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WHAT WILL THE PLANT OF THE FUTURE LOOK LIKE ?

by

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Overview

Fives is an engineering group which designs factories for numerous industrial sectors. It created a think-tank, the Fives' Observatory for the Plants of the Future, which fosters discussion about the future of industry. Fives also jointly manages the French government's 'plant of the future' plan, one of thirty-four plans in its 'New Industrialised France' initiative. In fact, the 'plant of the future' already exists : many technologies are developed and ready, and have already been implemented. We now have to distribute them throughout France's industrial fabric, especially in small and medium-sized enterprises (SMEs). The key question remains the role man will play in this new industrial landscape. Will he be thrown out of the plant and replaced by an excessive number of machines ? Or will his presence be necessary, not only to supervise and control the machines but because man, unlike machines, is creative and innovative ? Such is the opinion of Michel Dancette, the Innovation & Corporate Insight Director at Fives.

TALK : Michel Dancette

Having worked for about twenty years in research and development (R&D) management at Bertin Technologies, I joined the Fives group as director of one of their subsidiaries. Later, I was asked to create a Corporate Social Responsibility department at the company's head office. For the past three years, I have been in charge of Innovation and Corporate Insight for the group. This is why I was appointed to manage jointly the Plan 34 of the 'New Industrialised France' initiative which is called the 'plant of the future'.

Fives' history and activities

Fives has been building plants for two hundred years. It takes its name from a district of Lille where the company had a site which employed nearly 5,000 people at the beginning of the 20th century. In 1812, Napoleon's 'Continental Blockade' policy suspended the importation of cane sugar from French colonies in the West Indies. Napoleon therefore asked a small team of entrepreneurs in northern France to devise a method of extracting sugar industrially from beetroot. Jean-François Cail was part of the team which pioneered this project. Today, our Fives-Cail subsidiary still builds plants which produce sugar from beetroot and sugar cane.

In plant construction, there are two kinds of companies : those which develop technologies and manufacture industrial machines, and integrators who assemble these machines and then create workshops and plants. Fives is unusual as it does both these activities.

Approximately 25% of our employees are involved in the manufacture of high-value parts, and sometimes all the parts, of the equipment which we provide. In our workshops in Golbey in the Vosges, for example, we make cryogenic heat exchangers for air separation. They are made up of a series of plates, assembled by hand, which are put in an oven where they are brazed to the right degree. In our workshops in Nancy, we produce nuclear piping for primary circuits of Evolutionary Power Reactors (EPR). We are also the leader in the manufacture of crankshaft grinding machines. Using our equipment and operating with micron accuracy, we are able to machine crankshafts which are 12 metres long.

Our core activity, however, is the design and manufacture of turnkey production lines and plants in sectors such as material processing, energy, and, for the past twenty years, manufacturing and logistics. We specialise in combustion techniques, and have designed cement lining ovens, aluminium reheating furnaces and glass furnaces.

Our presence across different sectors has enabled us to develop R&D programmes which can be implemented in several of our subsidiaries, and these programmes have helped these subsidiaries to achieve the best possible level of technology. Our group is characterised by its strong capacity for innovation. Our R&D employs 200 people and we have patented about one hundred innovations over the past three years. We have a total of 1,800 patents, the majority of which are in the fields of energy performance and the environmental impact of process industries.

The group has 80 subsidiaries and employs 8,000 people, half of whom are in France. The remainder are in other countries, particularly the United States where we have a strong presence. The subsidiaries are managed like SMEs making them very flexible, close to their markets and their technologies, and are very reactive.

The Fives' Observatory for the Plants of the Future

Having built plants for two centuries and lived through different industrial revolutions, we feel we are well qualified to discuss the future of industry.

In 2012, when we celebrated our bicentenary, we created a think-tank made up of about twelve experts called the Fives' Observatory for the Plants of the Future. This Observatory organised a Citizens' Conference. This is a form of participatory democracy, often used in

Scandinavian countries, where the general public are asked about important topics such as the use of genetically modified organisms (GMOs), the nuclear industry, and so on. We used this forum to find out from a panel of citizens under what conditions they would agree to the construction of a plant at the bottom of their gardens. The aim was to analyse the slightly schizophrenic reaction which the prospect of reindustrialisation of France might have on its people. Everyone is affected by the lay-off of industrial jobs, but no-one is really willing to have a plant close to where one lives. For example, it took Fives as long as ten years to construct a workshop to carry out grinding tests even though the workshop was very clean and not very noisy.

