Evolution of automated production systems in SMEs: what are the consequences for the employees?

BAKKARI Mohammed, PhD student
Laboratory of Production Engineering,
Energy & Sustainable Development (LPESD).
Faculty of Sciences and Technology of Fez
Sidi Mohamed Ben Abellah University.
Fez, Morocco
Bakkari.mohammed@usmba.ac.ma

RACHIDI Abdelhafid, PhD in IndustrialEngineering
Faculty of Sciences and Technology of Fez
Sidi Mohamed Ben Abellah University.
Fez, Morocco
Abdelhafid.rachidi@usmba.ac.ma

KHATORY Abdellah, Professor
Laboratory of Production Engineering,
Energy & Sustainable Development (LPESD).
Faculty of Sciences and Technology of Fez
Sidi Mohamed Ben Abellah University.
Fez, Morocco
Khatory.abdellah@usmba.ac.ma

***Abstract*- The increase of productivity, improvement of the quality of products and performance was often a concern of industrial. It is in this approach; companies are always seeking for the best solutions, whether it is in terms of work organization or well in terms of sophisticated systems from a major scientific and technical progress.**

The automated production systems are becoming ubiquitous and essential elements in all businesses. The human being type his relief at work, because the automated systems running dangerous tasks, repetitive and precise. Year evolution without previous, yet lived as a kind of treason by the employees of the world, they believe that their seats are taken little by little by the automated systems.

This article aims to highlight the importance of the need of skills development either technical or non-technical (social, emotional and relational), and which are related to technological progress including automated production systems, and we will draw up an inventory of industrial strategies in several countries in 2030.

Keywords- automated systems, production, skills, technics, employed

I. INTRODUCTION

In a world where the industrial mass production is more and more important, it is necessary to quickly produce small and medium series of products with a better quality in order to adapt to the demands of the market. In this context, one of the goals of industrial is to have flexible systems capable of adapting to the fabrications ranging in time by the introduction of new products.

Thus, the automated systems of production are becoming ubiquitous and essential elements in all businesses. They are composed of two essential parts: Control Part (PC)and Operative part (PO)communicatetogether with a supervision of an operator via a human-machine-interface HMI.

The increase in the number of automated systems of production in the industries is very worrisome for thesociety, because each machine substituted several employees. These latter do not feel stable in their jobs especially when they see their colleagues in a state of unfair dismissal. Despite this, companies continue to invest in production systems even if their costs are still very high.

In addition that the companies which are investing heavily in the production systems, the countries themselves even adopt the industrial strategies long-term in order to improve the productivity of companies and remain in the ranks of the competitiveness.

With the technological progress including the automated systems of production, employees will need to adapt their technical skills with these systems in order to control them. They will also acquire non-technical skills which enable them to feel stable in their places of work.

II. ORIGIN OF REFLECTION AND CONCEPT

A. History & definition

The evolution of production systems has experienced a large scale over the last century. The mechanization has replaced the craft work during the industrial revolution, which stretched from the end of the 18th century and especially the 19th century, it was characterized by the considerable development in the techniques and methods of production of material goods. This revolution allowed the large-scale

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production of series of products. The market demand for manufactured goods was very high because everything that was produced is not enough consumers.

As the emergence of the electronic, during the first half of the 20th century [1], the manufacturing production had increased its capacity through specialized systems. The production process requires a sequence of specific operations and repetitive, therefore it is the main role of the automation which later becomes a vast field of research [2] containing different fields of application.

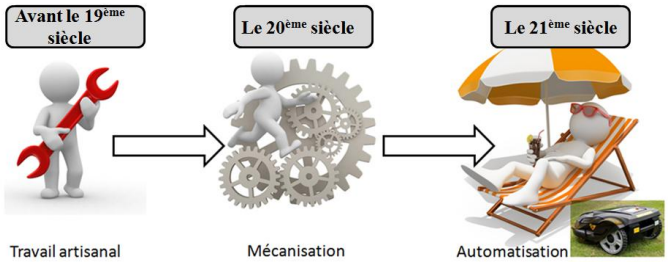

Figure 1: Evolution of methods of work

With the evolution of technologies, the automated system has not been able to have a single definition. Several researches in this area try to define and characterize them. According to Staroswiecki [3] the automation system is designed to check the transformations performed by the physical process. The control is carried out with the aid of sensors and actuators to the level of field.

