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**OPERATIONS  
OF THE FUTURE**

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# OPERATIONS OF THE FUTURE

MANUFACTURERS:  
YOUR OPERATIONS HAVE A FUTURE!

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## PREFACE

**This paper has the great merit of attracting the attention of decision-makers to an essential fact, which could go unnoticed in the turmoil of changes taking place: we are experiencing a period that has only one precedent in human history. One that saw, in a little over a half-century, the rise of the railway, the combustion engine, electricity, the first giant factories and the car, but also photography, voice and image recording. We are experiencing this huge scale of change again today, with ubiquitous Internet applications, the mass spread of smartphones and robotics. You only have to see the twelve points selected by the authors of this study that, from 3D printers to the Internet of Things, including virtual reality, people and robots working together, and the existence of autonomous robots and the Cloud, constitute a series of innovations entirely comparable, in their effects on our daily lives and on our industrial organisations, with the revolution in the second part of the 19<sup>th</sup> century.**

But unlike this period, these innovations are streaming around us, and will continue to do so over a period of barely 20 years. This prodigious acceleration in the flow of technology is one of the key factors of this new revolution. As this paper emphasises, all production systems are going to be changed dramatically. Dominant positions are already being challenged, and will be even more so tomorrow. This passage into a fourth (some would say third, no matter) Industrial Revolution is actually characterised by the fact owning machines ('equipment capital' referred to by the authors) no longer guarantees that a company will be able to dominate its sector tomorrow.

This is a revolution that may be particularly unsettling for senior management of industrial operations. There is no longer added-value in owning any kind of assembly line or production line. How is this possible, you ask, in a world where machines in all their forms can only occupy an increasingly important place? Look at your smartphone and tablet. Whatever their make, they come from the same company, Foxconn – the largest private company in the world with 1.3 million employees. But Foxconn only recoups 20% of the added-value of your favourite items while Henry Ford recouped 80% of the added-value of the cars he sold.

As Marx understood very well, in capitalism added-value is created by the production system and therefore returns to those having the capital needed to set it up, hence the term capitalism. But 25 years ago, Peter Drucker had already theorized, in his book, '*Beyond capitalism*'<sup>1</sup>, this post-capitalist society that, while maintaining the market economy, is essentially founded on intelligence, creativity and information. In short, intangible entities quite different from an assembly line. This change taking place was poorly understood. And yet it's obvious. In modern times, power is based on objects such as tanks and planes. But Saddam Hussein may well have had the fifth largest army in the world, but it was swept away in a few hours. He had no real-time information by satellite and, without this, his tanks and aircraft were reduced to children's toys.

1. '*Post-Capitalist Society*', Peter Drucker, 1993

Similarly, the added-value from your smartphones and your tablets goes into the pocket of two types of companies, those that created a design making the object ease to use and those that much earlier created the incredibly sophisticated design of the electronic components. Despite the huge size of its factories, Foxconn is only a dwarf in sharing out the added-value of this new civilisation. It is this pre-eminence given to human values, since intelligence, creativity and innovation are still and I believe for a long time will be done by us and not done by robots, which justifies putting people, as the authors say very well, back in the centre of the system.

But this change is accompanied by many others. First of all, Big Data, now become Smart Data, which will be the other major source of tomorrow's value. However, this is not unique to human intelligence, but *Deep Learning* algorithms able to extract a vast amount of data will be the most important for decision-makers. This is why advances in artificial intelligence, like Blockchain and neuroscience, form part of the fields that the authors quite rightly invite us to watch.

But there are other features of this revolution, addressed in different places in this report, that I would like to highlight here. Firstly, *mass customisation*, which implies a revolution in the supply chain.

A few months ago, I was in a business leaders' club where I showed a small film about the company Carbon, explaining that its 3D printers were going to make it possible to manufacture millions of Adidas shoes directly in stores and what's

more, made-to-measure, to fit customers' feet, so radically changing an economic model that was based on mass production in large remote factories and sending containers of shoes around the world<sup>2</sup>. This revolution, enabled by the 3D printer, is comparable to that of the first industries.

Then one of the business leaders stood up and told me that he supplied leather to Adidas and that he had recently visited this company's laboratories where he saw the prototype I had just shown. One of his friends, who was also attended the seminar, then described to me the panicked phone call he received from his friend, explaining that he was facing the death of his company. I imagine this reaction compares well with that of the first weavers after seeing a loom.

The change in business model will be huge. Thus, instead of selling objects, some companies will combine with manufacturers of 3D printers, as they are best placed to define the specific features of the 3D printer that will print their products, and they will sell their customers three things: the 3D printer, material refills and the electronic files of their new summer - autumn - winter - spring collection, etc.

The nature of the added-value is going to change completely. In an Auchan store in Northern France, it's already possible to go through a body scanner that scans all the characteristics of your body<sup>3</sup>. These scans are then sent to a company like Sculpteo.com<sup>4</sup> that will print garments for you on demand, based on the designs you selected and will send them to you by post. In such a case, Auchan will no longer receive its added-value from selling clothes,

2. <https://www.youtube.com/watch?v=zXE-icw28n8>

3. <https://www.capital.fr/economie-politique/grace-a-la-3d-le-sur-mesure-ne-sera-plus-un-luxe-1235250>

4. <https://www.sculpteo.com/fr/applications-fr/impression-3d-et-industrie-textile/>

but will receive a percentage on the sales of clothing printed by companies such as Sculpteo.com for having supplied... the customer's bodily data.

Many other business models are going to be revolutionised. A company like Logista France, heir of a subsidiary of Seita, serves 70,000 tobacconists and cafés in France. They have already started selling large companies information about deliveries of the products they distribute for them. One day they may earn more money from selling information about their business than from their business itself.

In such a situation, the supply chain will obviously be totally revolutionised. On the one hand, it will disappear purely and simply for a whole series of objects that it transported before and which will now be printed; on the other hand, it will be strengthened to enable ever faster and ever smarter deliveries (by drone? by autonomous robots running around like the famous Starship<sup>5?</sup>) to deliver products that consumers are less and less willing to wait for. Of course, there will be intermediate steps to implement all these revolutions, such as bringing production sites closer to the consumer as mentioned in the report, while waiting for them to become prosumers and produce part of their consumption themselves. In the same way, coming closer will affect distribution. While regularly wandering through Paris, I am amazed by the explosion over just a few years in the number of convenience stores that herald the decline, at least close to big cities, of huge shopping centres.

5. <https://www.starship.xyz>

Exactly like the previous revolution, this has the potential to advance and improve our living conditions in an unprecedented way for the whole of humanity. But also like before, it brings risks of uprooting people, a trail of broken lives, social revolts or even wars and revolutions. Just read Dickens and Zola to see the extent to which the previous revolution, which meant simply unimaginable living conditions for people in the middle of the 18<sup>th</sup> century, was not achieved without pain. A large part of the turmoil and its trail of tens of millions of deaths in the 19<sup>th</sup> and the first half of the 20<sup>th</sup> century are not without direct or indirect links to the consequences of this first great industrial revolution.

That's why, if we don't want to experience the same dramas, we have to consider two essential dimensions in the actions of our everyday lives, whether individually, as a company or as our countries or our united group of countries.

First of all, ecological issues. Corporate social responsibility has to include this dimension more substantially than it does today, because otherwise the damage caused by environmental problems is likely to have consequences just as, or even more, dramatic than those of the rural exodus in the 19<sup>th</sup> century and the various revolutions it led to. Fortunately, as the authors briefly mention, we have exciting solutions for this, at the head of which are the blue economy, developed by Gunter Pauli<sup>6</sup>, or the Cradle to Cradle movement of William McDonough and Michael Braungart<sup>7</sup>.

It involves reconciling the economic growth the planet needs to feed mankind as

6. 'The Blue Economy', Gunter Pauli, Paradigm Publishers, Sept 2010

7. 'Cradle to Cradle', William McDonough and Michael Braungart, Jonathan Cape, 2008

it heads towards eight billion people and protecting the environment. As shown by these authors, it's not utopian to be able to have your cake and eat it, i.e. economic growth and protecting the environment, provided you radically change the model and implement innovative solutions, such as factories that purify the air and water around them instead of simply being content to pollute less, or even not polluting at all. The other dimension, which is particularly emphasised here, is to put Mankind back at the centre of the organisation. Certainly, the current revolution is going to radically change the nature of employees that companies will need tomorrow. Any job based simply on physical strength, storemen or checkout operators, is destined to disappear. But what we are going to see is the development of organisations where Mankind will coexist and work with robots and artificial intelligence. This will increase the options for our civilisation, but will require reforming education as well as organisations.

This need to put Mankind at the centre is both made necessary by the fact that creativity, intelligence and design will be, as we have already said, at the heart of new economic activities and will generate added-value, but also that we have to consider this new civilisation as being built around Mankind and not around robots, a temptation that crosses the minds of some supporters of transhumanism. Neglecting Mankind would firstly be to make a mistake in terms of the company's strategic development, since it is mankind that can generate, by his spirit, the 'added-value of the future', but especially not considering mankind would trigger revolutions and wars alongside which the Marxist revolutions and the two World Wars would seem like micro-events. For that reason we have a historical responsibility. Contrary to what some authors cited here believe, we are certainly not facing a new 'Schumpeterian' cycle, the equivalent of changing from a world

based on the steam-driven machines to a world based on the petrol engine, with the replacement of coal by oil: our situation is equivalent to the change from the agricultural world to the industrial world, and we are making this transition with four times more people on Earth and much more rapidly.

But we shouldn't think only about our collective actions, but also about our individual education. What knowledge, what strategies should we develop, should we teach our children, to maximise their chances of successfully surfing over the world's complexity, which increases daily at the same rate as the information available on our planet is increasing? Agility, responsiveness and multiplying the strings to one's bow are the key factors, exactly the opposite of what many consultants are still telling their clients: "Focus on your core business". We have to apply strategies such as those proposed by Nassim Taleb in the *Black Swan*: since we don't know where tomorrow's successes will come from, we have to put our eggs in very many baskets. Focusing on your core business can be profitable in the short term but extremely dangerous in the long term, in a world subject to the laws of the complexity that Nassim Taleb called 'Extremistan' compared to the characteristic 'Mediocristan' of modernity.

