FRENCH NATIONAL REPORT

Fostering the Adoption of ICT-enabled AMTs by European SMEs

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Revision History

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2			

Applicable Documents

ID	Reference	Title
1	[PARTNER ORGANIZATION]	[TITLE OF THE REFERENCED DOCUMENT]

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I. Introduction of ICT-enabled AMTs: situation in Germany

A. Scope of the project and target group

When analysing the Germany structure of practices in the use of ICT-enabled AMTs by SMEs, it is absolutely essential to understand the impact that SMEs (specifically micro and small enterprises) have on the German economy. These SMEs, made up of less than 500 people, make up almost 60% of all businesses in Germany and employ over 60% of employed persons. This means that it is also important to think about the importance that these businesses have for the German economy. The adoption of AMT in Germany is crucial to the reduction of product cost, improvement of the quality of products and services etc. In this report the good practices of SMEs in terms of ICT will be proposed in order to prepare a report representing the Transnational Phase and with the National Phase will reveal the gap between the desired situation ("TO-BE") and the present situation ("AS-IS"). The implementation of ICT-enabled AMTs is focused on: design, test, simulation, maintenance, production phases in SMEs. That is linked to the optimization of production networks, product lifecycle and product data management systems, ERP, cloud manufacturing, mass customization, VR/simulation in product design and reconfiguration, supply chain management.

B. Project objectives

The main idea of this national report is to define the good practices in France and the needs in the defined sectors, size of the SMEs and the need of these SMEs (skills and knowledge, finance, etc.). As a result we will develop training programs and tools in order to enhance the skills and to grow a network to share the good practices between partners with an emphasis on strengthening the capacity of SMEs through the training, workshops and dynamic demonstrators.

The central challenge of the digital transformation of companies is to decompartmentalize the very distinct universes of traditional industries. Transversal to all sectors, new technologies offer new opportunities for industrial companies to transform their business models, and further improve their production lines and uses.

C. Research methodology and general state of art of ICT-enabled AMTs by French companies

The use of ICT-enabled AMTs by French companies presents contrasting characteristics. Based on the statistical source "*Eurostat, Community survey on ICT 2016*" we can conclude that:

- French companies have equipment and usage at the same rates as the European average, especially for high-speed internet connections, for the use of integrated management software (ERP) or for the purchase or online sales.
- French companies are rather far behind in terms of new uses, for which they are below the European average: cloud computing, the use of radio-identification technologies (RFID) and the use of social networks.
- In terms of ICT competences, French companies employ a little less often specialized staff and they have a training rate slightly lower than the European average, however the rate of recruitment of specialized staff is slightly higher than the European average.

A national report for the use of ICT in 2016 by sector is presented on the Table 1:

	France	UE 28	Leading country
Connectivity			
Internet broadband connection	99	97	100
Web site	68	77	95
Employees regularly using a computer	61	54	76
Employees regularly using internet	57	50	73
Use of ICT specialist	16	20	35
Use of advanced tools			
Enterprise Resource Planning - ERP	39	36	56
Customer Relationship Management - CRM	32	33	47
Sending invoices, allowing automated processing	15	18	72
Receiving invoices, allowing automated processing	33	26	70
Sharing information to manage the supply chain - SCM	13	17	30
Emergent use			
At least one social network presence	35	42	70
Use of cloud computing (cloud computing)	17	21	57
- including file storage	12	13	36
- including database hosting	9	9	25
Massive data analysis	11	10	19
Use of Radio Frequency Identification (RFID)	7	10	21

Field: Legal unit of at least 10 persons employed (excluding agricultural, financial and insurance companies)
Source: Eurostat, Community ICT Survey 2016

Table 1. Use of ICT-enabled in SMEs in France

Moreover, according to a study conducted in 2017 by "Katalyse" and "D & Consultants" companies on behalf of "OPIIEC" it is possible to synthesize the needs of ICT-enabled AMTs in France in term of employers, trainings and skills. This study analyzes the branch of two types of companies:

(1) Engineering and Technology companies contributing to the design and/or manufacture of a product or equipment: all of their services are related to the life cycle of a product or equipment, and range from assistance to the expression of needs in terms of operational safety and maintenance in operational conditions, through development and customer support in industrialization processes;

(2) Digital Services companies' experts in the field of news technologies and digital: consulting, design and implementation of tools, maintenance or training, and their main objective is to support a client company in the realization of a project.

The two groups of companies address the sectors of:

For these sectors the most important is that the big companies represent most of the half of the French market and it is even more difficult for the SMEs and Micro companies to survive. That means the rest of the market is addressed by a multitude of very small companies. The table below summarizes the use of ICT-enabled technologies based on a study comparing some key technologies and the opportunities for SMEs.