The concept adopted by Verlinde [4] for automated systems is based on the functions of the system which are: lead, maintain, monitor, secure. However, Bayart [5] does not take into account the operators in the model, the automation system is in this approach considers as an interface between the physical process and the operators. For Cauffriez, the automated system supports the principles of a physical system that this either internal or external [6]. In addition, the online dictionary Larousse defines automation as: "total or partial termination of the human intervention in the execution of various tasks, industrial, agricultural, domestic, administrative or scientific" [7].

Despite these definitions which characterize the automated systems, another definition adapted to the context is that of Chiron [1] which defines it as follows: an automated system of production is composed of a Control Part (PC) and an Operative Part (PO). The control section contains the operational logic of the process that wants to automate, it sends orders to the PO which the executed by using actuators and which returns information from sensors. The PC also manages the dialog with the operator through a mostlySupervision. The concept of automated system of production has been associated often with the CIM (Computer Integrated Manufacturing) [8].

B. Automated System and its structure

1) Decomposition of automated systems

In a comprehensive manner, all the automated systems of production are made up of two essential parts PC and PO who interact together with a supervision of an operator via a human-machine-interface HMI.

- The Operative part (PO): this is known as the process or the power part. It contains the organs of power (actuators) which act on the matter of implementation such as an electric motor, a pneumatic cylinder. The sensors that make account on the state of the system such as an inductive sensor, photoelectric, a temperature sensor, etc.
- The Control Part (PC): It is called also the PLC, it is the automatism which based on external information from the PO (sensors), developed external orders intended for the PO (actuators).It provides then the logical processing of information; currently it is common practice to use Programmable Logic Controllers (PLC).

The Human Machine Interface (HMI): allows the operator to configure and manage the system, it communicates with him through the means of dialog to give instructions to the PC and to receive messages from the PC.

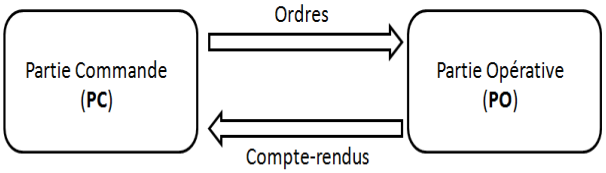

Figure 2: Overall Architecture of an automated system

To execute a sequence of operations, the PC sends the order (actions) of execution to the PO. Immediately after the executionof the task, this latter informed the PC of the achievement of each task using the sensors.

2) Global Approach to an automated system of production

The industrial process has seen the emergence of a computerized system man-management [9] which has experienced major magnitude since the years 80 especially after the migration of the centralized process toward the decentralized process that ensures the total control of the production tools and by the integration of the new automated computer systems.

In manufacturing companies, there has been a growing trend toward the use of computers to perform many functions related to the design and production. The technology associated with this trend is called CAD / CAM (Computer-Aided Design/ Computer-Aided Manufacturing). The name given to this more complete use of the computers is the CIM (Computer Integrated Manufacturing).

The approach of the CIM is to highlight the contribution of computing to the world of engineers [10].This concept is represented by several levels, it is often known by the CIM pyramid, corresponds to levels of decision, the level of decision is too important if it is very high in the pyramid of the

CIM, that is to say that the upper level decides what a lower level runs.

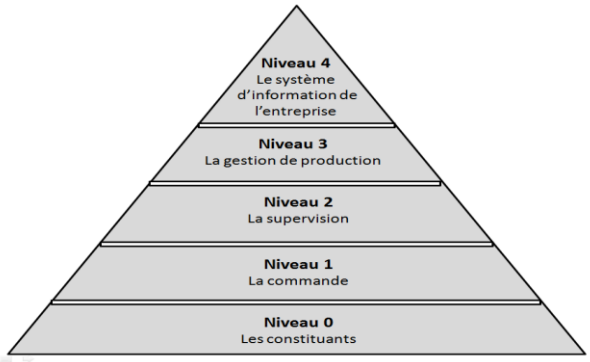

Figure 3: Pyramid Computer Integrated Manufacturing CIM

Yet, the execution time and data processing in this pyramid is very critical [10] when a level is too low in relation to the other, because each level is implemented with technologies well identified to him.