An important point is made here in the paragraph 'Organise monitoring'<sup>8</sup>; this is the application of parallel thinking. It won't surprise you that the technology used in watchmaking can solve a problem in the aerospace industry, or that cosmetics might call on the techniques used to manufacture chocolate. This parallel thinking, this way of transposing solutions from one field to another,

8. See page 37

in a world where not only physical but also intellectual and conceptual boundaries are being broken down (Glocal, Prosumer, Coopetitor, etc.), forms part of the attitudes needed, alongside those we've just listed, to succeed in an increasingly complex environment, richer in potential than ever in human history, but also with significant risks.

**Jean Staune**, science philosopher, futurologist and General Secretary of Paris Interdisciplinary University, author of the best-seller '*Les clés du futur*' [*The keys of the future*] (Plon, 2015)





- /Administration
- /Human Resources
- /Legal
- /Accounting
- /Finance
- /Marketing
- /Publicity
- /Promotion
- /Research
- /Business
- /Development
- /Engineering
- /Manufacturing
- /Planning

# MANUFACTURERS: YOUR OPERATIONS HAVE A FUTURE!

After steam, electricity and electronics, here we are immersed in the 4<sup>th</sup> industrial revolution, that of digital intelligence and the profusion of technologies. Germany paved the way in 2011 with its 'Industry 4.0' plan, followed by South Korea, which has the most robotised industry in the world and wants to increase the number of 'intelligent' factories from 500 in 2014 to 10,000 in 2020<sup>9</sup>. Such programmes are also emerging in China, the United States, France and the United Kingdom. At the same time, major groups are joining the race to this new industry: Bosch intends to improve its profitability by two billion euros by improving its productivity and using connected objects; Amazon uses Kiva delivery robots in its warehouses; SNCF uses predictive maintenance modules, and so on. It is therefore no longer about anticipating the 4<sup>th</sup> industrial revolution: it has to be on the agenda for company senior management.

9. '*L'industrie du futur: une compétition mondiale*' [Industry of the future: a global competition] - Thibaut Bidet-Mayer, La Fabrique de l'Industrie [The Factory of the Future], Presses des Mines, 2016

And yet, awareness is still very mixed. From the survey conducted in 2016 by Kea & Partners with 200 business leaders, it appears that not all functions are preparing for the impact of digital transformation in their activity. For example, only 3% of the industrial, supply chain or purchasing management functions are preparing for it, compared to 82% of information systems departments or 68% of sales teams. How is this explained? Because the transformation we are facing is complex. On one hand, it will lead to completely rethinking operations, i.e. all the processes contributing to the production, distribution or operation of goods or service: manufacturing, supply chain, logistics, purchasing, production and distribution systems. On the other hand, this transformation has a strong social dimension and raises major questions of responsibility for which new technologies can, moreover, provide part of the answer.

## HOW TO DEAL WITH THIS COMPLEXITY AND WHERE TO BEGIN?

It is to answer this question that Kea & Partners launched 'Quart d'Heure d'Avance - Opérations du Futur', a think tank bringing together around twenty business leaders from sectors such as food, textiles, health, aeronautics or construction materials. Kea kicked things off in summer 2016, on the premises of *FabLab Usine IO*, with a conference led by Jean Staune, who put the new industrial revolution into a global perspective spanned by five major changes<sup>10</sup>.

The think tank is interested in operations in the broad sense, covering the fields of development, manufacturing, purchasing and the supply chain. It is based on the 'Quart d'Heure d'Avance' method: proposals come from dialogue between peers, who maintain business confidentiality while conducting group discussions about their real problems; it must be possible to implement these proposals, presented with the aim of resolution by action, quickly within existing

<sup>10</sup>. See '*Les clés du futur*' [The keys of the Future] - Jean Staune

organisations – hence 'fifteen minutes' ahead and not 'an hour' ahead.

'Quart d'Heure d'Avance - Opérations du Futur' started with the observation that manufacturers are facing a real technological frenzy. The think tank therefore wants firstly to review emerging technologies, to see clearly into the current frenzy, to give itself the means to classify them and best seize the associated opportunities.

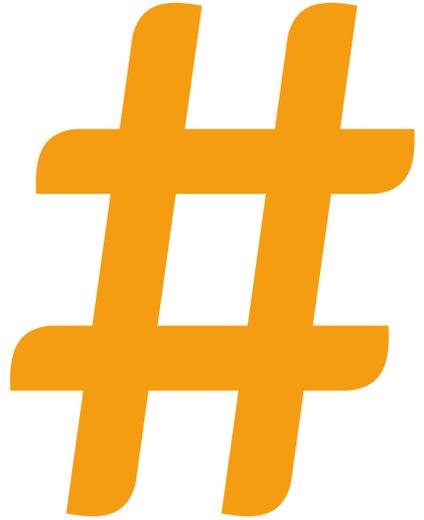
Thoughts next turn to the strategic issues underlying the industrial revolution, and then on Mankind's place in the face of new technologies and finally, on the transformations to be started. We have chosen to reproduce the group's work here by following this same path.

After a year's work, the think tank has identified some important lessons on industrial operations. It draws one belief from this: the profound changes facing industry are all sources of opportunity and optimism for business leaders.

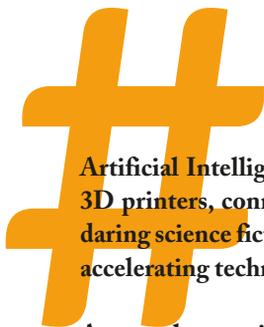
**Manufacturers, your operations therefore have a future!**



01



YOU DON'T HAVE ONE  
BUT SEVERAL FACTORIES OF  
THE FUTURE!



Artificial Intelligence, autonomous cars, robots, automated trolleys, drones, 3D printers, connected objects, etc. Reality currently goes beyond the most daring science fiction scenarios. Manufacturers, here you are projected into an accelerating technological world.

As a result, to maintain competitiveness and innovative capacity, the questions just keep coming: how best to exploit these new technologies? Which are likely to create value for your company? How can you classify them?

It is by proposing to answer these questions that the 'Quart d'Heure d'Avance - Opérations du Futur' think tank identifies a first lesson: the diversity of technologies, the variety of their uses, their different impacts on a sector or from one business to another... all this leads us to believe that there is not one but in fact a multitude of factories and warehouses of the future. You have to build your own!

## 1. Two beliefs about new technologies

### **Technologies are not static, they even evolve very quickly, and new ones emerge every day**

During the last thirty years, many prophecies announced that technologies were going to revolutionise industry and our way of working. Today it is a reality and with more power and speed than we could have imagined: the development of new technologies is actually and rapidly upsetting the equilibrium established by companies, whether this affects their production processes or their distribution systems.

A new equilibrium will only be found once these technologies have been mastered, which requires their developments to be understood and their impacts anticipated. In effect, each technology comes to be perfected, to find new uses or to disappear, turning the company upside down at the same time.

How do you end up in this technological frenzy? We have identified twelve technologies that have already proved their worth. All of them are mature, providing a leap in business productivity, increasing the intrinsic value of the product and progress in terms of responsibility.



**ADDITIVE  
MANUFACTURING,  
3D PRINTERS**



**SENSORS,  
CONNECTED OBJECTS,  
IIOT**



**DIGITAL  
CONTINUITY,  
MACHINE-TO-MACHINE**



**DIGITAL  
SIMULATION,  
3D MODELLING**



**EXTENDED SUPPLY  
CHAIN**



**ROBOTICS,  
AUTONOMOUS MACHINE AND  
AUTOMATED LOGISTICS**



**COBOTICS**



**AUGMENTED  
REALITY**



**VIRTUAL  
REALITY**



**SMART  
DATA**



**CLOUD  
AND MOBILITY**



**CYBERSECURITY**

Cybersecurity cuts across the other technologies because it raises the question of the risk linked to using the data. Among these twelve technologies, it is certainly the least mature.

In parallel, new technologies are emerging. On this subject, while it's still too early to recognise all their applications in industry, it is more than likely that they will represent sources of significant transformations in the coming years. The idea is not to make a complete list of all emerging technologies, but to be on the lookout for new trends and be prepared for them.

In particular, we have identified four areas of innovation to watch closely and that we can predict will lead to technologies capable of profoundly changing operations.

- 1**  
**ARTIFICIAL INTELLIGENCE**
  - 2**  
**BLOCKCHAIN**
  - 3**  
**NEUROSCIENCES**
  - 4**  
**NEW MATERIALS**
- ...

**ARTIFICIAL INTELLIGENCE:** *deep learning, machine learning...* so many methods that are revolutionising AI and giving it new capabilities. Economic forecasts in this sector are particularly positive, with average annual growth rates of around 50% and a market estimated at \$70 billion in 2021<sup>11</sup>. Many impacts should already be considered: the customer relationship (particularly using the *chatbot*), managing human resources (using individual tests, cross-referenced with millions of data items, to identify the profiles sought), assessing a credit or investment risk, analysing information (especially by recognising images, sounds or ideas).

**BLOCKCHAIN:** this may be a solution for better traceability of raw materials (Walmart uses it to track Chinese pork from the producer to the consumer), better control of the logistics chain (origin, distribution circuit, etc.), reliable protection of a company's ideas or documents, etc.) According to the MEDEF white paper, the blockchain market could represent \$20 billion in 2024. 90% of European and American banks are already exploring this technology and cumulative investments in blockchain start-ups reached \$1.4 billion in 2016<sup>12</sup>.

**NEUROSCIENCES:** new technologies and new management methods are emerging through the study of neurosciences. While we're not yet ready to create an effective link between the human brain and a machine, Elon Musk has announced that such an interface would be implemented as soon as 2021, with his company Neuralink. Would it be possible, in a few years, to give robots commands through thoughts?

11. France AI. 2017 summary report citing a study from the American bank, Merrill Lynch.

12. Livre blanc: *white paper La blockchain pour les entreprises* [White paper: blockchain for businesses] - MEDEF, April 2016

### **Technology is not the solution in itself: it's the uses that count**

To achieve the set objective, more than the technology itself, it's the use we make of it that matters. But not only can several technologies be combined as part of a specific use, but there are several possible uses behind each technology.

These uses vary depending on the sectors and, within the same company, they may differ from one department, activity or process to another. For example, augmented reality can be integrated in factories for product quality or reliability purposes (intelligent glasses which measure fatigue of the wearer, such as a driver on the road<sup>13</sup>), distinguishing it from augmented reality used for productivity purposes in logistics and picking (particularly to optimise the picker's route in the warehouse), which is itself distinguished from augmented reality used for guided tours and demonstrations (to provide a customer visit richer in information or to simulate a production process before constructing the factory).