Key technologies	Opportunities for SME's
Big Data	Platform, storage, analysis, architecture
BIM	Project mangment
Blockchain	Instant processes, certification and traceability of operations
Sensors	Autonomous vehicles, consumption support
Secure Communications	Secure sharing, reliability
Cloud	Data storage, secure sharing
Cybersecurity	Intrusion tests, security service, accompaniment
Additive manufacturing	Prototyping, replacement part
Artificial intelligence	Data processing, chatbot
Internet of Things	Traceability, geolocation
Modeling and simulation	Feasibility tests, cost evaluation
Virtual and augmented reality	Coaching training, quality follow-up
Robotics - Cobotic	Maintenance, programming

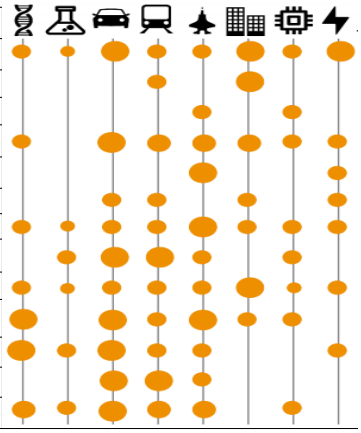


Table 2. ICT-enabled key technologies and opportunities for SMEs

(Source: Katalyse" and "D & Consultants" companies on behalf of "OPIIEC)

We can observe the ICT-enabled AMTs' use by sectors and to define the lack of use on the one hand and the good practices on the other hand. The sectors of automobile production, transport, defense & space are more developed in terms of use of ICT-enabled technologies. The sectors of smart cities and energy, still in strong and quick expansion, are also very affected by the use of new ICTs. The sectors which lack the use of ICTs are more related to the chemistry industry (including the agri-food industry, metal industry), electronic devices production, life science, wood industry.

Based on the two sources mentioned before, we can define the good practices and lack of knowledge and specialists in France in the ICT branches. Those branches belong to 3 groups:

1. **VR/Simulations:** in design and reconfiguration of products and technologies;

2**. Management:** a) Supply chain management (suppliers/customers), b) Optimization, lifecycle and data Management Systems and c) ERP;

3. **ICT- tools:** a) Cyber-physical systems and networking, sensing & intelligent components, b) Mass customization (three-dimensional printing, direct digital manufacturing) and c) Cloud manufacturing.

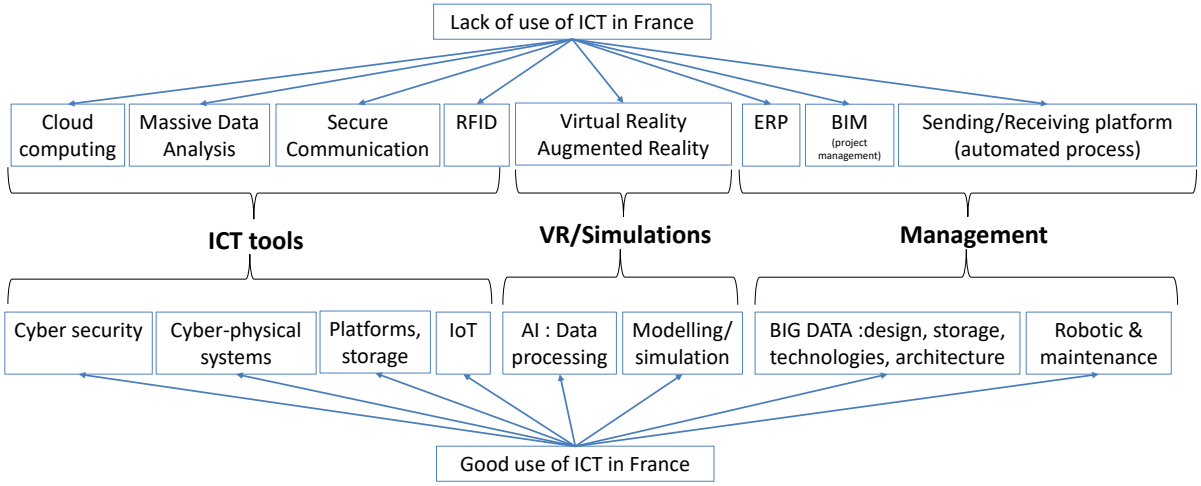
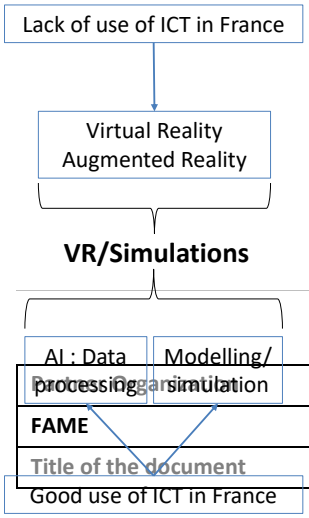


Fig.1 Analysis of ICT-enabled in France by category: ICT tools, Management and VR/Simulations (based on source: Katalyse" and "D & Consultants" companies on behalf of "OPIIEC)

II. VR/Simulations in design and product reconfiguration

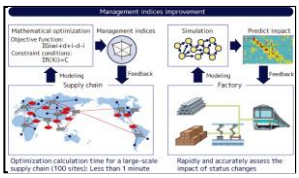
Regarding the study (*2017 by "Katalyse" and "D & Consultants" companies on behalf of "OPIIEC"*) what stands out first is the **lack of knowledge** in VR/AR, however, good practices are described below for the target industries.



Virtual and augmented reality – except the sector of medicine, space/aeronautic, game industry, transport and automobile the other sectors have considerable lack of skills and tools for developing the virtual and augmented reality for their activities. However there are

sectors where it is difficult to apply these technologies, like the wood and metal industry because of the lack of significant subsidies in the branch. There are some good practices for the agri-food sector in France (below).

