi-public technological infrastructure that will allow Spanish society to develop its own *blockchain* strategy. In this regard, the mission of this project is to provide infrastructure, so it aims to build a platform without a particular use case or business model, defining a new scenario of "coopetition" (cooperation-competition) in which to generate operational *blockchain* products and services that support the most advanced models of *smart contracts.*

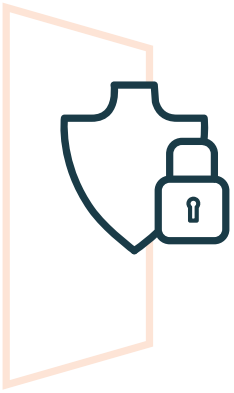
But **what is a smart contract?** It is nothing more than a pre-programmed contract capable of self-executing once the conditions set without requiring an intermediary to act as a witness or trusted entity are met. Although the concept of a smart contract was coined in 1997 by lawyer and cryptographer Nick Szabo, the technology that existed at the time did not enable its actual implementation. The emergence of *blockchain* now makes it possible to make smart contracts.

In a conventional contract, the physical contract is archived and management *software* performs an approximation of the terms and conditions of the contract which is effective in some use cases, but does not solve many other issues faced by a such as updating your new residence address in multiple services and administrations. It is in such cases that the idea of a *smart contract* takes special sense, since it solves in a simple and effective way a laborious task such as changing a home address in all public and private records at a stroke.

Despite efforts to modernize them, routine processes such as **contracting** remain largely paper-based. *Blockchain* reduces the time, costs and risks of applying administrative rules and establishes an immutable audit trail. With access to more complete and reliable data, government organizations can make better decisions about where to focus their attention. In addition, fraudulent activity can be detected quickly, i.e. it acts as a deterrent to this type of action.

Another important role of administrations is to retain trusted information about people, assets and activities. All organizations, local, regional, national and international, are faced on a daily basis with maintaining **information records**, including data such as dates of birth or death, information on citizens' marital status, commercial licenses, property transfers, criminal records, medical records, etc.





> “2018 was the year in which we were able to see the first experiences of the application of Blockchain in the public sector. After this, the global change will be unstoppable”.
>
> Miguel Ángel González San Román, Director of Digital Solutions at Minsait.

Managing and using this data can be complicated, even for the most advanced governments. Some records may exist only on paper, and if changes need to be made to official records, citizens often need to appear in person to make them. It is common for face-to-face offices to build their own data and information-management silos, often excluding other public organizations from using them. And of course, this critical data for the citizen and other organizations must be protected against unauthorized access, thus avoiding possible manipulation, which often hinders their interoperability.

In this scenario, *blockchain* can help state agencies to digitalize existing records and manage them within a secure infrastructure, which allows them to be converted into more reliable, invulnerable, transparent, and inter-operable records.

The IT departments of the various state agencies can create rules and algorithms, for example, that allow data stored in a *blockchain* to be automatically shared with third parties once the predefined conditions are met. In the longer term, technology may even allow individuals and organizations direct control over all government information.

Today, **the most advanced countries and public organizations are already conducting major proof-of-concept and experimental pilots** in order to demonstrate and validate the capabilities that this technology can offer their services and recent proofs-of-concept demonstrate the disruptive potential of *blockchain* at all levels of government (including smart cities).

Protecting infrastructure and critical information in the Public Sector

Although computer systems are never 100% secure against possible attacks, *blockchain*, thanks to its technological features, can significantly increase their security, minimizing the chances of cyber attack. A clear example of this is that Bitcoin, since its creation in 2009 and being a public network with a market capitalization, has so far not been compromised its security.

Estonia has already started to gradually implement a technology called *Keyless Signature Infrastructure* (KSI) in its services to protect all the data that the public sector stores in its infrastructures. Today it applies *blockchain* solutions to the electronic health records of all its citizens and thanks to this, its records have total reliability, guaranteed accessibility and resistance to disruptive events.

This technology gives citizens the ability to detect unauthorized changes in their records and provides them with all the necessary mechanisms to intrinsically ensure full transparency by making them the sole owners of their data without the need for trusting a third-party authority that could make illicit use of it.