Before integrating new technologies, it is therefore essential for manufacturers to identify those best matching the desired use. The list below, while not complete, includes a few examples of uses for each of the twelve technologies identified.

13. 'Jins Meme' glasses, from the Japanese optician Jins, measure the physical fatigue of the person wearing them in real time

## TECHNOLOGY

### **ADDITIVE MANUFACTURING, 3D PRINTERS**

*They consist of a manufacturing process by adding material based on a 3D digital model. Initially using polymers and resins, processes have been developed to use metal, ceramics, glass or organic materials.*

## POSSIBLE USES

- > Rapid prototyping at a competitive cost, compared to the cost of a mould (e.g. in aeronautics and jewellery, before producing parts in large production runs)
- > Manufacturing light parts or parts with complex structures (e.g. in aeronautics to reduce the weight of some on-board in-flight components)
- > Creating made-to-measure or customised parts
- > Manufacturing medium or large production runs
- > Repairing worn parts (e.g. SEB prints spare parts to reduce its stocks and the obsolescence of its products)
- > Manufacturing parts with geometries impossible to produce using traditional machining processes or as a single block

### **SENSORS, CONNECTED OBJECTS AND INDUSTRIAL INTERNET OF THINGS**

*The IIoT (Industrial Internet of Things), by means of embedded technology (sensors, actuators, RFID chips), consists of identifying and allowing communication between all the links in the value chain, where information is considered here as 'objects/things': machines, products being manufactured, finished products, products being used, employees, suppliers, customers, or infrastructures. All the data coming from the Internet of Things can be processed and used in real time.*

- > Predictive maintenance (measurement of actual wear, anticipation of incidents or breakdowns)
- > Better knowledge about the use of equipment
- > Monitoring production, controlling performance
- > Flow management (e.g. Bonduelle has equipped its trucks with sensors to facilitate geolocation of its fleet and to organise production based on progress in collecting vegetables)
- > Simulating operation of the factory
- > Allocating resources (e.g. Safran Aircraft Engines has equipped its mechanics with connected screwdrivers to improve quality control and the stock management)

TECHNOLOGY	POSSIBLE USES
<p><b>DIGITAL CONTINUITY, MACHINE-TO-MACHINE</b>  <i>Set of wireless or wired network technologies making systems connected so that they exchange information automatically, without human intervention.</i></p>	<ul style="list-style-type: none"> <li>&gt; Inspection and correction of any defects during the machining/assembly operation (e.g. in 2014, Airbus introduced its first collaborative robot on its production line in Cadiz, which collaborates directly with a worker to rivet parts)</li> </ul>
<p><b>DIGITAL SIMULATION, 3D MODELLING</b>  <i>It lets you run a program on a computer or a network to simulate a real and complex physical phenomenon, making it possible to conduct tests at lower cost. The digital simulation approach consists of simulating physical phenomena by computer using 'calculation codes' software developed on the basis of theoretical mathematical models.</i></p>	<ul style="list-style-type: none"> <li>&gt; Process optimisation</li> <li>&gt; Virtual factories/production lines to simulate processes and reduce the risk of design error</li> <li>&gt; Product design (e.g. Dassault Systems has created Simulia, a range of complex computer simulation products for different sectors)</li> </ul>
<p><b>EXTENDED SUPPLY CHAIN</b>  <i>This is the set of technologies and systems that are used to integrate the supply chain of suppliers and customers.</i></p>	<ul style="list-style-type: none"> <li>&gt; S&amp;OP optimisation and forecasts</li> <li>&gt; 'Connected' supply chain: real-time visibility, orders in progress, responsiveness of scheduling, production, traceability, etc.</li> </ul>
<p><b>ROBOTICS, AUTONOMOUS MACHINE AND AUTOMATED LOGISTICS</b>  <i>This equipment is able to integrate and use information to respond to a given function. The complexity of the information and the needs handled are linked to the equipment's level of intelligence.</i></p>	<ul style="list-style-type: none"> <li>&gt; Complex machining capabilities</li> <li>&gt; Adapting to changes in production conditions (e.g. change of product, versatility of operations carried out)</li> <li>&gt; Limitation of the programming, robots 'imitating' humans or repeating actions (e.g. Tomra offers fruit and vegetable sorting machines for industry: sorting criteria are programmed based on need - shape, size, defects, damage, foreign bodies, etc.)</li> </ul>

## TECHNOLOGY

### **COBOTICS**

*A collaborative robot is a robot designed to work in an area shared with the operator in the production phase. It incorporates safety features (intrinsic safety, sensors, cameras) to limit, or even eliminate, the need to fit a fenced enclosure and to make the human-robot interaction smoother.*

## POSSIBLE USES

- > Autonomous mobile robots within a workshop, without safety constraints for people
- > Exoskeletons (or powered support robots) to reduce the burden of work, carrying loads and particularly reducing physical effort (e.g. Colas has developed an exoskeleton to reduce the difficulty of smoothing bitumen on construction sites; Audi has implemented exoskeletons to restrict the loads carried in production and logistics)
- > Collaborative robotic islands performing tasks with low added-value for the operator and assisting in those requiring know-how/technical action

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### **AUGMENTED REALITY**

*Adding information and data to reality (sounds, 2D & 3D images or videos) processed in real time by a computer system. The technology inserts synthetic images over images of the real world, for example by using the camera in a mobile phone or video glasses.*

- > Order preparation: instructions for picking and guiding the operator (e.g. Oscaro has equipped its staff with connected glasses)
  - > Maintenance and quality control: guiding operators by providing instructions for the inspection to be carried out, or the technical documentation (e.g. Volvo is aiming to save its operators' time by leaving their hands free and reducing the cognitive load on quality control by indicating the inspection points)
-

## TECHNOLOGY

## POSSIBLE USES

**VIRTUAL REALITY**

*Simulating the presence of one or more individuals in a digitally-created artificial environment, virtual reality is already used in many business applications, particularly in industry: learning to operate a new machine, remote meetings, virtual tour of the factory, operator training, etc.*

- > Operator training (immersion)
- > Preview, customer demonstration (e.g. in 2015, Air France Industries unveiled, for the first time, a virtual-reality cabin visit experience)
- > New product development

**SMART DATA**

*Advances in computing (power and calculation speed) have promoted the boom of big data. Faced with the now colossal volume of data, smart data uses dedicated software to sort intelligently and appropriately, which really helps decision-making. The volume is no longer the only key to the data processing: speed, variety, accuracy and value are all crucial too.*

- > Data use, modelling impacts of possible variations in configurations (e.g. JE Dunn has designed the LENS software, an interactive dashboard that models the impact of a change in architecture on costs)
- > Decision-making support: predicting future events and suggesting actions to management
- > Breakdown diagnostics

**CLOUD AND MOBILITY**

*Remote storage, guaranteeing data preservation and access to data from different workstations: a prerequisite today for agile and horizontally-structured organisations, and for mobile and decentralised teams.*

- > Real-time and remote vision of production/logistics management
- > Advanced robotics: improving the adaptability and scalability of uses (remote programming), reducing obsolescence

## TECHNOLOGY

### **CYBERSECURITY**

*This is all the measures ensuring the confidentiality of information, its authenticity and integrity of the organisation. It affects all of the branches of data processing in the organisation (industrial computing, connected objects, management software, etc.) that have to be prepared against any risk of cyber attack.*

## POSSIBLE USES

- > Securing processes
- > Data integrity
- > Guarantee data availability and operational continuity
- > Confidentiality of encrypted data and processing by an external entity
- > Preserving industrial secrets
- > Securing communications
- > Detecting intrusions into networks

Beyond the benefits derived from each of these technologies, the most mature companies are now seeking to combine several technologies to get the most out of them.



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## **THE CONTRIBUTION OF TECHNOLOGY**

*If technology was only used to optimise or do the same thing at a lower cost, it could be perceived as a threat. On the other hand, used to open new paths, facilitate or replace difficult tasks, promote innovation and collaboration, respond to environmental aspirations and improve safety, it becomes a major asset. While the first point is needed in our highly competitive climate, we must promote the second so that overall, accepting this industrial evolution places us in a virtuous collective dynamic.*

*The winning companies will be those that significantly and fairly develop their trio of technologies-organisation-skills. New technologies (digitisation, robotics, augmented reality, virtual reality, etc.) improve operations. But they also bring down historical constraints and allow us to rethink organisations, for example by redistributing the tasks between operators, support unit and workshop supervision. To extract the very essence of each new technology and their combinations, and to imagine winning organisations, we are striving to develop skills in conducting operations but also in process industrialisation and architecture.*

### **Delphine Berilloux**

*Human Resources Director of Trains & Integration Division, Head of HR for Factory of the Future project*

### **and Benoit Martin-Laprade**

*Industrial Development Director*

## 2. Three golden rules to classify and identify good technologies

### Measure the full return on investment

This return on investment must be measured as three components: efficiency, value created (for both the customer and the partners), responsibility. It is the combination of these three components that ensure the investment is sound, guaranteeing the company's sustainability.

**Efficiency is the most common indicator**, the one that was always the aim of previous industrial revolutions. It can be measured in terms of cost reduction or as gains in productivity, quality or reliability of the finished product.

**Second indicator to consider, value.** Firstly, the value created for the customer: what are the benefits of such technology for the final consumer? How does this technology contribute to meeting customer expectations? Then, the value created for partners: how can such technology result in a monetisable service for partners, in a *Business-To-Business* context?

The Bosch Group is a good illustration of combining efficiency and value created for partners. In fact, by betting on the Internet of Things, the German equipment manufacturer is expecting economic savings of 2 billion euros: 1 billion euros from productivity (efficiency), particularly by managing production in the group's 250 factories, and 40% energy saving in the buildings; 1 billion euros in additional turnover (value) - this second billion is the result of a strategy of connected objects<sup>14</sup> and testing new services (production management, predictive maintenance) intended to be subsequently marketed to Bosch's partners.

14. *Eventually 100% of our products will be connected*.

