

Agents of Automated Systems and Training: What Impacts in SMEs?

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Abstract: Information and Communication Technologies (ITC) are more and more used in the Moroccan industry including the use of automated systems in Small and Medium-Sized Enterprises SMEs to improve productivity, competition and ensure the best product's quality. The agents of these systems have found difficulties with the advent of the technological development of the automation by what the industry of the future requires qualifiers agents, competent or even versatile. The acquisition of new skills that this either hard or soft has become a necessity for the users of automated systems in order to keep their jobs within the SMEs. Among the means to help them to acquire the skills is training, several researches related to the training have been established in several areas of activities. Yet, the industrial sector has not benefited from such research to find out the impact of the training on the employee, the research and the company. In this study, we will present the results of our survey in the three industrial sectors dominant in Morocco (textile, the agri-food and the automobile) by focusing our study on employees of the automated systems and their relations with the training.

Key words: Automated systems hard and soft skills, training, Small and Medium-sized Enterprises (SMEs), established, competent, automated

INTRODUCTION

What emerged in the last few years, it is the massive use of ICT in industrial production in addition, the automated systems are integrated in several industries such as automobile, textile and agri-food industry. The objective behind the introduction of automation in these industries was the optimization of the energy, improvement of productivity and of course the alleviation of the burden of the operator's work. Technological progress is constantly, automated systems are becoming more and more developed which require a skilled and versatile workforce adapted to this technology.

Small and medium-sized enterprises seek permanently the improvement of the competence of their employees on the basis of training in internal and external. The Moroccan SMEs them also, invest in the continuous training of their personnel to deepen their skills but in a modest way and non-fair between the operators, technicians and engineers.

Several studies dealt with the influential theory of the training on the skills (Salas and Cannon-Bowers, 2001). In the field of public administration (Kraja, 2015), health

professionals (Hecht *et al.*, 2016), the maritime industry (Nazir *et al.*, 2015a, b) and of the industrial process (Nazir *et al.*, 2014) as well in the various points such as the impact of training on the economic (Anderson, 2010) and social plan (Banda *et al.*, 2010). All these studies demonstrate that the continuous training has some positive impacts on the personality of the trained on their ways of working and on the company.

Yet, there is no such study on the impact of the training in the Moroccan SMEs regarding the users of automated systems. In our study, we are going to deal with this point because the advent of the industry of the future (Industry 4.0) makes their situations very vulnerable in relation to the other functions and the competent employees are rare.

Automation in the industry

ICT in the industry: Information and communication technologies indicate the integration of these technologies rapidly within companies and take a very important place in the companies.

Morocco is launched for several years in important investments to develop and equip the country of

industrial infrastructure. The industrial sector represents nearly 28% of GDP. Long dominated by the craft or manual and mechanized industries, the industrial sector has developed rapidly thanks to these ICT.

What has emerged in recent years, it is the massive use of ICT in all sectors and specially in the production. Employees commonly use of tools for the management of information and communication tools from the informatics, these ICT are more present in SMEs to facilitate the activities of the employees.

Moroccan industrial enterprises are convinced that they do not have a degree of liberty in the area of new technologies, investment in the ICT is mostly a need to submit to the requirements of the customers and survive in the face of the fierce competition in the medium and even long term.

The establishment of the ICT within a company promotes the automation of the research which is a technique ensuring the operation of a machine or a group of machines without human intervention. In other words, automation is intended to complement the human being (Sieben *et al.*, 2009) by performing the industrial tasks repetitive, dangerous and which require a precision in the automation process.

Industrial automation makes use of electronic systems which include the entire hierarchy of control-command and the ICT tools, since, measurement sensors, passing by the PLCs, the communication buses, the supervision, archiving up to the management of production and resources of the enterprise. It reduces the workload of the employee while keeping a better productivity and an excellent quality. The modernization of Moroccan companies has taken the path from a dozen of years via the introduction of new types of automated machines and computer tools and the movement is increasing.

Concept of automated systems: The advent of the automation is not of any abrupt but several steps have prepared its appearance from the mechanization up to the electronics. The mechanization has replaced the handicraft work during the industrial revolution which extended from the end of the 18th century and particularly 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 production of the series of products. The request of the market in manufactured goods was very high because everything that was produced was not enough suffice consumers. With the evolution of technologies, the automated systems became ubiquitous in enterprises and met the requirements of the market.

Despite the reputation of the automation in all areas such as aviation, automotive, smart home, medicine and industry in companies during these last years, this concept has not been able to have a single definition, several researches contributed to define it.