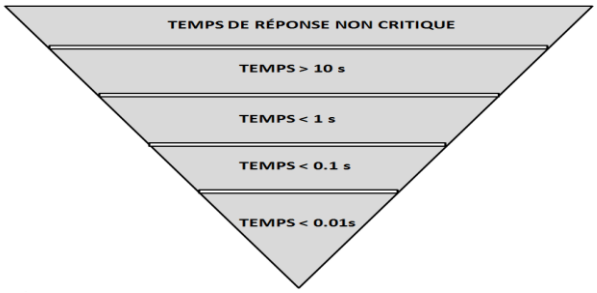

Figure 4: Response Time

The architectures of current production evolve toward a reduction in the number of decision-making levels [11] in order to meet the growing needs of flexibility and also to customize products.

C. Automated systems of production: bad or good reputation?

The increase in productivity and a better quality of products and low prices are the concerns of all the businesses, this requirement strongly linked at the request of customers the incentive to invest in the automated systems of production despite their costs which always remains very high. They have played a decisive role in the modernization of enterprises and in their quest for economic competitiveness.

Thanks to technological progress, all companies are equipped by automated systems that have taken the relay of men. What was done manually by the men in a few hours, the automated systems often do it in a few minutes or even less. In terms of efficiency the automated systems of production are very powerful because they can work without stop for hours and hours. This power and precision of production systems fascinatethe companies, that mean the abolition of intervention of the people in the execution of repetitive tasks, precise and sometimes dangerous because they are faster, more secure, and more they reduce costs.

Despite the bad reputation of automated systems from a social point of view [1], the enterprises continue to invest in this new technology including through the development and evolution of mobile devices, allowing the work less rigidly. It is for example possible to work remotely via videoconferencing systems or to access a work environment even if it is not physically located at his place of work.

In addition to the enterprises, the entire countries pose strategies for the development of their economies by linking on the new technologies of automated systems of production.

III. AUTOMATION AND SKILLS: WHAT VISION FOR 2030 ?

A. Industrial prospects of countries in 2030

1) In Europe

a) ***The United Kingdom:*** The industrial enterprises play a very important role in the British economy. All sectors of activities are involved in this economic progress, apart from the number of automated systems and robots installed in the English companies remains modest compared to the other countries of the European Union. The number of industrial robots per million hours of work does not reach the 0.5 [12] in the United Kingdom.

To encourage the British companies to have more productivity by using automation, the government has adopted an industrial strategy to 2020 [13], to provide the support to all sectors of activity, mainly concerning the robotics and autonomous systems (RAS).

The major objective of this strategy is the development of real industrial technology [13] such that the Manufacturing Execution System (MES) or the management of industrial processes, and the Computer Integrated Manufacturing (CIM).

b) ***France:*** It has a large industrial scale in the European Union, it is characterized by a level quite remarkable automation in the manufacturing industry in several areas of mass production such as the automotive and non-automotive [14].This automation allows the creation of added value and an employment rate of important enough at the time of its adoption, particularly by the launch of the project of innovation 2030 which is based on 7 ambitions in very different fields which can constitute the pillars of development [15].

c) ***The German:*** The German federal ministry has launched a large operation of foresight which aims to understand the main technological trends, identify the scientific challenges of the next fifteen years and anticipate their possible impacts. Among the eleven fields of priority research, the field of new technology whose main axis is "learn and work in a smart connected world" [16].The scenarios that can be envisaged by this strategy to 2030 are:

- The man has largely the control on the computer systems
- The computer systems arbitrarily decide, at least in part
- The computer systems are becoming independent

2) In Asia

a) ***China:*** China is without no doubt the country or the economic growth may persist. At the horizon of 2030, it will

be the first global economic power, accompanied in the top 10 other emerging countries: India 3th, Brazil 4th, Russia 6th,Mexico 7th, and Indonesia 8th [17].China has a vision of 5 essential objectives toward 2030, it is therefore imperative that it progresses in its value chain, abandoned its basic industry and focusing on the development of an innovative industry [18].