It is a technology that can also be applied to **Critical Infrastructure protection**. The government of the United Kingdom, with the *Future Catapult Cities* program, has recently begun to work on the development of a private *blockchain* network with the aim of ensuring that the operating system and firmware used in the management of critical infrastructures is tamper-proof. Blockchain technology will enable software status and integrity to detect illicit changes, and ensure that data transmitted from systems, such as the *Internet of Things* (IoT), has not been tampered with.

Sovereign digital identity

Knowing the identity of a citizen is the first step in all transactions that are carried out with the Public Administrations. For example, in order to know that a person is indeed a legitimate authorized representative of a natural or legal person, or for an authority to correctly link the data of an administrative agency or criminal penalty to a citizen. In this field, digital identity may also benefit from the use of *blockchain*.

With the new model of digital identity provided by new *blockchain* technologies, we can highlight initiatives such as the digital identity issued by the Estonian government where the state issues a digital identity to each individual from birth. In Estonia, each person can provide digital signatures using their ID card, mobile ID or smart ID to identify oneself and use all electronic services securely. Estonia is one of the countries where **99% of public services are available online 24/7** thanks to a secure, convenient and flexible digital ecosystem and where an unprecedented level of transparency in the governance of the country has been achieved, which has generated great confidence in its state agencies.

The technology used enables the control of personal information directly in the hands of the information consumers themselves and uses blockchain, the distributed ledger, to share details privately without going through a central system. As experts point out, **this advance represents a transformation of the concept of identity** in a digital world in which more and more services are connected.

Transformation of the Land Registry

The process of owning and transferring assets, whether in physical property or financial instruments, usually involves multiple interactions and a long bureaucratic path involving multiple agents and authorities to formalize the transaction. In addition to the bureaucratic context mentioned, it must be added that as a general rule these types of processes are not usually digitalized and therefore the physical presence of the agents involved is necessary.

In this respect, the registration of ownership is positioned as a context in which it can significantly reduce both lead times and costs of related transactions, by first digitalizing the information on the ownership of the assets and then storing this information in a *blockchain* network that replaces the current physical property deeds.

Currently the Swedish property register, Lantmäteriet, can be valued at SEK 11 trillion (Swedish kronor), which represents approximately three times the country's GDP.

Another benefit is the technology's ability to keep complete, safe, transparent, and up-to-date track of who owns real estate.

The Lantmäteriet is exploring ways to digitalize the process and for this purpose it has decided to create an application with which to carry out all the actions related to the transfer of real estate using a buying/selling space among private individuals, banks and realtors in which the transaction is registered in a *blockchain* network of the Lantmäteriet where the details of the information related to the transferred property, as well as every stage of the transaction, are recorded.

The advantages that *blockchain* can offer the property registration system are evident and very tangible. According to a study by McKinsey on the *Organization for Economic Co-operation and Development*, it is estimated that in countries that have property properties [i.e. land registries] the cost of administrative fees is estimated to be $3.5 trillion per year.

This significant sum of money could be significantly reduced with a digitalization of transactions, meaning significant savings for the state agency, which could leverage operating margins to provide better services to its citizens.

Another benefit of using *blockchain* to transform the property registration process is the ability of technology to keep track of full, up-to-date, transparent and secure tracking of property owners and therefore maintain exhaustive control of its legitimacy, preventing any unauthorized manipulation of records. In addition, it would provide **greater legal certainty and increase the security of property registration** especially in those countries with less democratic stability and a high degree of corruption.

Energizing local economy and tourism

Blockchain can become an ally that governments can rely on with the aim of fostering local trade in their cities and boosting their economy. The objective is to create a valid digital "city token" throughout the network of shops registered with the platform providing a series of extra services to the citizen by using it.

Bristol and Liverpool are some of the pioneers in this initiative and have recently launched their own city currency, with which citizens obtain significant advantages by purchasing goods and services from local stores. The way it works is simple: it can look like a loyalty point card valid in all outlets of the local merchants' network. In this way citizens accumulate discounts and other benefits for each good or service purchased that they can redeem in any of these businesses.