AI (data processing, machine learning and deep learning) & **Sensors** (autonomous vehicles & consumption support): Artificial intelligence is at the heart of recent debates about social and technological changes, in France and in the world. In a recent publication of "*France Stratégie*" it is pointed out that AI is a technological brick of digital transformation. The impact of artificial intelligence has been most prevalent in the three business sectors: transport (including electronic industry and metallurgy), health and banking (*Source: France Strategy mars 2018 "Intelligence artificielle et travail"*).



Modeling and Simulation technologies are in the average of use ICT-enabled in the SMEs depending on the sector. For transport and car manufacturers, life sciences, defense & space industries the conception of new products is related to modeling and simulation technologies. The use of ICT-enabled is crucial for the innovation process in the car industry with the construction of autonomous vehicles.

A. Common practices in Electronic and Electronical equipment industry

The main technological and industrial sectors that use **AI** in France are the transport with the innovation and concept of autonomous vehicles and the related sector of new generation of production line and sensors. Indeed, integrated into the autopilot system, artificial intelligence is able to optimize the speed of a vehicle given the acceleration or braking time and congestion. This optimization results in energy savings. Regarding the maintenance of equipment and production lines, many industrial **sensors** already measure the points of wear of the equipment or equip control points on production lines. The cost reduction of these sensors allows the collection of massive data. Artificial intelligence makes it possible to process these data on a larger scale than human treatment and thus to increase the number of control points, while refining the diagnosis resulting from the analysis of these data. The impact of the AI and in particular the appearance of the autonomous vehicle influence the sectors related to the transport as: (1) the logistics, optimization flows & transportation services, (2) the maintenance, supply chain and control and (3) diagnosis & supervision. Thanks to the countless technical and operational data that can be collected from the Internet of Things (IoT), predictive maintenance is now one of the priority topics of major industrialists.

B. Common practices of VR/AR and AI in Metal industry

Virtual and augmented reality can be very useful for the **manufacturing and logistics sectors.** In fact, augmented reality makes it possible, for example, to superimpose instructions or even holographic images on a user's field of vision. It can learn in a didactic and intuitive way to use heavy machinery or complex devices.

For example, the company **Inglobe Technologies** teaches how to repair a car's engine by highlighting different areas through augmented reality.

Virtual and augmented realities allow engineers to manipulate product designs using software as if they were already manufactured. This way, engineers can accurately visualize the consequences of each change and modification to a design element. It is possible to make rotations, to observe the design from all angles to understand how the changes impact it. Industrial designers can also use technology in the same way, and even collaborate with engineers via VR.

An example represents the interpretation of weak signals in order to detect very early the risks of failure of large production equipment in the **field of metallurgy**. However, this project showed that adding sensors was not always necessary. Indeed, innumerable data exist without being always suspected that they can be meaningful: video surveillance, minutes of meetings, reports of intervention, etc. **AI** is capable to digest and talk about all kinds of data, including - and most importantly! - Those which seem to us unintelligible or not easily analyzed.

C. Common practices of AI in OTHER SECTORS

Some companies with good practices in AI: **Wakeo** is an innovative company offering a **Saas** platform for real-time control of transport flows. **Wakeo** helps freight forwarders and industrialists gain visibility into their flows with the goal of improving profitability and customer service.

Dataiku is a company specializing in data science and is developing a platform to analyze data and develop predictive methods in the Big Data environment. This all-in-one platform, **Dataiku Data Science Studio** (DSS), makes it easy and fast to analyze data and develop of predictive services in Big Data environment.

D. Common practices of VR/AR in agri-food industry

The agri-food industry is in full swing thanks to ***virtual and augmented reality***. Immersive technologies are transforming the way 1) employees are trained, 2) which products are sold, and therefore 3) which products are developed.

1. These new possibilities offered by virtual reality and augmented reality improve the efficiency of training, while allowing companies to offer each employee a personalized training.

2. In this context, virtual reality and augmented reality make it possible to immerse the user in an advertising virtual experience. This type of content is already widely used in the food industry. A good example is the Boursin Sensorium, which combines movements with the smell and taste of Boursin cheese. Similarly, Tequila Patron's brand used a 360-degree video to reveal how their alcohol is produced. Innis & Gunn used VR content to add a contemplative dimension to their beer tastings. There are countless examples of VR marketing in the agri-food industry.
3. In this context, augmented reality can add a dimension of digital interactivity to different products. In the agri-food industry, this technology is mainly used for marketing. For example, Treasury Wine Estates allows consumers to scan the labels of their bottles to watch animations on their smartphone screen. Nestle, for its part, has created an augmented reality game inspired by the Rio animated film about Nesquik cereal boxes, in partnership with Dassault Systèmes.

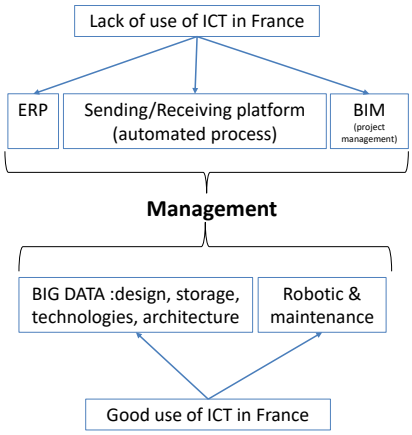
According to *Source "**ARTEFACTO**":* The virtual reality gives consumers the opportunity to visit a factory without the brand having to worry about logistics, hygiene or security issues. It is also a true experiential marketing tool that increases customer engagement. Many companies have already implemented virtual reality factory visit tools. This is, for example, the case of the company **Traou Mad**. This famous biscuit factory, born in Pont-Aven, wished to promote its know-how by launching the creation of a tool for virtual visit of its workshop. For this, the Breton SME turned to Artefacto to produce an application that meets its expectations. Available on smartphone and tablet, this virtual tour can be done with a VR headset and allows the public to immerse themselves in 360° within the biscuit factory without violating the measures of hygiene and safety.