Yet, the Chinese authorities have indicated that they have started the work in a purely technological domain to equip themselves with a space launch vehicle capable of placing in orbit the heaviest workloads and to bring men up to the Moon [19].

b) ***India:*** Long remained in the shadow of its powerful neighbor, India seems to arouse little by little. It is part of the developing countries whose economic growth has been strongest. With a political system and an economic strategy very different, it is looming as one of the future giants of the world economy.

Its strategy long-term is articulated on two points in the field of industry to strengthen its development. In a first time, it is based on the import of the new foreign technology to assist the Indian industrial to strengthen their capacities. In the second point, she concentrated on the research and development of high technology in order to reach 2.4 per cent of their GDP in 2034 [20].

c) ***Japan:*** It is one of the more developed countries; these marks are known in the world. The manufacturing industry is one of the forces of Japan, but the country to few natural resources. Therefore, Japanese companies must import raw materials, which they use to manufacture finished products intended for the domestic market or for export. The most important industry of the country is the electronics which has done in a few years in Japan progress extraordinarily rapid.

This trend has demanded in Japan to persist in the area of new technology and equip the companies by robots who will reach a million robots on the horizon of 2030 [21].

d) ***Russia:*** Certainly that Russia remains today one of the 10 most important economies and powerful at the international level, yet it has not posed a strategic vision regarding the civic production, it aims to be the first in armament.

3) In America

a) ***Brazil:*** Brazil is today the 9th largest producer of the industrial world; this regional power is open to the world. At the outset, it is regarded as an outsider, to any of even managed to climb to the 5th place in the ranking.

The Brazilian economy is changing, and thanks to its young workforce, which is often a positive sign for an economy in good health, the production will increase with the adoption of a strategic vision based on five factors in order to embark on the construction of ships, aircraft and automobile [22].

b) ***Mexico:*** In Mexicothere are two axes which will support growth. The first of the axes is the external factor, as labor costs are raising in China; several countries are turning to Mexico for the production. In addition, the aerospaceconstruction has a large value added for the country, because its cost is very high and requesting a human capital intensive.

The second axis is the strong links of free trade between the two economies (Mexico and the United States) which will be also made a support for the growth in Mexico [23].

c) ***The United States:*** They are the first world economic power according to the nominal gross domestic product (GDP) with a rate of growth which is one of the strongest of the developed countries. The industrialized country is today largely oriented to the tertiary sector and focusing heavily on innovation. The development of high technology industries is the result of a policy of investment in basic research and research and development.

The progress of artificial intelligence will be immediately integrated into the developments of the robotics. The avatars and robots will provide unpublished data related to touch, to smell. They would benefit from greater autonomy and an artificial intelligence consistent onboard.

The United States is producing today the bulk of technological innovation world. They have fully understood the strategic interest of a reflection at any scale on developments and the associated risks.

To cope with the end of the domination American worldwide, the United States are insists in the report Global Trends 2030 [24] on the launch of the production of implants, prostheses and motorized style exoskeletons which will abound in all spheres of human activities using the automated systems very powerful. In addition, research institutes integrating teams of researchers in the field of systems for augmented reality in order to improve our understanding of complex phenomena real.

4) Africa

a) South Africa: first economic power in Africa

Long first economic power of the continent, South Africa has economic results that place it at the forefront on the African continent. South Africa alone achieved a quarter of the GDP of the African continent, it is based on the mining sector, and large industrial regions are therefore located in the same areas of extraction, which have been growing cities.

The unemployment rate remains raise despite the mining industry. It is then diversified in the industry, especially the manufacturing industry in order to reduce the unemployment rate to 6% by 2030. For this vision, South Africa poses 3 scenarios (baseline scenario, solid minerals scenario and diversified dynamic economy scenario) for 2030 in order to keep its economic place in the continent.Almost a million jobs could be created in manufacturing over the 20 years [25].

b) Morocco: a country in full emergence

Morocco is the fifth economic power of Africa, it seems like a relatively small country, yet it is the second emerging country the more promising for the investment behind the South Africa according to the classification established by Bloomberg [26], it is also in the list of emerging countries most promising in the world.