The Observatory regularly organises surveys about the perception of industry in France, China and the United States. One result shows that the French do not think that they are sufficiently informed about industrial issues and projects. They feel that 'people are hiding things' from them, and this is probably one of the obstacles in reconciling the French public to its industrial activity.

Multiple challenges for the plant of the future

The plant of the future, as we have designed it, has to respond to several challenges.

Competitiveness

Most of the programmes dedicated to the plant of the future in the world come from developed countries, especially European countries (via the EU Research and Innovation 'Horizon 2020' programme) and the United States. This movement has made the most developed countries wake up to this fact, and prompted them to make their industries competitive again.

Performance

The aim of the plant of the future is to improve performance. This requires reviewing the user interface, the machines themselves, the production line, the complete plant and, finally, its integration into its value chain and the surrounding ecosystem.

Diversification

We are currently building production plants for steel sheets the life expectancy of which is thirty years in a context where our clients often do not even know what products they will be manufacturing in three years' time ! The production tools therefore must be as versatile and reconfigurable as possible. They should also make it possible to simultaneously manufacture a large variety of products. The same manufacturing line should be able to make steel sheets for cars as well as for washing machines, despite very different thermal cycles are required for each. We have just built a line for Jaguar which makes it possible to assemble small cars, 4x4s and sports cars. To do so, it was necessary to adapt the conveyor tools and anticipate the supply of all the 'just-in-time' parts on the side of the production line.

Energy transition and environmental performance

The plant of the future must also satisfy environmental performance criteria and contribute to the objectives of energy transition and the fight against climate change.

Attractiveness of industrial jobs

I was recently in Picardy, a region where one thousand engineering, technical and factory-worker jobs are vacant despite the fact that the work conditions there have greatly changed and today it is much more rewarding to work in a plant rather than a service industry in terms of the significance of the job and the social ties which can exist. The problem is that industry continues to suffer from the image which Zola described in his nineteenth century novels. The plant of the future will have to change this image.

Integration into community life

Due to the fact that they have become more flexible, smaller and more environmentally responsible, it should be possible to build plants closer to towns. This would reduce the crucial problem of transport of staff and goods.

The place of man in the plant

Contrary to the popular belief that automation excludes man, the plant of the future ought to confirm the place of man in the factory, with an increasing assistance of collaborative robots and digital terminals.

New technologies to satisfy the challenges

New technologies make it possible to alter competitiveness and present new opportunities to developed countries both in emerging and in more traditional industries.

The digital revolution

The digital revolution is an essential component and even an original part of the plant of the future. Sensors on machines and products allow one to judge the state of the production tool in real time. Computing resources, data transmission via the Internet and mobile terminals make it possible to 'virtualise' the plant and optimise its design, functioning, potential reconfiguration and maintenance.

In the plant of the future, machines are connected to their supply chain (which makes it possible to have permanent updates on production), but they are also connected to each other (which ensures constant production management), other plants (in order to optimise consumption and even maintenance), and, of course, to the employees (which continuously helps to improve the processes as a result of the man/machine interaction).

Digital Furnace® reheating furnaces which reheat steel sheets before hot rolling are equipped with three hundred burners which are operated digitally. The sequences for ignition and extinction are optimised according to the thermal load, temperature uniformity, combustion efficiency and emission of nitrogen oxides. These furnaces can be operated from outside the plant because of a sophisticated security system which is impossible for a third party to activate.

The digital system also makes it possible to improve the management of the economic aspects of the plant. Sugar cane plants produce sugar, ethanol (by the fermentation of sweetened juice or molasses) and electricity (because of the combustion of the bagasse, the cane residue). Since the price of sugar, ethanol and energy varies greatly in some countries, operating the plant digitally optimises its production on a day-to-day basis, focussing on either the sugar yields, ethanol production or energy efficiency.

New materials

New materials, such as composites or nanomaterials, provide opportunities for the plant of the future. Currently, half of the structure of an aeroplane is made from composite materials, which is far from the case in the car industry. However, car and parts manufacturers are trying to redress this with the aim of making vehicles lighter and reducing fuel consumption.