The online dictionary Larousse defined the automation such as the total or partial cancellation of human intervention in the execution of various tasks, industrial, agricultural, domestic, administrative or scientists. In addition, automation is the fact to assign impossible tasks to be done by human beings to the machines (Cederfeldt and Elgh, 2005) that it is this open loop job or closed loop (Parasuraman *et al.*, 2000). It is regarded as the substitution of the physical labor and mental health of the human being by the machine (Sjobakk *et al.*, 2014; Vagia *et al.*, 2016; Frohm *et al.*, 2008).

The automation system, according Staroswiecki (Bakkari *et al.*, 2015) has for goal control of the changes made by the physical process. This check is carried out with the aid of sensors and actuators at the first level. The concept adopted by Verlinde (Bakkari *et al.*, 2015) for the automated systems is based on the functions of the system which are: lead, maintain, monitor, secure. However, Bayart (Bakkari *et al.*, 2015) does not take into account the operators in the model, the automation system is in this approach considered as an interface between the physical process and operators. For Cauffriez (Bakkari *et al.*, 2015), the automated system takes the principles of a physical system that this either internal or external.

Despite these definitions which characterized the automated systems, another definition adapted to the industrial context is that of Chiron (Bakkari *et al.*, 2015) who composed it in two parts, the first part is the control part and the second is operative part. The control part contains the logic operation of the process that we want to automate, it sends orders to the operative part which executes them with the help of actuators and which returns information from the sensors. The control part also manages the dialog with the operator through the more often a supervision. Yet, the automation is designed to be compatible with human capabilities (Kaber and Endsley, 2004).

The interest of the companies to equip by these three types of automation (fixed, programmable and hose) (Adejuyigbe, 2006) is to have the speed and the precision during the execution of the tasks to have a better quality of the product to minimize the cost of products and of the labour force and to have an efficient research (Hodgson, 1963).

The automation does not exist in a mode all or nothing (Kaber and Endsley, 2004; Parasuraman *et al.*,

2000) but there is a consistency between the two modes: manual and automatic. And this characterizes the degree of automation in the enterprises which it depends essentially on the industrial sector, the size of the company and the ability to invest in new technologies.

Implementation of automated systems in the industrial environment: The technological revolution industrial automation systems allow production very varied products and with a huge amount (Bakkari *et al.*, 2015). Before the industrial revolution, the operators had to work with simple tools or even manually to achieve the appropriate tasks which creates operator's exposure to potential risk and a hassle to research.

With the implementation intensive use of automated systems in the industry, operators have felt a relief by running the repetitive operations and dangerous. The majority of manufacturing firms are equipped by automated systems which was done in a few hours they are often in a few minutes or even less and it brings a significant benefit to companies. The role therefore of operators is limited to do maintenance and industrial monitoring due to the increase in the complexity (Nazir *et al.*, 2015a, b) of automation systems.

Since, the control command of automated systems is done in rooms of decentralized supervision, those equipment must provide correct information and in real time to operators to help them make good decision at the appropriate time. In such a situation, the operators will begin by the perception of the information from the automated systems, then comparison this information and their importance in order to help them to predict what will happen to automated systems (Endsley, 1999).

As the automation, thanks to technological progress, becomes more and more complex and high i.e., autonomous, it requires a skill very high also (Balfe *et al.*, 2015) such a request requires personal of very competent, qualifiers even versatile. The companies are constantly trying to improve the competence of their employees (Bakkari *et al.*, 2015), otherwise the latter must keep the same level of skills and this is very difficult in a world that is characterized by a strong daily technological progression.

Skills in the industrial field

Concept of competencies: The concept of skills is often presented as an elusive concept in eyes of its users. It is a matter of several research that try to give a precise definition according to the field of study because this notion of competence remains blurred. As the competence cannot be defined that in the specific context (Brailovsky *et al.*, 1998), the competence in the field of

industrial engineering is the mobilization of a set of heterogeneous knowledge, leading to the production of a recognized performance, compared to a given environment and as part of a finalized activity.

In addition, the movement of enterprises of France has proposed a definition adapted with the industrial context: the professional competence is a combination of knowledge, know-how, experiences and behaviours is practicing in a specific context. It is noted during its implementation in the professional situation from which it can be validated. It is therefore to the company that he belongs to the mark it, the validate it and make it evolve (Bruxelles *et al.*, 2002).