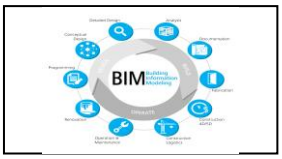
However, the interest of augmented reality is not limited to marketing. Companies can also use this technology to inform consumers about nutrition information and product composition. Consumers can scan the packaging of a food product with their smartphones to discover this detailed information.

Another example: thanks to modern technologies, farmers can benefit from a lot of data on their plantations. The drones, in particular, are equipped with 360° cameras making it possible to spin the fields in aerial view. But virtual reality headsets are the perfect support for viewing these videos. Farmers can therefore use VR to monitor their crops to improve yields, and reduce costs and the number of diseases.

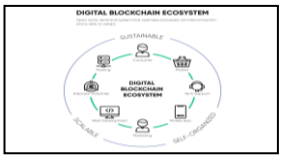
"INFOSYS" has already entered the AR / VR market in the service of agriculture with its Plant.io project. It is a system of sensors, lamps and cameras to accurately measure the health of a plantation. With ***AI***, it is then possible to automatically determine what each plant needs to maximize its growth. The data is transmitted via a wireless connection to a pair of ***augmented reality*** glasses. Thus, agriculture can see in real time what each plant needs: water, light, fertilizers.

III. Management of supply chain (suppliers/customers), optimization, lifecycle and Data Management Systems and ERP:





Building Information Modeling (BIM) –assure the project management in a new way from the programming and conceptual part, through the design, analysis and documentation, later by the construction (fabrication), maintenance of the product/process.



Blockchain – open socio-technical system that **optimizes processes** via interconnection and is able to adapt. The statistics are quite overwhelming and exciting, indicating the importance and potential of block chain technology. The ultimate aim in engineering an ecosystem model in blockchain is to enhance the factor of **autonomy and performance**. As the industry grows and the technology matures, new solutions will surface to cater to existing problems in terms of certification and traceability of operations.

As presented, the **best practices** in France touch the Sectors of Big Data, IoT, AI, Modeling & Simulation and Cybersecurity. For the optimization and management platforms, for storage and treatment of Big Data some good practices are presented below:

Big Data in France (platforms, storage, analysis & architecture) – (source "*BIG DATA GUIDE REFERENCE DIRECTORY TO USERS THE 2017/2018*") the best practices for Big Data are regrouped in four levels of expertise by a set of companies skilled in the area of Consulting Data & Digital: we distinguish the (1) Data Architecture, (2) Data Engineering, (3) Data Science and (4) Data Governance. These four levels of expertise are complementary for the realization of Big Data projects which consist, first to explore the data, then to realize a prototype and finish by the step of implementation in an industrial level. The Figure below summarizes that.

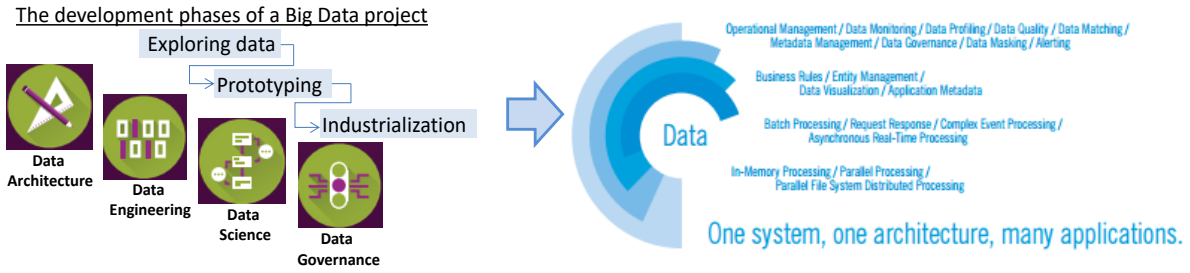


Fig.2 BIG DATA GUIDE REFERENCE DIRECTORY TO USERS THE 2017/2018

A. Common practices in Electronic and Electronical equipment industry

ERP Sylob software covers all the needs of companies working in the electronics industry and can evolve in sectors such as aeronautics, automotive, medical or the general public with different constraints and production processes: volume, size of series, complexity of products, quality environment, and deadlines. This tool proposes: intelligent inventory management, piloting the production, provision, tractability and quality control.

Thanks to this software the results are regrouped in four categories:

- Optimized purchases and simplified component management;
- Optimized production management, including outsourcing;
- Improved quality and traceability;
- Anticipation of needs.

Another example of management system is **Thales MicroElectronics**: TMI specializes in the design and production of value-added microelectronic components and cards for the healthcare, transportation, telecommunications, avionics and defense industries. PMI has put Agile PLM (product lifecycle management) into production, which has enabled the transition from a consulting firm's SGDT to a true transversal and collaborative PLM solution and for the co-design of products with customers.