The promise made by Heiko Carrie, the new president of Robert Bosch France, who has held the position since January 2016

## VALUE & PRODUCTIVITY: TWO INDICATORS TO BE CONSIDERED TO IDENTIFY YOUR TECHNOLOGIES

VALUE



SENSORS, CONNECTED  
OBJECTS, INTERNET OF  
THINGS



ADDITIVE  
MANUFACTURING,  
3D PRINTERS



SMART DATA



VIRTUAL  
REALITY



DIGITAL  
SIMULATION,  
3D MODELLING



EXTENDED SUPPLY  
CHAIN



DIGITAL  
CONTINUITY,  
MACHINE-TO-MACHINE



CYBERSECURITY



AUGMENTED  
REALITY



CLOUD  
AND MOBILITY



COBOTICS



ROBOTICS, AUTONOMOUS  
MACHINE AND  
AUTOMATED  
LOGISTICS

PRODUCTIVITY

**A third indicator is added to these two, representing the social value of technology:** does the considered technology promote employment, reduce the burden of work (exoskeletons), does it facilitate staying in a position or professional development of employees through the acquisition of new skills (augmented reality glasses that aid quality control by supplying parts lists)? This social value, which is particularly important for the 4<sup>th</sup> industrial evolution, echoes the increasing level of responsibility demanded of companies.



## **TECHNOLOGY TO PROVIDE MORE VALUE TO THE CUSTOMER**

*Nexans is a world leader in the cable industry. Our ambition today is to ramp up the value chain in the areas of energy and data, to become a leader in cabling and connectivity solutions by relying on the increased importance of the energy transition, data transmission and mobility.*

*The new technologies derived from Industry of the Future offer a first field of operational excellence, as much in the new services that we offer as in the competitiveness of our factories.*

*Four examples:*

- > First of all, we have established a partnership with an Internet of Things (IoT) specialised start-up, to develop new services enabling our customers to manage their stocks better, to track the location of their cable drums accurately on installation sites and so save time and improve efficiency.*
- > We are now able to integrate sensors in cables, using IoT, to know their operating level in real time or the position of an installation fault, immediately maximising the operation of a network*

*and reacting very quickly if necessary.*

- > The use of 3D printing is becoming widespread, particularly to develop and manufacture of special small-scale tooling. 3D production of these parts enables us to quote strongly on costs and lead time - in days instead of weeks - but also to apply any technical innovation very quickly. 3D printing is now challenging our ideas of what can or cannot be manufactured.*
- > The analysis of factory data using big data and networking these data give us a very detailed analysis of the performance of a site or a machine, of its effectiveness and maintenance risks, offering very powerful opportunities to improve productivity, and by moving from the description to prediction.*

### **Gilles Drouard**

*Vice-President Transformation*

## **Organise monitoring of new technologies and their uses**

The temptation is to set up a central solution; this is necessary but it's not enough. The scope under observation is so vast that multiple viewpoints are required. The challenge is therefore to encourage field teams also to be on the lookout for trends, those likely to change the sector or contribute to the company's business, and to organise the relationship between central and local.

The monitoring process, responsible for mapping emerging technologies and identifying their possible uses, must go beyond the scope of the sector involved. Indeed, some technologies that have emerged in different sectors can be integrated to meet new uses. For example, a major player in the luxury industry has recently integrated a technology into its cosmetics manufacturing process that was originally used to produce... a chocolate cream! Similarly, to ensure the reliability

and accuracy of its products, the aeronautics industry doesn't hesitate to consider technologies developed in the watchmaking industry.

This monitoring should obey several principles to be effective: putting all the 'monitors' in the business in contact with each other, research using different information sources (patents, publications, competitors, etc.), meetings and discussions with other manufacturers, links with the academic world, capturing ideas from employees or the contribution (or even acquisition) of start-ups.

### **Try out your solutions**

Going beyond thinking about factories of the future, it involves introducing a *bottom-up* approach, split by industrial process to ensure the technologies are appropriate to the company's precise need. At the end of this approach and once appropriate solutions have been identified, it only remains to deploy them.

Our advice: go step-by-step, follow a *test and learn* approach, make good use of POCs (*Proof of Concept*) to adapt the technological solutions before deploying them widely. In other words, it means combining being entitled to make a mistake (to develop the spirit of initiative) and assessing the proposed solutions rapidly (to revise the proposals, if necessary).



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## **MONITORING AND EXPERIMENTATION: TWO PRIORITIES**

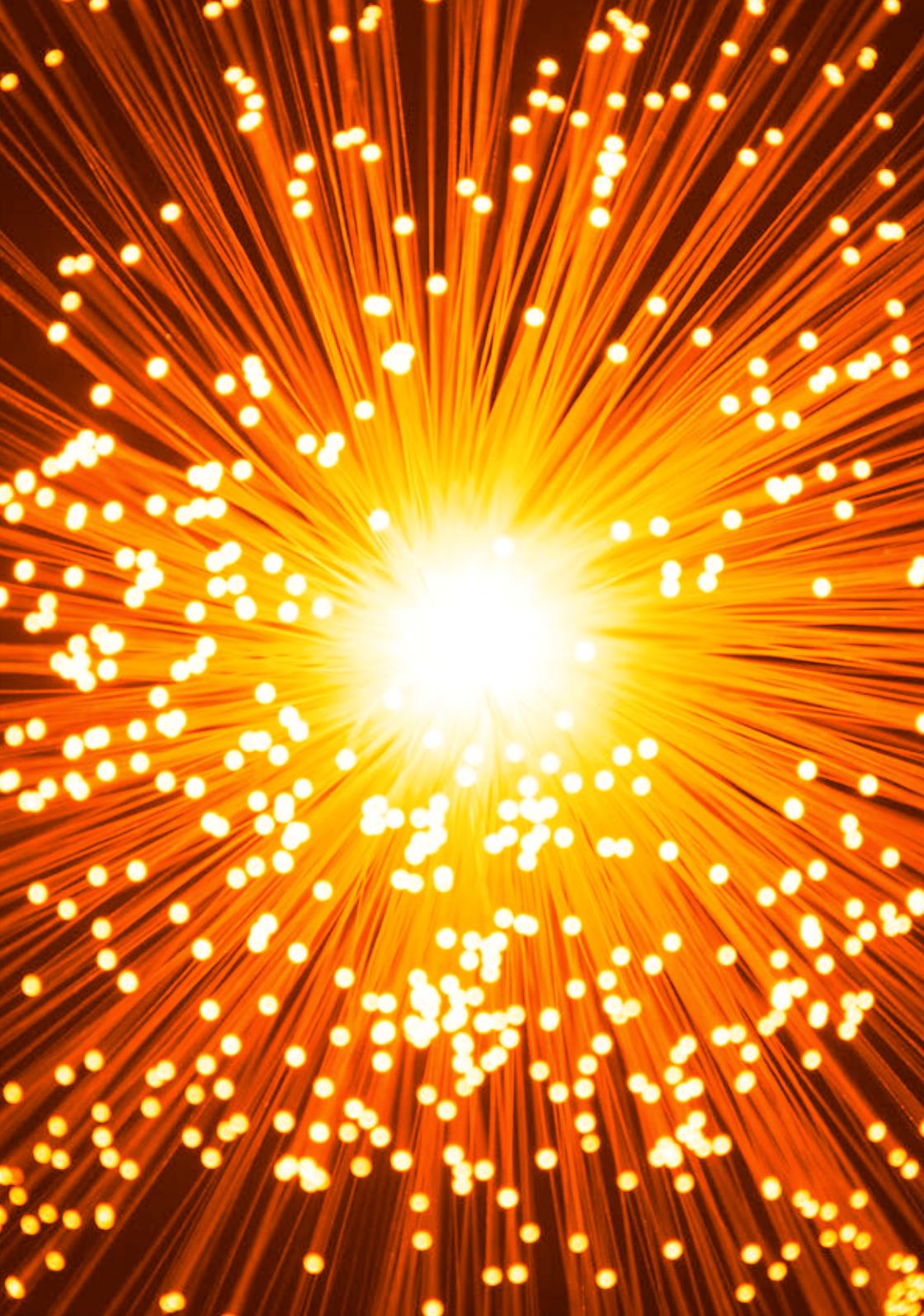
*We have thought about the challenges of Industry 4.0 and what it contributes compared to previous industrial revolutions. Today, the issue is not to introduce the steam machine in all activities, in other words to master all possible tools, but to select the one that will meet the company's strategic needs.*

*To succeed in this transition, we have two challenges to overcome: maintaining a sound skills base in industry 3.0 to be able to build our service offerings... and being selective and agile in experimenting with new technologies.*

*Monitoring remains one of our priorities. As Supply Chain Director, I wonder about the demand forecast: a good understanding of the S&OP process allows you to achieve 95% reliability of forecasts. Which technologies can make us more efficient? We are studying a POC (Proof of Concept) on machine learning/smart data to assess the added value of these technologies.*

### **Frédéric Pouille**

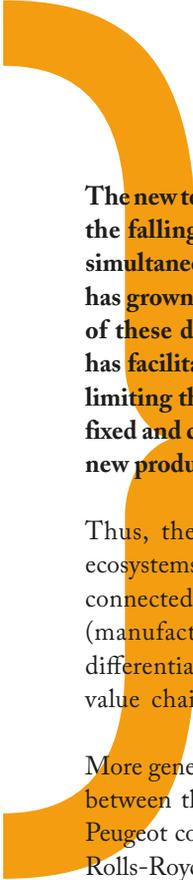
*Insulation & Gypsum Supply Director*



# 02

OPERATIONS OF THE FUTURE ARE  
A FIELD OF STRATEGIC  
OPPORTUNITIES





**The new technologies are contributing to profound changes at work in industry: the falling cost of sensors has encouraged their proliferation and mobility, simultaneously facilitating the collection of numerical data; computing power has grown exponentially over the years, enabling increasingly voluminous use of these data; the boom of the Cloud and embedded software in machines has facilitated their development and their remote renewal, at the same time limiting their obsolescence and reducing the massive investments; the heavy, fixed and costly robots have gradually given way to more agile tools able to test new products easily and to manufacture in smaller runs, etc.**

Thus, the whole production system is overturned: the management of ecosystems is becoming a major part of industrial strategy (control of sectors, connected supply chain, open innovation), the logistics plan is transformed (manufacturing/*logistics as a service*, regional footprint, network, delayed differentiation) and new consumer behaviours are disrupting the traditional value chain, placing manufacturers in B-to-B-to-C (*Do-It-Yourself* trend).

More generally, new technologies are changing competition and the power ratios between the market players. Who would have imagined a few years ago that Peugeot could become a supplier to Google? Or that IBM would compete with Rolls-Royce aircraft engines? Or that the service level of pure players in terms of delivery would become a standard? We are actually witnessing a paradigm shift: equipment capital and technologies no longer protect the company; increasingly it is intangible assets and the use made of these technologies that constitute real value.

The 'Quart d'Heure d'Avance - Opérations du Futur' think tank draws a belief from all these observations: such changes must be handled by the top executives

as strategic issues. Here, we describe four major developments, enabled by new technologies, that industrial players must consider in their activities. Then, we offer three golden rules so that the challenges related to operations are handled by the highest management level.