The *blockchain* network is distributed among all businesses and users, and each establishment can act as a node, thus ensuring that no-one can manipulate the records and take advantage of exclusive advantages for their own benefit without respecting the agreement defined in the creation of the network. From the user's point of view it is simple to use, it is enough to acquire through a mobile application as a "virtual wallet", the tokens or virtual currencies of the city, and make payments in the relevant stores, hotels and other outlets via NFC.

This type of initiative will also impact the processes and roles of the tourism ecosystem. Let's think about safe, cheap and easy payments. As it is a distributed and immutable database, the transactions that are performed and their corresponding registration is immediate and irreversible. **This prevents duplicate travel charges**, such as *overbooking*, ticketing or sporting events illegally, and also provides greater security since it does not require the use of debit or credit cards.

On the other hand, a public service rating management system can be built for points of interest (hotels, restaurants, monuments, etc.) that leverages the advantages of security and decentralization offered by *blockchain* technology, prevent the manipulation of ratings and ensure their integrity and resilience over time.

Citizen participation

Some governments and political organizations are already exploring the possibilities offered by *blockchain* for citizen participation, as it is one of the key mechanisms in the governance strategy of various public institutions. Facilitating this participation, guaranteeing **digital identity and anonymity** with legal validity is one of the many uses provided by *blockchain* technology.

In **electoral processes**, *blockchain* can be a powerful tool, since it enables transparent and distributed voter registration and also checks that the vote cast has been properly accounted for while maintaining its secrecy. Some countries have already begun to develop successful *blockchain-based* voting, such as one organized in a South Korean province or in the state of Maine (United States), where it complements the use of ballot papers.

Blockchain has also been used to hold internal political party elections and in shareholder voting of a number of companies. In addition, the EU appreciates the possibility of its implementation to improve electoral processes as it reduces costs and increases their reliability.

In conclusion, we can claim with confidence that we have a very encouraging future ahead of this technology, as it can deliver a host of benefits that will enable, among other things, a **reduction in transaction costs and increase security, by encouraging and driving innovation.**

7 Conclusions

The so-called disruptive technologies, such as digital reality, artificial intelligence, blockchain, big data and cybersecurity are transforming the world and impacting current business models and how state agencies will have to serve society.

Digital innovation in the public sector, although it may be inspired by the one previously generated in the private sector, has an enormous creative capacity to generate solutions and services that meet the needs of citizens, businesses or institutions it serves.

Public service innovation depends on the will and motivation of those who govern us, who must choose digital solutions that contribute to increasing the fairness of society and building trust through the transparency of their public policies. The choice of investments in disruptive government technologies in the coming years is key to the future of the welfare state.

In the sphere of big data, new algorithmic methods such as predictive and prescriptive analytics will create scenarios for defining the best public policies in areas such as health, justice, education and anti-fraud measures.

Artificial intelligence will complement the work of public employees and help deliver higher value-added services. Virtual assistants, machine vision, intelligent digital recognition systems or self-manned drones will help make life easier for citizens and a safer society.

> “We are at a time of intense change in economy and society, as we have moved from an environment in which physical prevails over digital, and in which public administrations must give a comprehensive response to challenges and opportunities they face in a context of accelerated change.”
>
> Cristina Ruiz, Minsait’s IT Business General Manager.

Digital reality with virtual, augmented or mixed reality solutions will improve the educational experiences of the future, create countless opportunities in the field of tourism promotion of cities and contribute to the integration of differently abled people.

Cybersecurity will be responsible for protecting our digital footprint and our most valuable assets, data, in a hitherto connected world where cybercrime is already a business model.

Finally, the use of *blockchain*-based solutions will optimize the way state agencies and their customers relate to one another and will change the way in which certain public services have traditionally been provided, giving them greater transparency and achieving a more active participation of citizens in the decisions of the authorities that govern them.

Can you imagine what the future public administration will look like?

Big data

Smart Cities
Health
Justice
Tourism
Fraud

Ciberseguridad

Simulations platforms
Biometric identification
Internet of Things

Artificial Intelligence

Document intelligence
Machine vision
Chatbots
Drones

Blockchain

Infraestructure Protection
Land Registry
Digital Identity
Energizing of economy
Citizen participation

Digital reality

Education
Tourism
Social Integration

We already see it

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