B. For the sector of metal in France

For the sector of metal the company **Armor Meca** is specialized in high precision machining and assembling subassemblies. As a historical actor, it has also been able to position itself in the very demanding sectors of defense, energy, naval and medical. The company integrates technological innovations with new products and new processes such as ***metal additive manufacturing***, social innovations and environmental innovations with the recycling of cutting oils or autonomous energy production. The company decides, in a difficult economic context for the aerospace industry, to produce more complex, *higher value-added parts and expand its range to new metals such as*

titanium. Aware of the technological challenges, it is necessary to modernize its processes and production methods and to equip itself with software tools to support its development strategy: these are the first steps towards digitalization. Armor Meca has a modern park of machines, of which 75% in 5 axes, saving time, quality and programming security. Complex *aluminum parts are machined "in the air"* to minimize surface defects and reduce cycle times. It is a delicate operation that requires advanced know-how in FAO programming and that few companies are able to achieve. Three robotic cells control the machines: from the loading of the stock and pallets, to the setting up of the cutting tools, to the three-dimensional control of the machined parts. The production is organized on 5 buildings: storage of raw materials*, machining of aluminum parts, machining of hard materials, metrology and additive fabrication*. Armor Meca has set up Teamcenter Manufacturing to replace the "file" management with ***"database" management***: 60 stations are equipped and have access to CAD / CAM data centrally and collaboratively. Designers, engineers, and machine programmers work closely together from a single source of information. The benefits were immediate: more fluid communication between different departments, conflict management between different versions of the data and better traceability of changes. Janus Engineering is a company helping optimization process in term of production of “Armor Meca”. The use of new technologies is crucial in each manufacturing process.

For example **Simatic IT Preactor** is a tool to ***optimize the flow*** on the production lines and the loading of the raw materials in the warehouse. The use of the NX MKE tool (Machining Knowledge Editor) should also help to standardize and speed up programming tasks through greater reuse and thus reduce programming time. The benefits of software implementation are numerous and tangible: reduction of NC programming and machining times, improvement of surface finishing of precision and quality of parts, reduction of production time and errors and optimization of the use of manufacturing resources.

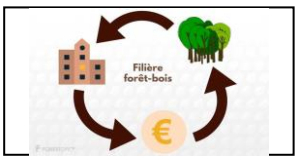
C. For the sector of agriculture and food & beverages in France:

AGTECH - *SMAG Smart Agriculture* (**including Food & Beverages**) supports professionals in agricultural and agro-industrial (food and beverages) sector on national and international level. They deploy simple and efficient information systems to ***optimize the management and technical and economic management*** of farms and agricultural production. The aim is to produce more and better thanks to the adoption of new technologies and in particular through the exploitation of data. The fields of application of ***Big Data*** in the sector of agriculture and food & beverages are omnipresent by:

Farm management software: strong involvement of software solutions in crop farming or livestock farming, offer the opportunity to track production costs on different crops or plots and monitor benefits across the farm to optimize processes and improve decision-making.

Precision Agriculture and food & beverages: "Pôle Agro-Digital d'InVivo" dedicated to the development of precision agriculture.

D. For the sector of wood in France:



For the sector of wood in France, there is a new wave of innovations sorted by their multiplicity and that contributes to the wood-forest sector to be more competitive. Two fields to achieve innovation: on the one hand the "Construction and market" and on the other hand the "Process and digital transition" (source: "Innovation on the agenda of the forest-wood sector", expo "ForestINNOV", "Euroforest"). All forest-related business sectors are targeted to ensure innovation in the wood-forest sector: software and geographical information systems solutions, ICT companies, drones, insurance companies, banks, certifications, cooperatives and forestry experts, training establishments, R & D, logistics, transport, logging.

Innovation must be synergistic, that is, it must be complementary to production and processing. **In the field of construction**, these projects are also the result of a pooling of activities between architecture, engineering, civil engineering and materials science. They help to make the sector more competitive thanks to an ***optimized organization between the different operators***. For the field of Industry the innovation will also affect the automation and robotization of production lines, in order to adapt them to the industries of tomorrow. Combined with ***digital innovation, the BIM*** (Building Information Model), lays the foundation for a ***future industry, a 4.0 plant***. This digital transition increases the productivity of the industry and could also give it a lasting boost. It generalizes the exchanges between the industrialists, the investors and the researchers.

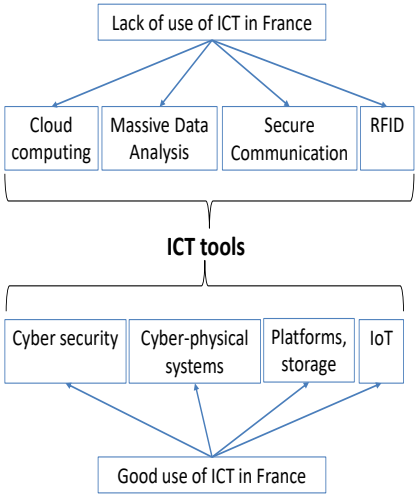
A development of technological and process innovation, such as ***BIM***, which makes it possible to ***virtually create building models*** in a very precise way. The digital model of the wooden building or BIM is not limited to a 3D drawing. All the speakers come to manage this model. The main objective to add digital tools to take ownership of forest management, with the use of ICT in the wood-forest sector is to help owners to become involved and more and more managers and producers.

The **laforetbouge.fr** ***platform*** is a ***computer tool*** designed to "advance the mobilization of wood in private forests by offering innovative services". It aims to "gather tools, which already exist on the Internet, in the same space".