## 1. Four industrial trends to follow

### **The boom in *mass customisation***

Before the noughties, industry as a whole worked on the basis of mass production, with objectives to reduce costs, specialise sites and set up global logistics plans. With the 4<sup>th</sup> industrial revolution, new technologies have promoted the boom in *mass customisation* by meeting two simultaneous needs: on one hand, the possibility of the manufacturer producing in small production runs at a competitive unit production cost compared to the cost of mass production; on the other hand, the possibility for the consumer to customise its products.

In terms of production systems, we see the emergence of mobile and agile robots. Using these technologies, the company can adjust its offer, advance step-by-step, customise this or that product, meet local market needs - a bit like the American army, which has changed from deploying massive forces to a *light footprint* approach, to adapt to a constantly evolving playing field. Thus, for manufacturers, it is becoming possible to favour production units close to consumer locations. In

particular, this illustrates the Adidas industrial relocation project called 'Speedfactory': the customer's demand for responsive production has led to the creation of a more flexible production facility located very near the final consumer<sup>15</sup>.

In terms of demand, we are witnessing the development of *Do-It-Yourself*; the customer is expressing the need to become a 'prosumer', i.e. both a producer and a consumer. Once again, new technologies are making it possible to meet his aspiration: with 3D printers, virtual reality technologies, digital simulation, B-to-B manufacturers are gradually positioning themselves in B-to-B-to-C, directly incorporating the final consumer in designing the product and short-circuiting traditional distribution networks.

15. To find out more, refer to Supply Chain Magazine no. 116 (summer 2017): "Relocation - Which scenarios make the case for returning to France?"

## The development of *make and buy* and ecosystems

For a long time, companies had to ask whether it was preferable to do something or have it done, whether to insource or outsource. Now, they can change tactics more flexibly and more regularly. The idea is no longer to choose one or other (*make or buy*) but to switch from one to the other (*make and buy*) depending on the vagaries of the market.

This flexibility connects the business to its ecosystem and smooths relations with each member of its sector, in particular:

- > **With suppliers.** Through the better use of data enabled big and smart data, easily accessible by means of the Cloud, it becomes possible to anticipate demand and limit spurts. In this way the schedule is regularly updated, optimising processes and resources.
- > **With logistics and distribution partners.** Sensors, the Internet of Things and robotics are helping to manage flows better in real time and equip the network logic.
- > **With innovation partners.** Firstly, through progress in IT: use of better adapted collaborative platforms, digital simulation, modelling and virtual reality facilitate building and testing new products and services. Secondly, through new ways of working: agility, the MVP (*minimum viable product*) development strategy to test products quickly and market launches, the *test and learn* approach, *Fab Labs* or even collaborating with start-ups.

## The emergence of a data and services supply chain

Data are now ubiquitous throughout the value chain, particularly due to new technologies: from design (3D modelling, digital imaging) through to market launch (multilingual analyses, cross-references between images and comments), including the production phase (sensors, connected objects, Internet of Things). These data can help in design, improve the production system, facilitate the analysis of consumer behaviour, etc. For manufacturers, it therefore becomes essential to master the data and so acquire a high quality operating system with ongoing maintenance.

The service can also be integrated and controlled at each stage. Thus, at the time of design or production, manufacturers can resort to *manufacturing-as-a-service* by bringing in specialised players to respond quickly and make their production facilities more flexible. For example, Voodoo Manufacturing has more than 160 3D printers, enabling manufacturers to test their products on limited production runs, a solution between prototyping and mass production. For logistics, we are also seeing the appearance of expert start-ups in *logistics-as-a-service*, such as Fluid-e, which proposes putting logistics supply and demand in contact through a connected and customisable data portal. And finally in terms of distribution, the company can switch to a network of stores/warehouses where each storage point is also a sales outlet able to prepare and dispatch customer orders using interactive terminals. Undiz launched its first concept store of this type in 2015: *"You order your items on digital terminals and they are delivered through pipes, in air-propelled capsules that replace conventional packaging materials. A radio-identification system (RFID) lets you check they are the right products and pay for them quickly."* The benefit? An innovation in the customer experience with interactive

terminals and a huge space-saving: *"The products we can't display are stored in the basement and brought up using to this revolutionary technology"*<sup>16</sup>. Many players, such as Adidas or Décathlon, have also started down this path.

Just as manufacturers are led to control the product value chain, in the same way they are increasingly motivated to control the data value chain. Who owns the data? How is it sourced? What to do with it once the production process is finished? The same questions arise for the services value chain.

### **The rise of CSR challenges**

Corporate responsibility is no longer an option and is even becoming a strategic issue<sup>17</sup>, whether it involves social responsibility (safeguarding jobs, training, employee well-being, work/life balance), societal responsibility (charity commitments, sponsors of foundations, etc.) or environmental responsibility (respect for the environment, regeneration, reducing pollution, etc.).

The production system can be considered differently and these CSR challenges integrated by putting forward solutions combining growth and responsibility. In particular, operations of the future:

- > Present considerable ecological advantages such as new materials used to develop and manufacture products or new production schemes following a circular economy principle.

16. Undiz tests the store-machine, LSA, March 2015.

17. See Kea & Partners *La Revue* #21 – *L'heure de l'entreprise responsable* [The age of corporate responsibility]

- > Facilitate the product traceability and safety requirements: RFID chips, optimisation of logistics and flows.
- > Contribute to data sharing in a business ecosystem committed to a responsibility project. Such is the example of Coca-Cola and Danone that, in 2014, decided to invest jointly in Avantium, a green chemistry company that supplies biotechnological solutions such as PEF, a 100% biosourced plastic, made from starch and sugar.

In the cosmetics sector, the example of 'Responsible Beauty Initiatives', the alliance between L'Oréal, Clarins, Coty and Groupe Rocher is noteworthy: the aim is to advance the sector by imposing a new standard in terms of responsibility on the supply chain of each of these major groups.



GÜNTER PAULI: *LA TECHNOLOGIE,  
SOURCE D'UNE ÉCONOMIE BLEUE ?*  
[TECHNOLOGY, SOURCE OF A BLUE ECONOMY?]

Günter Pauli, a Belgian entrepreneur and graduate of INSEAD, is a pioneer in the field of CSR. With his *Blue Economy*<sup>18</sup> concept, he shows it is possible to produce not with less waste, but with zero waste. And particularly through technological leaps inspired by nature. For example, how do natural systems generate electricity every day? *"Natural systems don't use batteries or metals (...) Forget technologies that need too much energy to operate, like Bluetooth! You can create electricity with the body (60 volts/hour) or by pressure of the voice. And this makes it possible to consider making a mobile phone operate for more than 200 hours! Let's make everything battery-free: hearing aids, mobile phones, etc."* We're not there yet, but the book, '*Économie Bleue*' [Blue Economy] proves that initiatives are proliferating. With 14 chapters and 100 innovations, some of which are already working, Pauli demonstrates that biomimetic technology leaps already let you keep well away from the traditional economic system.

18. Gunter Pauli, 'The Blue Economy', Xlibris, Sept 2017



## 2. Three golden rules to make operations of the future a strategic issue

### **Think broadly, not tied to the scope of the factory**

As we have seen, logistics plans and the whole value chain are being redrawn. To deal with these industrial transformations and begin thinking about operations of the future, we have to bring all stakeholders from the industrial ecosystem together (suppliers, service providers, employees, consumers, experts, legislators) and stay connected to all the company's functions (operations, development, financial services, marketing). Regular formal meetings with a representative of each business unit and each function can help better identify the changes involved and find solutions supported by everyone.

### **Make the issue of operations an opportunity ahead of strategic plans**

Operations are more than a resource serving a business ambition: they have major impacts on the company's ecosystem, its logistics plan and its value chain. As such, they feed into strategic considerations. That's why it's essential to raise the issue of operations of the future to Executive Committee level. This must be driven by the operations department, which means taking the time to wake up and initiate the marketing and sales functions.

### **Adopt modular and agile thinking**

Strategy has evolved. In a complex, volatile and uncertain market, deterministic programmes and master plans lose their benefit. It is more about acting quickly and step-by-step, testing solutions, constantly readjusting, in short, adopting an agile and modular approach.

This tactic, inspired by the American *light footprint* military doctrine, also works for your operations: transforming your industry in one fell swoop by massive

integration of new technologies and redesigning logistics plans will get you nowhere. Of course, you need to begin your industrial transformation urgently, but it's better to take it in stages. A bit like the game of 'Go', where stones are placed one after the other, your operations have to adapt to the situation potential and build up over time.

G K R R O Y U S P

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## **COMBINE REVERSIBILITY AND AGILITY**

*We now have an exceptional range of technologies. However, they have reached different levels of maturity and some, better suited to our needs, will only see the light of day in a few months. In the face of this dynamic, our challenge is to ensure our commitments can be reversed and we are able to grasp new opportunities. To do this, we have several choices to make: which investments to choose (human, financial, etc.)? Which methods of cooperation to implement with our ecosystem? How should we optimise our technology watch?*

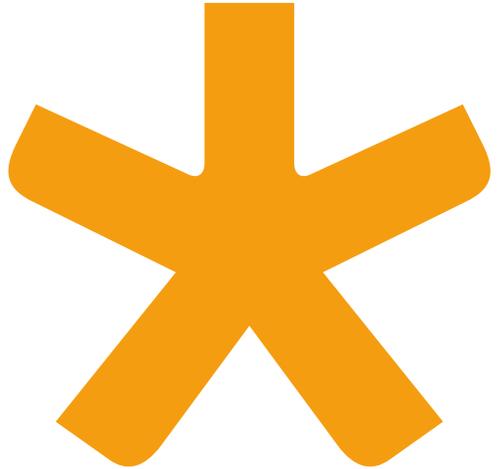
*We believe the human factor is essential in this context. To commit the teams to implementation, we have to train them but above all give them meaning by showing the benefits of these new technologies for each stakeholder (from production operators through to customers, including logistics teams, etc.).*

**Nicolas Hannebelle**

Management Audit Director



03



MANKIND IS AT THE  
CENTRE OF INDUSTRIAL  
TRANSFORMATIONS



**In 2000, the advent of e-commerce suggested the end of sales outlets. While their number really has since declined, history demonstrates that many remain and were able to reinvent themselves.**

**We are making the same bet for the industrial revolution: the operations of the future won't replace Mankind, but they're going to renew employment and call for new skills, new organisations and new management methods.**

**This chapter therefore offers a review of the issue of employment facing operations of the future, before sharing the working group's beliefs and suggesting three golden rules for putting mankind at the centre of your industrial strategy. Because if men and women are led to change under the influence of the 4<sup>th</sup> industrial revolution, they will more than ever be the main factor differentiating companies from their competitors.**

# 1. Uncertain employment prospects

## Studies don't agree

While some studies defend the idea that new technologies will create jobs, or even that they will contribute to a return to full employment in western economies<sup>19</sup>, most warn about the hazards of artificial intelligence and robotics for the labour market. However, none of the studies agree with one another on these issues.