Additive manufacturing

Additive manufacturing (AM), also known as 3D printing (the process of making objects from 3D model data by joining materials layer by layer), is the solution to numerous limitations of traditional machining, but it is still marginal. The aim is to manufacture steel, aluminium or titanium parts industrially which will be similar to parts manufactured using

traditional production techniques. Clearly, this is not going to take place straightaway and we will still be seeing shavings lying on workshop floors for some time to come. However, these techniques are already a very interesting addition compared to traditional machining.

Eco-design

Eco-design is becoming the standard for the manufacture of machines. For example, at Fives we have perfected a grinding system for cement works which operates by compressing a bed of material, like a rolling pin. Using this technology, we can cut energy consumption by 30 % compared to traditional methods. We have also designed cement works which can operate without water, and we have even managed to build such a plant in a desert region of Mexico.

Our Novaflam burner works with alternative flammable materials or fuels (such as tyres, biomass, and household waste or even hospital waste) and is more efficient than traditional fuels (such as gas or heating fuel). It also has fewer nitrogen oxide (NOx) emissions.

Another example of eco-design is the line of high strength steel sheets we have built in which the sheets are reheated and then soaked in order to fix useful metal characteristics to them. The aim is to save 15 % on the consumption of fuel by cars because these sheets are very lightweight but as resistant as the original sheets. This quality is obtained due to new technical processes as well as close monitoring of the controls throughout the mechanical and thermal manufacture of the sheets on production lines which sometimes can be up to one kilometre long.

All the same, there is still a great deal of progress to be made in process engineering as well as in traditional processes of energy recovery and even of energy recycling, and the circular economy between different plants.

Cobotics and 'augmented reality'

The factory immortalised in the Charlie Chaplin film 'Modern Times' no longer exists. Numerous technologies are currently being developed to strike a balance between something completely automatic and something completely manual, and France is at the forefront in this field. 'Cobotics' (the collaboration between people and robots) alleviates the tediousness of work, and 'augmented reality' helps the operator to find the necessary information and right movements to make, and checks the parts and their assembly. On a car assembly line, for example, the operator is helped by robots to fit the dashboard inside the car and to avoid banging and damaging it. The operator's comfort is enhanced and the wastage rate is reduced.

The Société alsacienne de meubles (SALM) company manufactures one-off, personalised panels (helping clients on the placement of doors, colours, etc.) for Schmidt and Cuisinella kitchens. Panels are cut out according to specific customer orders in order to reduce wastage. Robots pick up the panels and prepare the orders and packaging so that the clients can receive their furniture in record time. Because of this automation, the company has become more competitive and has increased its turnover. As a result, seventy people were hired for jobs requiring more qualifications than those when employees had to sort and transport panels manually.

In this process, operators become the supervisors of workshop production. They do not have to carry out tedious tasks, but if they do, they can be helped by robots and they can concentrate on checking the end quality of products or the state of the machines.

Plan 34 of the 'New Industrialised France'

In September 2013, Arnaud Montebourg launched a programme with the ambition of breathing new life into French industry. It is called the 'New Industrialised France'. It includes 34 plans, some of which involve sectors (such as renewable energy, wood, and so on), and others cross-cutting technologies (such as Big Data and Cloud computing) and

specific topics (such as the TGV of the future or the electric aeroplane). Plan 34 is dedicated to the plant of the future, and its management was entrusted to both Fives and Dassault Systèmes. This Plan recognises the fact that apart from the choice of developing a particular sector, the quality of the industrial tool is fundamental if French industry is to be competitive.

Three objectives

The first objective of the Plan is to strengthen the competitiveness of sectors with challenges which may vary from one sector to another. For the aeronautics sector, for example, the challenge is essentially to increase production : as far as the A350 is concerned, we have an order book of at least five years for the entire industrial chain, but the leading and number two subcontractors have to increase by a factor of ten the number of parts they need to produce between now and 2018. With regard to the car industry, it is more a case of increasing the variety of options available on the cars and the flexibility of plants. This is why we are working on plant designs which can be reconfigured or, alternatively, copied very quickly. In the food processing industry, competitiveness is measured by improving the quality, traceability and energy efficiency.

The second objective of the Plan is to strengthen the competitiveness of the production tool, in particular that which is used by SMEs. France has been very slow to introduce robotisation unlike Germany and Italy.

The third objective is to increase the competitiveness of suppliers of industrial machines and production lines. The technology available is changing all the time, in particular because of the growth of the digital sector and new materials. Nevertheless, it is still necessary to help existing parts manufacturers and start-ups to capitalise on this, and to do so by setting up R&D platforms.