The **eMobois** project aims to facilitate the ***exchange of data*** between forest producers and consumers and processors of wood.

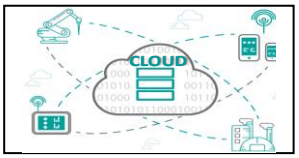
Forestopic is a ***digital tool*** that can be used by professionals in the forest and wood as well as the public. Moreover, web portal on plant health or forest communication strategy take part of the innovation in the wood-forest industry for 2018 (source: "*Forestopic*").

IV. ICT- tools: a) Cyber-physical systems and networking, sensing & intelligent components, b) Mass customization (three-dimensional printing, direct digital manufacturing) and c) Cloud



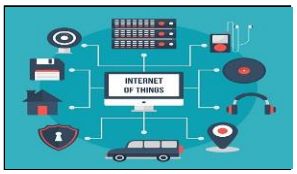
manufacturing

Secured communications – the sharing of messages and mails, reliability and data storage (storage space) represent a risk for companies, productions and humans. There are tools and strategies to deal with common threats and risks associated with using certain ICTs, as well as possible products and strategies to improve an organization's security measures.



CLOUD – the cloud (cloud computing) meets the Secure communications problems in terms of data storage and secured sharing. Depending on the sector there are good practices in the sector of transport, automobile, energy and smart cities in France, but there are still needs in other sectors such as metal and wood industry, agri-food and beverages, chemical industry.

A. Common practices in Electronic and Electronical equipment industry



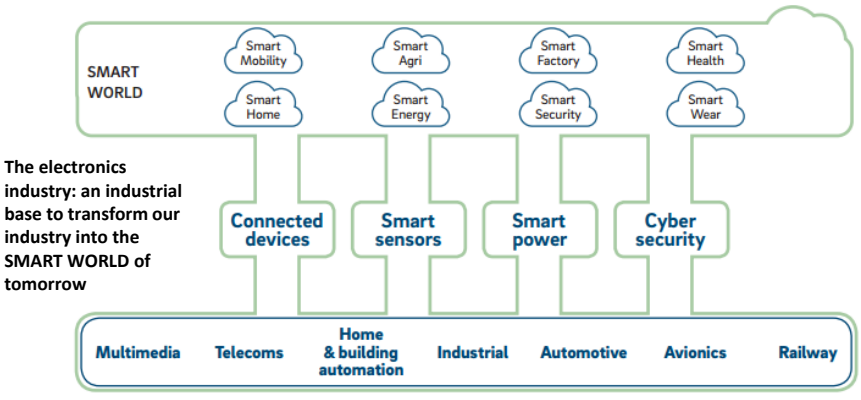
IoT. Source: "The city and the internet of things 2017-2018" report of "AGROENGREF Paris Tech" and "Ecole des Pont Paris Tech". In this study the example of the city of Angers is presented. The city has a strong industrial heritage in the **field of electronics** (with Thompson, Folan),

which it seeks to maintain and develop. The choice of Angers was to promote the local manufacture of connected objects. The city created the City of Connected Objects, a kind of factory where start-ups are accompanied to create their connected objects from A to Z. In 2015, the "French Tech IoT label" was awarded to the city to reward this initiative. The city has created the PAVIC, a platform for connected objects that aggregates data from different connected projects. The mode of governance chosen for this structure is intended to give it a great flexibility.

France, 1st European country for electronic subcontracting according to "*DECISION*" (*source: report "Vers l'Industrie Electronique du Futur"***).** In addition to take stock of the realities of the market of professional electronics, the "*Cabinet Décision*" study conducted in November 2017 showed the dynamism of professional electronics in France:

- France is the 2nd largest European country in terms of computer, electronic and optical products manufacturing.
- France is the leading European country in the assembled electronic cards manufacturing.
- 85% of the turnover of French manufacturers of electronic equipment is made for professional electronics.
- The West is the 1st region of France to manufacture assembled electronic cards. It represents from 46% to 55% of the jobs and 51% of the turnover of Metropolitan France.

Electronics is the keystone of the development of ***IoT*** and the digital transformation of French industry.



Source: « Vers l'Industrie Electronique du Futur »

*Fig.3 Electronic of the future in France (source: report "Vers l'Industrie Electronique du Futur"***)**

The work of the experts of the World Electronics Forum 2017 in Angers shows the major projects for the professional electronics sector:

- Competitiveness: Towards a digitized and competitive French electronic industry to accelerate the relocation of production.
- Traceability: Traceability in electronics, an issue of transparency, competitiveness and quality of production.
- Access to skills and training: Attract talent, a critical issue for the electronics industry. A sense of urgency about training due to the depletion of the workforce at technician level and an aging population pyramid. A degradation that risks the loss of know-how for the industry of electronics.

France has a strong experience in the field of electronics and electrical devices but nowadays this expertise is completed by the integration of smart numerical technologies as we presented previously for the city of ***Angers*** called the "***City of Connected Objects***" in the field of electronics.

Another example for IoT in the electronics sector is the city of Nantes with the company **Naonext** which created an interactive and innovative product: "Crystall Ball", a MIDI controller with a motion-based interface. Naonext has invented, produced and marketed this product and knows perfectly the path of a company that wants to put on the market a connected object or any other electronic product. They have all the electronic prototyping equipment to carry out studies and prototyping.