The researches for the identification of skills have also proposed this definition: the competence is the ability of an actor (an individual, a collective work) to act and react with the relevance required to perform an activity or 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 behaviours on the one hand and of the resources of the environment on the other hand in order to achieve the performance expected. The competence is the intersection between four observable and measurable aspects (Fig. 1) which are the knowledge, skills psychomotor, the ability to solve the problems and attitudes (Brailovsky *et al.*, 1998). All of these definitions are in agreement on the fact that the personal skills lead to a better productivity.

Types of skills: In the industrial context, competencies can be divided into two categories: hard and soft skills. These skills are the key to success for each company and values employees and they are juxtaposed as the two sides of the same coin.

Hard skills: Hard skills refer to the mastery of equipment or specific machines or of skills and competencies to technical character (Hendarman and Tjakraatmadja, 2012) acquired in a specific domain. In other words, it is for the

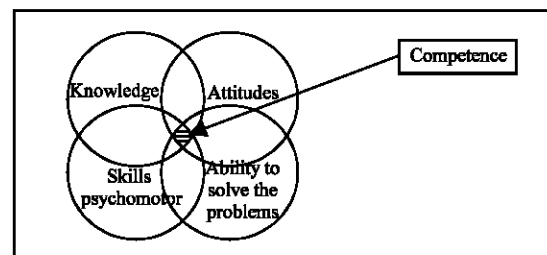


Fig. 1: Competence: intersection between 4 aspects observable and measurable (Brailovsky *et al.*, 1998)

implementation of methods, procedures and tools. Employee's hard skills provide indications that are essential on what they can do on the extent of their abilities. The employee's technical skills provide essential information on what they can do about the extent of their abilities. We will briefly mention a few main methods which allow to acquire hard skills.

The main resource of the human potential of each enterprise is higher education and it is it that firstly prepares people for the world of work. Therefore, the importance of higher education is paramount and the state will have to give a great interest in the formation of these citizens because the good qualification encourages Foreign investors to disembark in.

Training is a set of training activities planned in advance and are financed fully or partially by the company, it allows the individual to acquire the knowledge and necessary know-how to exercise a profession or a professional activity. The interest in training by all enterprises, especially, small and medium-sized enterprises is seen as an essential element to the professionalization and as a necessity in the profession. The training of employees plays an important role at the level of the internal cohesion of the company and the employee involvement, this last will feel more motivated and its results may be best if it feels the involvement of the company to its training.

Soft skills: Conversely, soft skills are skills that are more oriented towards human interaction and that use the emotional intelligence of attributes and personality traits (Hendarman and Tjakraatmadja, 2012) and affect different interpersonal interactions. They aim to collaborate with others in a communicative and cooperative way and demonstrate social behaviour. In addition, they encourage people to contribute constructively to the design of their workstation and their professional environment to know how to organize and decide on their own and to be willing to take on responsibilities.

There are several soft skills to develop, among which there is conflict management, innovation, communication and the language's mastery and the spirit of working in a group. Several technical devices and interactive exist in order to facilitate the work of cooperation between individuals within a group. These capabilities are neglected by most of the employees and yet it is they who make the difference, many types of training allowing the acquisition of these skills to know.

Coaching is a personalized professional accompaniment to obtain concrete and measurable results

in the personal and professional life. Through the process of coaching, the coached person deepens its knowledge and enhances its performance.

The self-training is a way of learning using the capabilities of the autonomy of the learner. It allows the person to form at its own pace through the exploitation of specific resources.

The e-Learning or online training, designate the set of solutions and ways of learning by electronic tools. The online training is especially, suited to develop cognitive skills with specific methods, it includes as well of educational web sites, tele training, teaching telematics or even the e-Training. It is more often the use of computers or mobile devices (smart phones, tablets, PDA, etc.) connected to the internet.

MATERIALS AND METHODS

Case study

Context of the study: What characterizes the Moroccan economy in recent years is the wide diversification and the large opening in the national market that international. We were interested in our study, to the three dominant sectors (textile, agri-food and the automobile) of the Moroccan economy.

The textile sector is a strategic sector that has been able to keep its place in the Moroccan economy despite international competition, it contributes 7% of industrial added value and the creation of 27% of jobs in the country.

The first industrial sector in Morocco is the agri-food sector which has a fairly high demand both nationally and internationally. All companies operating in this sector is 29% of industrial companies and they offer more than 90,000 jobs.

In the last 10 years, the Moroccan automotive industry has grown to sustained levels of growth. Its performance is particularly remarkable for export (first export sector) and in terms of job creation.