A study based on 702 jobs, widely circulated and derived from work by Frey and Osborne in 2013, suggests that 47% of jobs in the United States could be automated in the next one or two decades. In its wake, Bowles (2014) estimated the potential for automating jobs in Europe at 54%. But other studies have put forward more conservative estimates. In 2016, the OECD assessed the proportion of jobs that could ultimately be automated in 21 member countries at 9%, based on an analysis of task automation, with country-related disparities (6% in South Korea, 12% in Austria). For its part, the McKinsey Global Institute estimated in 2017 that only 5% of jobs in the United States could be completely automated, but that 60% of jobs have at least 30% automatable tasks.

More particularly, artificial intelligence could change employment rates, but here again, opinions differ. The FHI (Future of Humanity Institute at Oxford University) surveyed several hundred experts in artificial intelligence. For them, there is a 50% chance that AI will replace humans in all tasks in the next 45 years<sup>20</sup>. Conversely, in March 2017, Steven Mnuchin, the United States Treasury Secretary, considered that the impact of artificial intelligence "*was not even an issue before the*

19. According to Gartner, 2.3 million jobs will be created in 2020 compared to 1.8 million lost; for Accenture, "by changing their organisation to better prepare their employees for man-machine collaboration, companies could increase their turnover by 38% and their workforce by 10%, between now and 2022" (Davos, press release, 23 January 2018)

*next 50 to 100 years*" and that robots were not ready to replace people in their workplace.

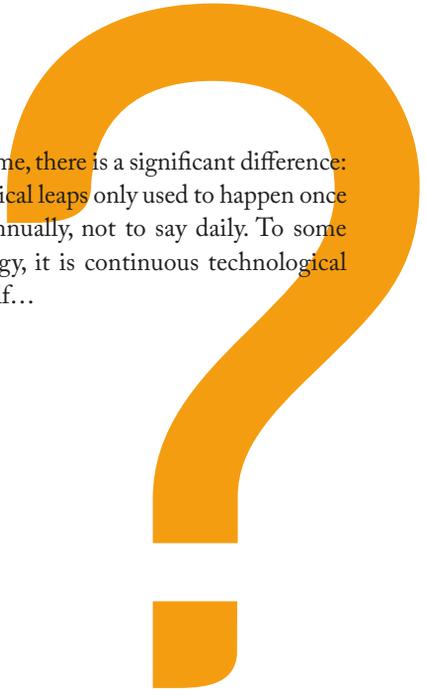
### **Fear of replacing people by machines: a scenario already seen?**

The idea that machines and new technology are replacing human work is as old as time. In addition to abundant literature on the subject, we know of the impact of the Gutenberg printing press on the work done by monk scribes in the 15<sup>th</sup> century, the Luddite and then the silk weavers (knitters, shearers and weavers) rebellion against weaving machines in the 19<sup>th</sup> century, or the effects of the digital revolution in the noughties, which again raised the question of safeguarding jobs against digital technology.

While some jobs will certainly disappear with the 4<sup>th</sup> Industrial Revolution, others will evolve and new ones will appear. Here again, this is proven by previous eras of technological change. For example, the digital revolution has promoted the digital marketing boom, new skills such as *community management*, new marketing and IT organisations. Even education appears to be adapted as a result: for example, Xavier Niel's *École 42*, a self-study computer science school, opened its doors in 2013. In summary, the concept of creative destruction so dear to Schumpeter still seems to be in the news.

20. When Will AI Exceed Human Performance? Evidence from AI Experts (Future of Humanity Institute, Oxford University; AI Impacts Department of Political Science, Yale University), June 2017

So, nothing new under the sun then? All the same, there is a significant difference: sophistication is accelerating. Where technological leaps only used to happen once in a generation, they now seem to happen annually, not to say daily. To some extent, Mankind no longer updates technology, it is continuous technological change that pushes Mankind to update himself...



## 2. Four beliefs about the future of employment and management in your industry

Although quantitatively, many tasks will be automated with an obvious impact on industrial jobs, we remain convinced that Mankind will not be absent from factories of the future and will retain a key role around machines. The working group has therefore expressed four beliefs:

### **Positions evolve more than they disappear**

This is also one of the findings from the study '*Travail industriel à l'ère du numérique*' [Industrial working in the digital era], with a preface written by Louis Gallois<sup>21</sup>. The technological content of jobs is going to increase in the future with the emergence of new technologies, such as *additive manufacturing* or intelligent machines, as well as man-machine complementarity – ultimately, the idea is that Mankind is not absent from factories, but working alongside machines, as foreshadowed by the development of cobotics and virtual reality.

21. '*Travail industriel à l'ère du numérique, se former aux compétences de demain*' [Industrial Work in the digital era, training yourself in tomorrow's skills] - Thibaut Bidet-Mayer and Louisa Toubal, Preface by Louis Gallois, *La Fabrique de l'Industrie*, 2016

## New skills are emerging

According to the World Economic Forum, 65% of children entering primary school will occupy jobs that don't exist yet and more than a third of the skills needed in 2020 are not yet considered crucial<sup>22</sup>.

By their technological content and by their impact on organisations, the operations of the future therefore demand new skills from employees.

Meaning *hard skills*, the skills to gather and analyse information, solve problems and master new technologies will be more highly valued. For example, in the consumer goods sector, manipulating data will be a comparative advantage and will make it possible to establish more accurate inventories, implement more detailed customer segmentation and make better use of personalisation.

In terms of *soft skills*, workers will have to offer more evidence of their ability to work in a team, listen and communicate in cross-company communities, adapt to change and new technologies, and to show sociability, empathy and initiative. In a VUCA<sup>23</sup> world that appears more to follow chaos theory than order and pure logic, the ability to solve complex problems will also be sought.

22. 'The Future of Jobs' - World Economic Forum, Jan 2016

23. VUCA is an acronym invented by the US Army War College in the 1990s to describe the contemporary world: volatile, uncertain, complex and ambiguous

Technologies will therefore transform jobs, irrespective of the qualification level, surgeons no less than workers, but they will have less effect on those who will be able to show resilience and agility, faculties more commonly found among very highly qualified people. In addition, this transformation will be unequal depending on whether the jobs are based on repetitive, manual or cognitive tasks, or conversely on the challenges of creativity, human interactions, management or decision-making in complex situations. Positions created as a result of operations of the future will probably demand high levels of qualifications, as in the case of *data scientists*.

### **The organisation of work is being transformed**

An indirect consequence of technologies promoting versatility and cross-company teams is that organisations are becoming horizontal and open.

The agile mode is no longer limited to manufacturing, IT functions or marketing, it's appearing in all functions. Similarly, jobs are opening onto their environments, an activity is transverse and connected to other activities. For example, the purchasing manager is no longer only a buyer, he is becoming a real leader of his sector, aware of the evolution of his ecosystem, connected to his suppliers, his experts and his customers.

## Traditional management methods are outdated

The subject of empowering teams is not new. It is at the heart of *lean management* methods deployed for more than a century! What's new today is that, on one hand, empowerment is becoming fundamental – a *must-have* strengthened by demand from new generations – and that, on the other hand, technology can contribute to it. Mastered and used to serve rather than enslave, they can indeed help employees to free themselves from simple repetitive tasks, by carrying out a quantifiable, measurable and checkable part of the work more quickly and more efficiently. As a result, they are being pushed to develop towards more involved, more complex and non-procedural jobs, and can be major assets in their empowerment.

This increased autonomy, which is both the result of operations of the future and sought by individuals, is reflected in a transformation of the structure and working methods. The underlying idea is that we don't need more managers, but better management.

The role of foreman, who directs and controls, is thus being gradually replaced by the "conductor" manager, who sets the pace and lets others act before acting. *"The manager of an autonomous team takes the role of catalyst for the decision, encouraging a consensus to emerge. The manager works continually to increase his staff's independence, without interfering directly in their action – at least until asked to do so. He provides method, asks questions and suggests solutions, highlighting initiatives and successes, and promoting talent<sup>24</sup>".* For the manager, the challenge is therefore to accept letting go to a certain degree (hence the development of the *test and learn* concept and being entitled to make a mistake) than the traditional trio of command-execute-report.

24. See Kea & Partners *La Revue* #20 - 'Les chemins de l'autonomie dans l'entreprise' [Paths of autonomy in the organisations]

In symmetry, the employee who performs is gradually being replaced by a proactive employee, able to take the initiative, i.e. to achieve management objectives while enjoying a certain freedom on how to achieve them. While taking such initiatives should be encouraged at all levels of the organisation, from the decision-making unit down to the operational teams, it doesn't mean absolute emancipation.

As Jean-Dominique Senard, CEO of the Michelin Group, recalled during an interview with Kea & Partners<sup>25</sup>, empowerment can be understood as accountability, which involves both increasing one's power to act, but also answering for this power, by being accountable to the manager or director for it.

25. See Kea & Partners *La Revue* #22 on the alert business, to be published



## ORGANISATION MIX: THE ADVENT OF AUTONOMY IN BUSINESS

As Jacques Jochem and Hervé Lefèvre show in their book, *Le mix organisation* [The organisation mix], it's not easy to implement autonomy in business, although it is considered as a source of natural power. *"In any company, four forms of organisation cohabit: tribal, mechanistic, transactional and holistic (...). Each company or sub-set combines them following its own specific configuration: its 'organisation mix' (...). In this 'organisation mix', today's least developed form is the one we call 'holistic'. But it is also the most promising. Its main unique feature is to place more trust in people, managers and employees than in systems to deal with complexity<sup>26</sup>."*



26. *"The organisation mix – What if companies finally started to harness natural power of empowerment?"* - Jacques Jochem, in collaboration with Hervé Lefèvre and Kea & Partners - Eyrolles, 2014

### 3. Three golden rules to put mankind at the centre of your industrial strategy

**As a responsible player, clarify your vision of mankind's place in the organisation**

New technologies don't only transform the relationship that we have with machines. Robotics, augmented glasses, exoskeletons, bionic prostheses, controlling objects by thought... through all these innovations, it is Mankind's place in the organisation and his role in the company that are redefined.