B. For the sector of metal in France

As regarding the use of ICT-tools as: Cyber Physical System (CPS) concept, smart sensors and intelligent components, digital manufacturing and even cloud manufacturing, this analyze of situation if France, meet the previous part concerning the "Management and Optimization systems in the production and machining in the metal sector". The example of **Armor Meca** shows the use of new ICT-enabled AMTs in the production process with emphasis on a new machining process called "***metal additive manufacturing***" and to smart digital manufacturing using intelligent components. Their common platform of work covers not only the management of the process but the idea joint to the creation of cyber physical system.

Snecma worked to install intelligent and connected production lines in its engine assembly plant. Namely, fault detection robots or use of IPad, in order to reduce the human intervention and assure the fault diagnosis and measure the risk during the production process. As consequences we distinguish: the ***optimization*** but also the creation of a ***cyber physical platform*** where all the participants in the manufacturing process collaborate. Thanks to this smart platform pacification, production and automation of the process are achieved by the bidirectional connection between the operation/modeling part and the real part of the production. For this smart factory the product ***efficiency and traceability*** are also assured by the use of ***RFID chip***. The RFID chip is used for example on the assembly of vehicles; it makes it possible to check the good location of the parts or to identify the characteristics of the product.

This connectivity offers more efficiency to operators, and also allows remote control of production. In Saint-Etienne, the **Technical Center for Mechanical Industries (CETIM)** provides manufacturers with a platform for shared and remote-controlled production. This shared platform helps to spread ***risks and test the profitability*** of production. Cameras inside and outside the machines help supervise the production environment. In the same way as interoperability, security is an important issue for the connected factory.

However, for the metallurgy sector, according to an oral report in January 2017 of "*The Joint Observatory, Prospective and Analytical trades and qualification of metallurgy*" the major problem remains the workforce for the sector. The challenges for training and trades technicians in the high-tech sector are the following:

- Recruiting technicians in the field of electricity-electronics related to the metal sector,
- The difficulties of recruitment appear again acute,
- Issued in connection with the digital sector (not only in metallurgy).

The *Survey* "*Labor requirements 2016*" (of an employment center in France) for the metal sector and related jobs shows the difficulties for the metal sector not only in terms of recruitment but also in the knowledge and use of new ICT for this branch (Table 3 & 4):

Survey "Labor requirements 2016" (of employment center in France)	Number of recruitment projects	Recruitments deemed difficult
Electronic Electricity Technicians	2 682	53%
Electronic electricity designers	284	73%
Supervisors in Electricity Manufacturing	120	47%
Mechanical and Metalworking Technicians	2 153	60%
Draftsmen in mechanics and metalworking	1 357	57%
Supervisors in mechanics and metalworking	530	62%
Process industry technicians	3 262	44%
Supervisors of the process industries	936	29%
Technicians and technical "AM" identified Metallurgy	11 324	51%

Table 3. Labor requirements 2016 ("Employment Center in France")

Survey "Labor requirements 2016" (of employment center in France)	Number of recruitment projects	Recruitments deemed difficult
Unskilled workers in metal sector	10 120	37%
Qualified maintenance workers	6 576	51%
Unqualified machining workers	4 873	48%
Boilermakers, skilled blacksmiths	3 897	63%
Qualified machining workers	2 708	70%
Pipefighters	404	65%
Qualified Surface Treatment Agents	359	71%
Etc.		
Identified workers Metallurgy	53,547	48%

Table 4. Challenges for training and trades of workers in the high-tech sector ("Employment Center in France")

C. For the sector of agriculture and food & beverages in France:

According to *Source: National Association of Food Industries* **ANIA** there are some practices of use of new technologies in the agri-food sector as:

***FOOD FOR LIFE FRANCE*:** A platform to create links between researchers, technical experts, and food companies to build the food R & D of tomorrow.

***INCREASED DEMATERIALIZED LABEL*:** In collaboration with farmers, industry and distributors, this project will allow consumers to access, via an Internet portal, a complete information on their products, but also to improve their traceability.

***VALORISE*:** An interactive platform of self-evaluation, to simplify CSR exchanges between suppliers and distributors.

CONNECTED WEATHER STATIONS: are parts of the Internet of Things (***IoT***) and allow the capture of data that feeds meteorological algorithms and determine the ideal treatment ranges on a parcel depending on weather conditions. The collected data are: soil (temperature, humidity, quality, and organic elements), air (temperature, hydrometric, wind, and sunlight), plants (water stress, strength, chlorophyll level) as well as plots of lands (treatments, fertilization, fields etc ...). In France, we are still far from the current development of Open Data compared to the United States.

D. For the sector of wood in France:

Representing 10% of the total deficit of the French trade balance, the wood industry faces many questions as why France imports wood to build, when one of the largest forests in Europe has.

Interesting fact in France: Wood in all its forms: build the highest office building with its 31 meters from solid wood structure. Perspective is the largest office building made of this material from France. Solid wood, which composes it, is the only building material that stores carbon instead of emitting it: one cubic meter of wood stores 1 ton of CO2. The "post-beam" technology used allows a structure 5 to 7 times lighter than with concrete, while being twelve times more insulating.