Pilot industrial lines

In the context of this Plan, twenty projects of pilot industrial lines were selected, nine of which will take place in the first wave. Three composite lines will be set up in plants for the aeronautics, car and offshore wind farm sectors. A production line where people will be at the centre will be created in a car manufacturer plant. Another project involves assisting soldering activities in shipyards, which is a huge challenge, because France is well placed in this field, but shipyards have to become more competitive. A gas producer will work on the automation of conditioning units for its bottles of liquid gas. Two projects exist which focus on the 'five E's programme' (***E**fficacité **E**nergétique et **E**mpreinte **E**nvironnementale des **E**ntreprises* : energy efficiency and environmental impact of companies) ; one in the food processing industry, and the other in cement works. Finally, an aerospace group is working on MIM (metal injection moulding) technology.

Calls for projects

Six themes were defined as the subject of calls for projects which will be launched by the government. They are virtualisation and the Internet of objects ; 'transitic' (in other words, flow optimisation) and robotic processes ; additive manufacture and advanced manufacturing processes ; non-destructive control ; composites and new materials (particularly with work on powders used in additive manufacture) ; and the place of man in the plant, cobotics and augmented reality.

Regional programmes of industrial excellence

One of the objectives of the Plan 34 is to strengthen the competitiveness of SMEs in regions. We have devised the following three-stage work plan : firstly, an awareness campaign intending to reach 10,000 SMEs ; secondly, a diagnostics phase which should be implemented in 2,000 SMEs on the basis of 27 technological or organisational axes identified as levers of

competitiveness ; and thirdly, financial aid for investment thanks to various financial government mechanisms with an allocation of approximately 1.2 billion Euros.

Three years to act

The Plan should be implemented between now and the end of 2017. The arrival of the plant of the future will not take place in the form of a revolution, but rather by a change of pace and the scale of an evolution which reflects an underlying tendency.

DISCUSSION

Co-ordinating eighty subsidiaries

Question : *How does the Fives group manage to co-ordinate its eighty subsidiaries and the different activities they carry out ?*

Michel Dancette : Each subsidiary has a well defined technological and geographical limit (for example, 'the systems of postal sorting for Europe') and operates autonomously. On average, a subsidiary has 150 employees. This small size means that they are very flexible and close to their customers.

The existence of operational divisions (metal, cement, car and aeronautics, energy, and logistics) means that the group has a solid foundation and can co-ordinate the development of its business. The very light, centralised structure includes departments such as for marketing, legal issues, CSR, innovation, and human resources. I am in charge of innovation. My department helps subsidiaries to draft patents, analyse offers from rivals, define joint research programmes, create cross-company skills clubs, and manage relations with important research bodies (such as the CEA Tech) or other structures (such as the Institut de recherche technologique Jules Verne or the Systematic competitiveness cluster).

Q. : *Are these subsidiaries just engineering-based, or do they also manufacture machines ?*

M. D. : In general, they do both. Fives FCB, for example, makes grinders and ovens for cement works and creates turnkey plants. It has just won an order to make a 300 million Euro plant in Algeria. One does not have to be a company with several thousand employees to build a plant. We have a wealth of experience, stable and competent teams, and we also subcontract out part of the detailed design studies, for example for framework structures and civil engineering.

Setting up a plant

Q. : *I am surprised that it was hard for you to find a site to build your workshop for carrying out grinding tests. One gets the impression that many regions would do anything to attract companies.*

M. D. : Regions are often looking for people who will buy existing industrial sites. Therefore setting up a new plant may seem like an obstacle course.

The future is already here

Q. : *Your talk left me hungry for more. I thought that you would make us have stars in our eyes, just as people talked to us about the Year 2000 thirty years ago. In reality, what you have described already exists. Very many SMEs are extremely flexible. They work every day according to the orders and requests they receive and which they satisfy in twenty-four or forty-eight hours. A director of an SME once explained to me that he had not used his order book for sixteen years due to lack of continuous business.*

M. D. : The plant of tomorrow and its technologies already exist. The aim is to distribute them. In many industries, this technology is not yet being used.

The economic value of flexibility

Q. : *I was very interested by the example of the sugar cane plant and the choice between three types of production according to variations in price. In this approach, uncertainty is not seen as a risk but as an opportunity.*

However, in general, management controllers hate uncertainty. They prefer budgets to be almost predictable and contractual. Furthermore, they think that the greatest value is that obtained by reducing costs, whereas a flexible plant is necessarily more costly than a traditional plant.