Given the changes caused by technologies, the leaders, with industrial manufacturers in the front row, will be made to take a position, i.e. to clarify and restate their vision of Mankind in the organisation and particularly his role in relation to technology. Is mankind always the cause and the purpose of strategic decisions? Conversely, what place does technology have in the organisation? What social issues does it raise and how far should one go when integrating innovations?

The choice is decisive because, at a time when more and more businesses want to assert themselves as being responsible, the subject becomes a major one. You have to position Mankind at the centre of company strategy while considering the beneficial effects of new technologies. This vision must then be spread through all levels and be embodied in the day-to-day activity: share the changes at work (without making it a source of anxiety but, on the contrary, by emphasising the opportunities they offer), encourage dialogue about new technologies and their role in relation to employees; finally, in a crisis, give Mankind the last word.

This last point is not a minor one: it reflects the idea that, for the responsible leader, the company's sustainability requires retaining and developing its teams. With this in mind, individuals can no longer be considered as a replaceable workforce, but conversely as personalities and talents who should be given the resources to grow and bloom aligned with the company's aims.



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## ***THE SOCIAL COMPONENT***

*Various studies show that this industrial evolution will have a strong impact on the map of jobs. One out of two existing jobs will evolve and not all jobs may continue in the future. We are therefore basing our project on major work employment and skills forecast management, as we want to build career development plans with and for each of our employees.*

*In parallel, we are updating our social framework to respond to tomorrow's industrial organisations and the aspirations of those involved. So it is that we are currently considering the possibility of rolling out proofs of concept in social matters with workers and management to build the future of our factories together.*

### ***Delphine Berilloux***

*Human Resources Director of Trains & Integration Division,  
Head of HR for Factory of the Future project*

## Anticipate the skills revolution

A study by the firm EY, in partnership with LinkedIn in 2014, recalled that among the most sought-after technical skills, the most important concerned digital, computing and new technologies (mentioned by 35% of leaders). And that among behavioural skills, the most important involved team working and interacting with others (33%)<sup>27</sup>. While the study gives an idea of the major global trends in skills development, it is important for you to do this analysis in your own organisation.

To do this, it can be useful to map the impacts of technologies by job, or at least (since new technologies are changing rapidly), to distinguish the underlying trends: identify jobs where technology complements and will increasingly complement the work of employees (e.g. warehouse workers will tend to be supported by new instruments, such as intelligent glasses or robotic vehicles); jobs that will be phased out by new technologies (call centres versus *chatbots*?); jobs and skills created by new technologies (e.g. *data scientists* or *web ergonomists*).

27. 'The jobs revolution. New jobs, new skills: what are the challenges for business?' - EY, LinkedIn, 2014

### **Build a scalable and customised training system**

The work to train your teams in the new skills required is all the more urgent for the company given that the educational system cannot be reformed at the same pace as technological change.

In terms of form, to set up the right training system, draw on new learning tools such as simulators, serious games, MOOC (*Massive Open Online Course*), SPOC (*Small Private Online Course*), as well as videos, tutorials or collaborative applications. For all that, don't favour the modernity and flexibility of tools to the detriment of the clear and thorough training methods: calendar, learning targets, tools used, teams involved, frequency of meetings, content of each session, positioning by an internal or external expert; all these factors must be defined in advance and monitored.

Essentially, first make sure that people at all levels are aware of the changes at work. Industrial revolution, technological revolution, skills revolution: to get the teams on-board, it is essential not only to remember the background and reasons for the training, but also to show that these revolutions, far from causing anxiety, can be seen as opportunities. Then, while the new training tools no longer need to be demonstrated as useful, they still need to be adapted to your expectations and to take everyone's reality into account. For example, particularly for reasons related to age, habits or skills, some employees may have some degree of reluctance or request different support better suited to their needs. So it's important to explain the new technologies and to find the right role models to guide the most inexperienced.



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## ***INDUSTRY 4.0 WILL HAVE A MAJOR IMPACT ON THE ORGANISATION OF BUSINESS AND ON EMPLOYMENT***

*A true paradigm shift is taking place in learning. In this field, initial training now represents 80% - versus 20% during a career. Tomorrow, not only will the ratio be reversed, but the training methods will be transformed. The training materials will be diversified and methods decentralised for greater efficiency. Faced by these developments, we have several challenges to overcome: be able to spread all this knowledge in some 60 countries where the business is present, ensure recognition of training done, etc.*

***Frédéric Pouille***

*Insulation & Gypsum Supply Director*



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## **TRAINING TEAMS IS A KEY CHALLENGE FOR SUCCESSFUL TRANSFORMATION OF OUR BUSINESS**

*In the on-going changes, we see people as a key factor of the transformation. Augmented reality offers new opportunities for training:*

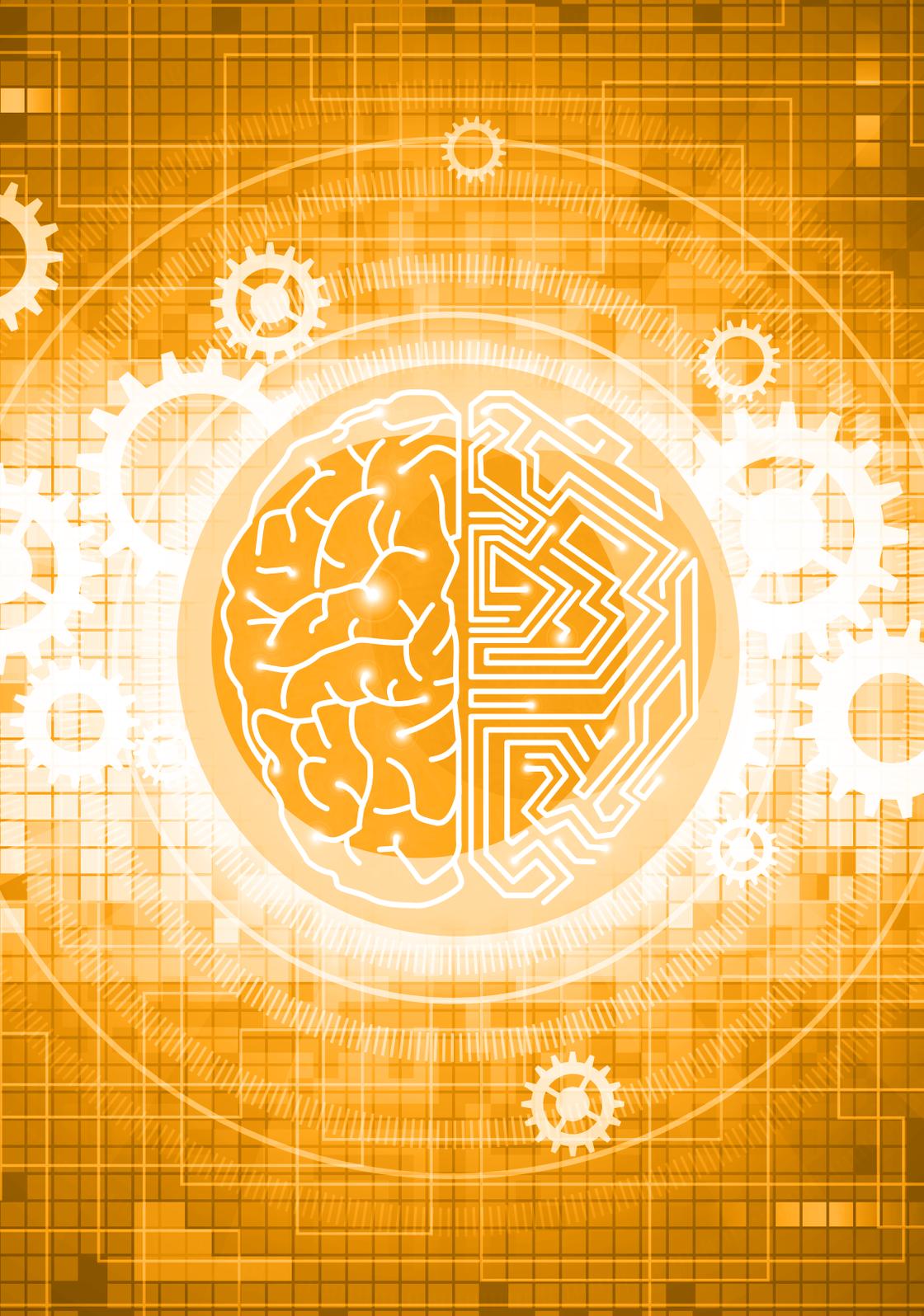
- > Safety training on production sites;*
- > Training to assemble and dismantle complex tools, such as the extrusion heads, in order to reduce the instruction time and to have one learning standard, whereas training is currently done by watching a more experienced worker;*
- > Simulation of jointing operations for two cables, particularly high-voltage or undersea cables, which accelerates the learning time (it takes a year to train a good 'cableman') and reduces consumption of very expensive real cables.*

*We are also making MOOC available to our employees, through an e-learning platform, enabling them to be trained in the company's different jobs: finance, purchasing, etc. Associated with gamification tools, this platform helps us roll out a common core of practices and to promote all Nexans' values.*

*More generally, digital transformation presents several challenges for an industrial company like ours: creating a culture that breaks down silos, building a model fully aligned with our customers' needs by collaboration between functions following an end-to-end process, which leads us to change our management model.*

### **Gilles Drouard**

*Vice President Transformation*



# 04



## CONCLUSIONS OF THE WORKING GROUP



**We are in the middle of a large scale industrial revolution. For each player in industry, it means finding the right approach to anticipate and prepare the future of operations rather than be subject to them.**

**But how can such a comprehensive transformation be undertaken, affecting the vision, productive system, skills and management methods?**

**Far from imposing a miracle recipe, the 'Quart d'Heure d'Avance - Opérations du Futur' think tank here offers four pieces of advice drawn from its work to lead this operational transformation successfully.**

## 1. Make it a subject for the Executive Committee

This subject of the operations of the future, born from the technological opportunities for your industry, has an impact on the whole business, its strategy, its offer of products and services, its structure, its organisation, its working and management methods. In this sense, it goes beyond the industrial challenges. It is therefore crucial, firstly, for the Executive Committee to take hold of it, with impetus from the operations department; secondly, that it organises debates on the subject; thirdly, that it helps create an understanding of the scale of the underlying issues, particularly with the marketing and sales functions.