Industry 4.0 advances in the wood industry, in sawmills or in furniture or wood construction companies. Industry 4.0 is the next industrial revolution for the wood industry. It holds promises of connected machines that "communicate" with each other, increased productivity and flexibility, better yields that limit material loss and machine optimization through predictive maintenance. Virtually all sawmills equipped with a canter are already at the heart of the 4.0 sawmill, that is, those

of a certain size. The hardware manufacturer collects data in the processes, in order to make its equipment more reliable. The wood industry has shown at Eurobois 2018 (*source: Eurobois, show of the wood industry, held its 2018 edition from 6 to 9 February at Eurexpo Lyon*) that it is dynamic and that offers are developing for the connectivity of machines, or that companies think about it. But, digital in itself has no value. It must be accompanied by data analysis and response actions.

Some examples of companies innovating in the wood sector concerning the use of ICT-enabled AMTs are:

Corvus Monitoring: specialized in imaging and airborne measurements: a web platform based on interactive cartography fed by all the actors of forest exploitation. They use LIDAR (Light Detection and Ranging) on the drones. The sensors used by the company are hyperspectral sensors, which allow multiplying the bands of the electromagnetic spectrum (visible light, infrared and ultraviolet). The light and the colors are thus decomposed into several shades which are analyzed by these hyperspectral sensors. Coupled or not with a LIDAR, these hyperspectral sensors make it possible in particular to distinguish the species and thus to carry out precise forest inventories. They can also be used to evaluate the health of a logging operation (stress, yield, detection and early diagnosis of diseases, etc.) or to refine selective cutting plans. Corvus Monitoring is working with researchers from Lausanne Polytechnic to develop this technology.

Delta Drone: specialized in data acquisition for agriculture, hydrology, visits of wood sites, industrial inspection;

yourmachine.com: the first rental site for agricultural and forestry equipment.

Brugère (group: **Les Manufactures Février**), specialist in peeling beech. The company is renowned for its ***automated production lines*** and as "the only national manufacturer to offer custom panels" for industry, construction, layout or furniture and flooring.

The **Ducerf group**, with its three sawmills which processes 50,000 m3 of logs per year, mostly oak. In addition to its pre-drying and drying, high temperature wood treatment (THT) capabilities. The start-up I-Tech-Bois works on the creation of custom wood facings of building, with a view to insulation from the outside.

Tertu Equipements, a company based in Orne (Normandy), has expertise in Douglas fir-wood. These are his wood-metal safety barriers, intended for 40% export and in addition, use ***computer simulation*** to test these road and off-road devices (*Source: "Palmares 2017*);

V. Solutions

Bringing a true digital culture to France is possible through innovation, which can only develop in our country if we create a digital culture. This requires a hybridization of knowledge and the creation of interdisciplinary centers to think collectively about the impact of technology on society. Moreover lifelong learning is becoming a key factor in the strategic management employment and skills development for SMEs in France. So, key technologies still immature such as IoT, AI, VR/AR, and Cloud & Security need qualified employers and workers. The companies become actors of the learning and training and they help increase the performances and the skills of their workers. Also, each person must be willing to achieve some level in his/her personal development. That means building a Smart and Agile College of Knowledge (SACK) that's to say a hybridization of knowledge process using Smart Learning Tools Platform (SLTP) with personalized training in the form of bricks. That is to say the employee can choose his/her courses from a cluster of training modules according to his desire for personal development in the SME. This SACK using SLTP represents multi-layers of interconnected knowledge tools (courses) and learning modules "bricks".

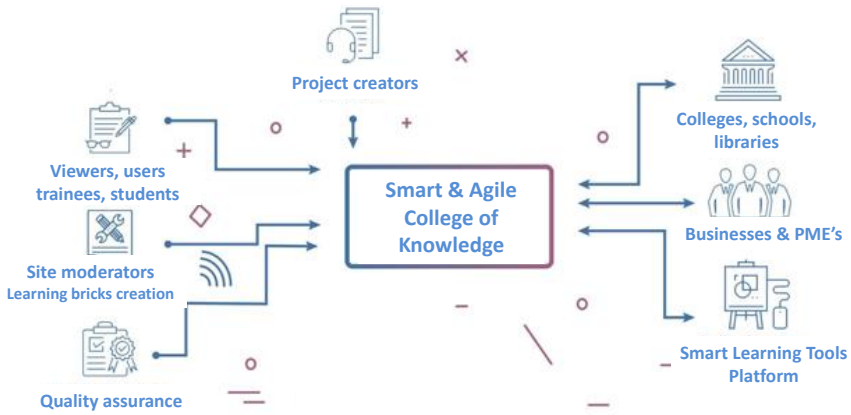


Fig.4 Smart and Agile College of Knowledge structure

According to (1) the good practices from member countries of this project in each key ICT-enables AMTs in the sector of electronics, food & beverages, metal sector; (2) the needs of the SMEs in terms of design, simulation, test, maintenance, production and (3) the obstacle to invest and relation to the size of the SMEs, different solutions can be integrated in the SACK:

Virtual Smart learning tools platform – using digital tools of smart and agile knowledge the platform proposes a self-building of the proposed learning courses and to adopt the so-called "self-learning & fast-learning". Of course a training opportunity that we know so far will also be possible but using the same smart tools platform. People learn on the platform by watching how

peers build real projects and can also download all project resources and files. The platform is powered by Education tokens, students & trainees' feedback, site moderators by creation of learning bricks etc.

Real Smart learning tools platform – develop training programs and tools to enhance the skills and grow a network to share the good practices between partners to strengthen the capacity of SMEs through training, workshops and dynamic demonstrators.

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