The world of finance invented the concept of options, and in the 1970s some researchers used this idea with regard to the supply of natural resources or even the flexibility of output. Unfortunately, this research was not continued.

M. D. : The price of inputs (such as energy and raw materials) is generally fixed, but if one had a degree of flexibility regarding the outputs then one could benefit from opportunities. Our profession consists of designing flexible plants which can be adapted rapidly to different situations. Their flexibility can be shown on a scale of seconds (when it is a question of manufacturing one sort of vehicle or another), minutes (when one goes from the manufacture of one type of sheet metal to another), days (as in the example of the sugar cane plant), or even years (when one decides to reduce the production of a line, or to double it).

To implement these solutions, one must be able to identify the right people in the company. Ten years ago, we were dealing with buyers for the most part. Their sole criterion was short-term financial optimisation. Today, the trend is once again for industrialists to find a strategy and discuss it with their suppliers.

The future of jobs

Q. : *In developing countries where populations are increasing very quickly, the problem is not excess automation of plants, but giving the population the largest number of jobs possible. This does not mean that we should promote the model of Apple plants in China with people working almost like slaves, twelve hours a day, seven days a week.*

Between this option and that of plants which are completely automated, is it possible to find a balance ?

M. D. : For the time being, the topic of the plant of the future is only really of interest to developed countries even though China is interested in new technologies. Furthermore, entire parts of the economy will employ large numbers of employees. There is talk of printing buildings in 3D, but this is not going to happen soon…

Even among developed countries, it is likely that there will be plants which co-exist but which use different methods. Some ageing countries, such as Germany and Japan, lack labour. Others have a more dynamic population growth rate, such as France or the United States, and need jobs. This is why it was suggested to offer collaborative jobs (cobotics) rather than to automate everything.

Q. : *Some traditional functions run the risk of being significantly undermined by the new model, and this would create considerable social consequences. What will become of the industrial management controller or the person in charge of supplies ?*

M. D. : I probably did not explain adequately about the human dimension of the plant of the future which is fundamental. I am convinced that it is pointless to complain about the fact that jobs may disappear and plants may close. A plant cannot create jobs if it does not develop its markets.

There are two ways of creating industrial jobs. The first consists of devising work stations which rely on the collaboration between people and machines ; and the second is to develop activity and create production lines in our country rather than relocating them abroad. The

number of people affected by a job compared to its activity will perhaps continue to decline, but the increase in activity will lead to a rise in the number of jobs in absolute terms.

The increase in the added value of products due to diversification and associated services will also create jobs. It is uncertain whether basic chemical sectors will still have a future in Europe in twenty years' time. However, the speciality chemical sector, enriched with new uses and services, will certainly have a place.

The same change is foreseeable in all fields where the finished products will be 'encapsulated' in global services satisfying new needs and social expectations in terms of climate change, the ageing of the population, and so on.

Some of the current functions will be enhanced because of this change and new professions will emerge within the plant itself or, more generally, in the company.

The qualifications of future jobs

Q. : *What will be the level of qualification required for future jobs ? What will happen to existing employees ?*

M. D. : The new generations do not have a problem in adopting new tools, especially since, contrary to what had happened during previous important revolutions, the digital revolution began in homes and the service industry, and not in industry which lagged behind in this field. Even low-income households have access to technology. One of the ways to make industry more attractive consists of highlighting the use of digital technology in plants.

On the other hand, older employees are sometimes anxious as a result of the arrival of digital technology. We experienced the same difficulty in our engineering and design offices when we changed from using the drawing board to CAD (computer aided design). Most people tried to train themselves and only a few did not succeed. I am hopeful that the transition will take place smoothly for most of our French workers who are already qualified.

Nevertheless, we must be supportive both in terms of technical training and management. The role of middle management will have to change. At Michelin, 1,500 employees are currently working on this issue. I am convinced that there are many intelligent people among the employees in our workshops and plants. It is important that we mobilise them to avoid future social unrest where the only possible solution would be to close the plant or make it completely automated.

What about traditional professions ?