After deploying two main sector strategies since 2000 to know "E-Morocco" and "Morocco Numeric 2013", it also adapts an industrial strategy for the long term up to 2030 which covers a broad scope of topics: smart cities, innovation, education and training, digitalization of the State, electronic commerce and the industry of course.

It is true that industrial development is essential to the economic prosperity of Morocco. From this approach, it is designed in a first time the creation of 500,000 industrial jobs to the 2020 that will represent an envelope of 20 billion dirham[27], and the construction of industrial parks to rental vocation to facilitate the access to the land such as the free zone of Tangier and Kenitra. This allocation affects mainly the sectors automotive and aeronautics which are based on the productive ecosystems.

IV. WHAT SKILLS TO ADOPT FOR THE FUTURE

A. History

The term laborer defines all the artisans of the 18th century. A century later, particularly with the industrial revolution, it refers to the one who works manually including its main function is the production in exchange for a wage. This evolution of the vocabulary expressed the changes in society.

The greed led the employers' associations 19th century to demand a job always more intense for the maximization of profit, especially with the development of the lighting to the gas which has lengthened the working day which can reach 15 hours per days. The workers have the right to a weekly rest day.

Because of the population increase and the rural exodus, the workers are more numerous than the jobs available. Unemployment is chronic, which allows the employers to keep wages down and exert constant pressure on the employees. In the plants are imposed very strict regulations. In addition to any breach which is punishable by a fine or even a dismissal, fatigue, permanent and the difficult working conditions are increasing the risk of accidents at work.

During the industrial revolution, factories were equipping themselves with manufacturing machines. This integration of the machines has been a contribution relatively positive for the workers: a small relief concerning the dangerous tasks, the machine does the work which demands a large force and the reduction of hours of work. Certainly that is a benefit for the men, but the working conditions are still painful, and in addition their earth which has no qualification always present in the plants.

After the technological development, the manufacturing machines become more sophisticated, fast and multitasking. Thanks to this trend, businesses are looking for skills and abilities necessary to occupy a determinant post, which is later called by the professional qualification. It may be acquired by several ways:

- A quality education validated by a diploma
- A continuous training awarded by a recognized body
- A professional experience gained on the ground

The quality of education and training continues to allow the company the adaptation to its environment and development [28] and the employees of the new capabilities to acquire.

B. Towardscompatible skills with the future

From the vision 2030 of the countries, the automated systems of production can have serious consequences that this either positive or negative.

TABLE 1: CONSEQUENCES OF AUTOMATED SYSTEMS OF PRODUCTION

Consequences of automated systems of production	
Positive	***Negative***
-The alleviation of the burden of work because the different stages of production which are causing problems will be supported by the automation systems. -The mastery of the time. -A more independent organization of working time. -The increase in productivity.	-Substitution of man by the machine. -The increase in unemployment. -Deterioration of social relationships. -Loss of jobs especially for the non-competent.

On what factor the industrialists are based to say that employees are competent and to judge a person by his skills, it is imperative to know the concept of this term.

1) Concept of skills

The concept of skills is often presented as an elusive concept in the light of the diversity of its users. There are several researches which try to give a precise definition according to the area of study because this notion of competence remains blurred. In the field of industrial engineering, the competence is the mobilization of a set of heterogeneous knowledge, leading to the production of a performance recognized, by report to a given environment and within the framework of an activity finalized [29].

In addition, the Movement of French Enterprises MFE has proposed a definition adapted with the industrial context: the professional competence is a combination of knowledge, know-how, experiences and behaviors is exercising in a specific context. It is noted during its implementation in professional situation from which it can be validated. It is thus the company that belongs to identify, validate and evolve [30].

The research for the identification of skills were also offers this definition: the skill is the ability of an actor (an individual, a working collective), to act and react with the relevance required to achieve an activity or a set of activities in a type of work situations given. The actor is at the heart of a process which is to select, combine and mobilize its knowledge, know-how, its skills and behaviors on the one hand, and of the resources of the environment on the other hand, in order to achieve the expected performance [31].

All these definitions are in agreement on the fact that the personal skills lead to better productivity if they are essentially based on the knowledge and know-how.