This understanding must first involve monitoring and raising awareness of the huge scope of opportunities that open up to the operations of the future, covering efficiency, value and responsibility.

## 2. Choose your transformation strategy

Faced by the scale of matters raised by the operations of the future, four pointers can help you begin thinking about the transformations required. Firstly, how quickly do you want to go? Are you seeking rapid changes or continuous transformation? Secondly, how great a change do you propose? Strong, visible and demonstrative or weak, continuing the existing situation? Thirdly, who should identify the solutions? Is it head office or done locally? Fourthly, how can the results be implemented more widely? Is it necessary to apply a 'big bang' approach that massively and immediately deploys all the solutions at once or, conversely, work gradually, step by step?

From these initial questions, it is possible to consider different types of

transformation strategies that we describe below. You have to select your strategy, keeping a few beliefs in mind: first, there is no choice good or a bad in itself, the transformation should be conducted to suit the culture of your organisation, the desired pace, etc. Then, the four proposed types of transformation are frameworks or benchmarks, and not templates to be applied radically. Finally, it doesn't mean building a completely new factory, but on the contrary, taking account of the existing one to make it evolve effectively.

## **1/ Incremental transformation**

This refers to all incremental adjustments made to the company. These adjustments, or modifications, are made locally and point by point, using continuous improvement methods. They therefore encourage experimenting with the first solutions using a *test and learn* approach on clearly targeted areas.

## **2/ Reforms**

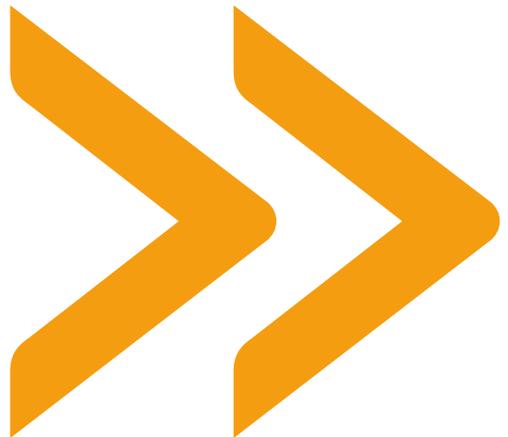
This method of transformation is useful for making general changes of direction in the way structural elements of an organisation operate. Designed centrally and rolled out locally, these reforms aim to change behaviours and daily practices.

### **3/ Radical reforms**

This involves a set of proactive and radical breaks with an old system deemed entirely unsuitable or flawed. Radical reform arises from central decisions and actions that aim to reinvent the activity on a new basis.

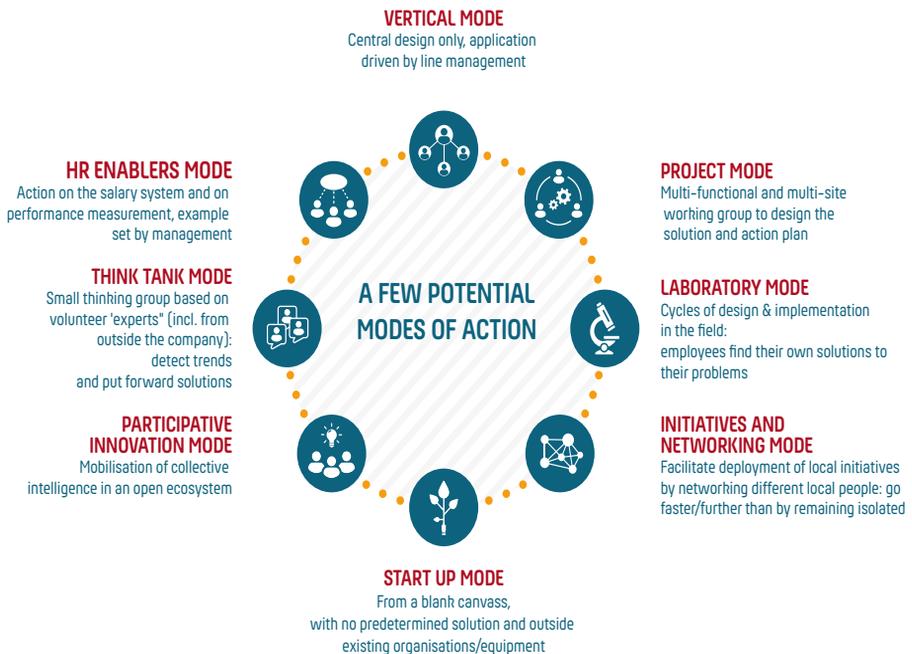
### **4/ Silent transformation**

Without taking direct action on the course of things, silent transformation is based on energy present in the organisation (such as people who publicly endorse your project, or those who oppose it but may change opinion if the reasons are better explained). By taking advantage of all this energy, silent transformation seeks to create the conducive conditions for a goal to appear, i.e. a change in how the work is viewed. In other words, the ambition is not communicated, but actions are undertaken little by little.



Once the type of strategy has been chosen, it is important to link each component of your transformation to the appropriate means of action.

The list below doesn't claim to be complete but includes eight potential means of action that can be combined.





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## **HOW TO LEAD TRANSFORMATION OF THE BUSINESS?**

*To begin our Factory of the Future project, we left the strategies of our divisions behind and worked on the vision of our operations. Considering the immediate needs of operational managers, we pragmatically built the roadmap to achieve this vision.*

*By driving this project, we are developing cross-company channels in the business, for example by launching 'test & network' initiatives to share the initiatives from each of our sites. With our Chief Digital Officer, we are also preparing to launch a collective innovation forum to roll out the culture of connected objects across the company.*

**Benoit Martin-Laprade**

*Industrial Development Director*

## 3. Rethink the core functions of your operations department

Certainly, the role of the operations director and the role of his so-called 'central' teams have evolved. What roles are they responsible for now? The think tank has identified four:

### **Drive the approach in a changing world**

While the role of central management is to drive all new topics related to operations, it may not, for all that, control what will be done in each factory.

Early on, central management must therefore have a less centralising role, but more one that clarifies or inspires, trying to give direction, communicate, remain alert, or monitor to identify the scope of opportunities.

Later, it has the responsibility to create and lead an ecosystem to feed in new subjects and make the new means of action possible, to set a framework and priorities in the light of possible proliferation of initiatives and, finally, to launch POCs (*Proofs of Concept*) – to demonstrate the financial or operational benefit – or experiments 'outside' the organisation - to go faster or break free from internal constraints.

### **Lead the transformation process rather than control it**

The aim here is not only to develop subjects, raise awareness, educate employees from the whole organisation about the challenges of operations, but also to give reassurance about anxiety-provoking topics, highlight successes, encourage sharing of initiatives, or even break the mould!

So for the operations management, it doesn't mean driving all subjects and

controlling everything. On the contrary, it is more about releasing initiative, encouraging people to take action and picking up little gems to circulate them.

### **... but keep control of data**

The role of the operations director and his teams is to give the framework for the data architecture, cybersecurity and supply chain for the data (where the data are sourced, how and when to circulate it, what to do with 'rubbish?').

In parallel, it is important to raise staff awareness about using these data, about attitudes to adopt regarding confidentiality and about using social networks, whether internal or external.

### **Steer the transformation by embodying industry of the future**

To do this, and given that technologies are evolving daily, the objective is certainly to be dogged, but also to remain agile and seize the opportunities that will occasionally appear during the project. In other words, be clear on the purpose, but don't get lost in a detailed programme that takes a long time to implement and can't be changed.

In addition, the transformation will be made easier to steer if you embody the industry of the future, i.e. if you set an example and demonstrate that central 4.0 is also being transformed.

## 4. Instil a transformation culture

Here are a few recommendations to instilling a real transformation culture at all levels.

- > Set up highly responsive mechanisms: nurseries, special forces, *business units*, *war room*, laboratory mode, etc.
- > Integrate (acquisition or partnerships) agile measures and scalable organisations, comparable to start-ups in the new economy, into your organisation.
- > Create a monitoring and forecasting unit to sort and analyse large volumes of data, define potential future scenarios and anticipate changes.
- > Connect your organisation to its ecosystem (suppliers, customers, service providers, experts, competitors, etc.). Take inspiration from platform-based organisations to put all stakeholders in your business activity in contact with each other.
- > Create measures promoting the change culture: training, corporate university, conferences and testimonials are also methods to favour.

A transformation culture doesn't establish itself! It takes time. Thus, in a world becoming increasingly complex and accelerating, it is not only necessary to prepare mindsets for change, but it is also essential to build this transformation over time.



IN SUMMARY  
**4FUTURE  
OPERATIONS**

**So your operations do have a future! New technologies offer a range of opportunities that goes beyond the challenge of competitiveness, and enables new growth potential to be captured and a more responsible approach adopted.**

**So there is no need to dread these new technologies. Quite the opposite, you should take the time to understand them, to prepare for them, keep your hand in and get 'fifteen minutes ahead'. The challenge is twofold:**

- &** > qualify the opportunities offered by new technologies
- &** > develop the assets and expertise to achieve them

**Moreover, this publication is not the end of the story for the 'Quart d'Heure d'Avance - Opérations du Futur' think tank; it intends to continue its work...**



# QUALIFY THE OPPORTUNITIES OFFERED BY NEW TECHNOLOGIES

# #01



# #02

## & DEVELOP THE ASSETS AND EXPERTISE TO ACHIEVE THEM

DIY: 'Do-It-Yourself'  
IoT: 'Internet of Things'

# the authors



## **Stéphanie Nadjarian, Senior Partner**

After starting her career at Bossard Consultants, Stéphanie Nadjarian was part of the creation of Kea & Partners in 2001. Today, she manages the teams responsible for operational excellence and competitiveness in the field of supply chain, manufacturing and purchasing. She also oversees the firm's innovation on the transformation of organisations and directs the editorial committee of 'La Revue de Kea'.

## **Mathieu Daude-Lagrave, Director**

After having jointly created and developed a consultancy firm with partners from AT Kearney and McKinsey, Mathieu Daude-Lagrave joined Kea in 2011 as a Director in the Operational Excellence & Competitiveness team. His roles cover the fields of strategy, development (product-mix, pricing), operations (supply chain, purchasing, manufacturing) and organisation, particularly in the retail, luxury and fast-moving consumer goods sectors. Today, he oversees Kea's innovation on the use of digital technologies in operations.





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# Thank you!

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