Q. : *Are you sure that the plant of the future will only employ qualified people ? Currently there is a great deal of talk about the shortage of people in traditional professions, such as welders and boilermakers, for example. Is this a transitional or a long-lasting problem ?*

M. D. : At Fives, 25 % of the employees work in workshops, and we are also faced with a shortage of welders. Since we were unable to find enough trained people, we have had to create our own welding school. It is undeniable that this shortage represents an obstacle to the growth of the industry and the creation of jobs. On the other hand, one must devise 'just-in-time' training because, from past experience, we trained people for certain professions and there was not necessarily a job waiting for them at the end of their training.

Q. : *It has been predicted that in 2030, 65 % of people who are currently in universities or schools will be practising professions which do not exist today. How will universities or schools be able to teach them these professions ? Surely it is the job of the industrialists to finance this training.*

Q. : *A study showed that over a three-year period, 60% of executives have training sessions compared to 36 % of workers. I am less worried about 'recycling' management controllers and middle management than workers…*

The socio-technical side

Q. : *You talked a great deal about the technical and economic aspects of the plant of the future, but relatively little about the evolution of management and organisational systems, what we used to refer to as the 'socio-technical' side. It is too often the case that investments remain unproductive because in the early stages there is no discussion about the human dimension and the ways in which one could work with new equipment. It would be a good idea to involve the human resources department in all these discussions, and not to restrict this department simply to issues related to the social effects of restructuring which the transition towards the plant of the future will impose.*

M. D. : Our group is focussed more on technologies than on the organisation of plants. Having said that, when someone orders a new machine from us, we not only listen to the buyers ; we also ask the machine operators. Generally speaking, I have noticed that industrialists have realised that they cannot improve the efficiency of their production tool unless they involve their employees to a large extent.

We recently organised a meeting about the plant of the future with the human sciences department of the CNRS (French national Scientific Research Council), and they decided to launch a 'call for expressions of interest' based on these topics of restructuring trades and organizations.

What timescale ?

Q. : *In Germany, which is the most advanced country in terms of the implementation of the plant of the future, people are talking about a digital revolution which makes one think that the plant of the future will appear very soon. In reality, it is a paradigm the implementation of which will necessarily take time. How urgent do you think it is to start this approach towards the plant of the future ? Are we talking about three years… or twenty-five ?*

M. D. : The digital revolution is an important component of the plant of the future both because of the technologies it will bring, but also because all the other technologies need digital technology. However, it is not the only component. Our friends at Dassault Systèmes tend to think about physical plants initially from a purely digital vision of industry. We, on the other hand, prefer to start with the machines and the operators to see how, thanks to digital technology, we can improve and enhance production, develop services, and so on. The two approaches are complementary.

I do not know how much time it will take for the transition towards the plant of the future, but one thing is sure, we must breathe new life into the industrial fabric of France urgently. I mentioned a three-year timescale. The diagnostics phase of the SMEs has begun, and many regions have already launched calls for projects. The government confirmed its budget to help SMEs a few days ago. It is essential that we relaunch investment in a major way in SMEs and quickly demonstrate the strength and stamina of our industrial fabric.

The dream, vigilance and goodwill

Q. : *Three factors are essential to make a plant function properly. The dream, which is at the origin of all important modern inventions (such as objects which are heavier than air can fly) ; vigilance, which is essential for facing the multitude of possible breakdowns in a setting as complex as a car assembly line ; and goodwill, in other words, the self-esteem which everyone needs to want to go to work. These three factors do not exist in academic research. They were implicit in your talk, but were never mentioned specifically.*

M. D. : Perhaps I did not emphasise this point sufficiently but I am convinced that man should be at the centre of the plant. Human presence is essential to ensure that an assembly line works properly, whereas mathematics may predict the opposite. The role of operators who stand by the machines, feel the noise and the vibrations, and breathe in the smells that they produce, is irreplaceable. Human presence on the production line is also essential to improve these lines and to innovate. Creativity and innovation remain the prerogative of man,

even if machines can help him considerably in this approach. This is why man should be at the heart of the plant of the future, not as an element which is added in *a posteriori*, but as the centre from which everything emanates.

Presentation of the speaker :

Michel Dancette : graduate of the École polytechnique and the École des mines de Paris. He first worked for nearly twenty years as innovation manager at Bertin Technologies before joining the Fives Group in 1996 as an operating subsidiaries director. He then worked in the Group's head office in 2008 and created the Corporate Social Responsibility department. He is now in charge of Innovation and Corporate Insight at Fives. He also manages the Plant of the Future programme, the Plan 34 of 'New Industrialised France' initiative.

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