2) Skills to consolidate for the future

After defining the concept of competence, it remains that the determination of the skills to develop among the operators and their methods for 2030 in order to respond to the

imperatives of industrial and to keep their jobs without any dismissal.

In the industrial context, the skills can be divided into two categories: the technical skills and non-technical skills that are juxtaposed as the two sides of the same coin.

a) Technical Skills

The technical skills refer to the mastery of equipment or machinery or specific to the skills and competencies of a technical nature acquired in a specific domain. In other words, it is a question of implementation methods, procedures and tools. The technical skills of the employees provide invaluable guidance on what they can do on the extent of their capabilities.

The many advantages offered by technical skills, all depend on the rigor of the person and of a dynamic environment in which they can be applied. We will briefly mention some main methods that allow acquiring the technical skills.

- The main resource of the human potential of each business is higher education and it is it who prepared first people in the world of work [29].Therefore the importance of higher education is paramount and the state will have to give a great interest in the training of these citizens because the good qualification encourages foreign investors to land.

- Continuous training is a set of training activities planned in advance and financed fully or partially by the company, it allows the individual to acquire the knowledge and know-how necessary to the exercise of a profession or a professional activity. The interest in the continuous training by all businesses, especially small and medium enterprises, is seen as an indispensable element to the professionalization and as a necessity in the profession.

- The training of employees played an important role at the level of the internal cohesion of the company and of the involvement of the employee: the latter will feel more motivated and its results may be best if he feels the involvement of the undertaking to its training.

b) Non-technical skills

Conversely, the non-technical skills are skills rather oriented toward human interactions and they are appealing to the emotional intelligence of attributes and personality traits and which affect the different interpersonal interactions. They aim to collaborate with others according to a communicative mode and cooperative and to demonstrate a social behavior. In addition, they incited to contribute constructively to the development of his work station and its business environment, to know organize and decide on its own and be prepared to assume responsibilities.

There are several non-technical skills to develop, among which there is conflict management, innovation, communication and mastery of languages and the spirit of group work. Several technical devices and interactive exist in order to facilitate the work of cooperation between individuals within a group, such as help system for the cooperative work HSCW for (Help System to the Cooperative Work) [32] which shows a new discipline for the study of individual and collective mechanisms of group work.

These are the capabilities neglected by most of the employees and yet it is they who make the difference, many types of training that allows the acquisition of these skills.

- Coaching is a professional coaching customized to obtain concrete and measurable results in the professional and personal lives. Through the coaching process, the trained person deepens his knowledge and enhances his performance.

- The self-training means learning using the capabilities of autonomy of the learner. It allows the individual to train at their own pace through the exploitation of specific resources.

- The E-learning, or online training, shall designate the set of solutions and ways in which the learning by electronic means. The online training is particularly suited to develop cognitive skills with specific methods; it includes as well the web sites educational, distance learning, telematics education, or even the e-training. It is more often the use of computers or mobile devices (smart phones, tablets, PDAs, etc.) connected to the internet.

- The continued training of course.

V. CONCLUSION

The key factor for business success is the automated systems of production which are present in all sectors of activity. In this approach, it is imperative to ask the question of the consequences of work of these systems on the employees particularly when countries support the industries by the industrial strategies for the long term aimed at the adoption of several production systems.

Before bring some elements of answers to this problem, we have analyzed in the first place the concept of automated systems of production and their structures. Then we have compiled a status of places of industrial visions of several countries to the year 2030. And then we have started the question of skills to acquire in order to be in a good fit with the requirements of business.

During our research on the futuristic skills, we have considered several obstacles concerning the lack of research applied to the Moroccan industry, and the lack also the indices of competence and levels of weighting vis-a -vis the evolution of automation.

In return, there is a study that has been able to trace the new skills relating to maintenance personnel for the exploitation of new technologies of information and communication technologies, and also demonstrate that there is a need for technical intervention and relational to enrich the repository of the trades and skills for operators and more particularly the maintenance operators [33].

As perspective of the development of this work, we plan an investigation launched in the industrial areas in order to assess the dedication of enterprises to develop the technical

and non-technical skills of their employees using the continuous formations well adapted to the global context.

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