Choice of the sample: The sector the most dominant in the city of Fez is the textile, this city contains national and international companies as well the production is intended for the national market than international. Casablanca is an industrial crossroad, the agri-food sector is a sector witness to the development of the city. The Tangier free zone abounds of companies operating in the automotive sector, this sector has a special interest by the Moroccan authorities. The selected sectors in our study are textile, the agri-food and the automobile. We took a sample of 12% of the SMEs in the three industrial cities (Fez, Casablanca and Tangier).

Elaboration of the questionnaire: To proceed to make this investigation, the development of the questionnaire is essential and was the first step in the collection of data in order to determine the involvement of SMEs in the continuous training of their employees. The collection of data has been made by the on-site visit of the SMEs and also by e-Mail. After we have defined the aspects to be dealt with in this investigation, we have begun to develop the questionnaire under the Sphinx Software Plus2 V5 which it is dedicated to the collection, processing and analysis of data.

RESULTS AND DISCUSSION

The SMEs and training: In the field of continuing training, the Moroccan companies are a little involved in the training of their employees. The textile sector, comes to the last place (Fig. 2) in the training of these personnel by 16%. With 52% the automobile sector occupies the first place in the training by against the agri-food sector takes the second place by 32%.

Skills needed for the use of automated systems: In fact, skills necessary for the use of automated systems the three industrial sectors admit that the skills required for the use of automated systems of production differ from one sector to another (Fig. 3).

The automotive sector says that 72% of their employees have more than 70% of the skills necessary to the use of automated systems, 25% of the users of these systems have between 50 and 70% of the skills and the 3% which remains divided in 2% who have skills between 20 and 50% and finally, 1% have <20% of the skills.

As regards the agri-food, the rate of employees who have more than 70% of the skills is a little low at only 7%, those who have skills between 20 and 50% for use the systems of production are estimated by 48% of people. The percentage of those who have skills between 50 and 70% is about 32% and those who have <20% of the skills are 13%.

The textile sector is characterized by a low percentage, only 2%, skills more than 70% of their employees and 16% of users of automation that have between 50 and 70% of the skills, those who have skills between 20 and 50% are estimated by 26% and more than half of these users 56% of people have <20% of the skills. According to the data above, it can be seen that the companies of the automobile sector require the profiles in which their curriculum are adapted with the needs of the companies 53%. In addition, they spend more time to train their employees 61% on the automated systems. About the textile sector, the curriculum of 18% people recruited

is adapted to the needs of the companies in this sector by against 9% of its employees benefit from training continues. For the agri-food sector, companies recruit persons which their curriculum are adapted with their needs 29% in addition, they organize ongoing training for their employees 30%.

Employees trained by gender: The access rate to continuing training of men 53% is higher compared to that of women 27% which explains that the jobs in relation with the Industrial automated systems are dominated by a majority of the men.

In a general way, behind this inequality of access to continuing training lies the family constraints and domestic tasks, according to the study (Fournier, 2001) (Table 1).

Employees trained by professional grade: The study shows that the participation in continuous training in the Moroccan SMEs, depends primarily of the professional grade. The training enterprises spend the greater part of the training to managers, more than 80% of them have

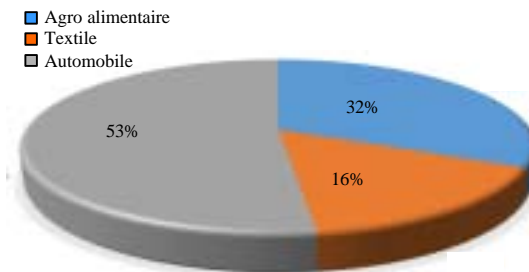


Fig. 2: Training in SMEs by sector

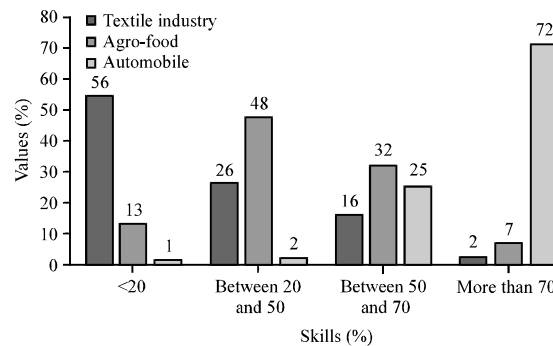


Fig. 3: Distribution of the skills necessary to use automated systems by sector

Parameters	Trained employees (%)
Men	53
Women	27

been trained more than 5 times. Concerning the agents of automated systems including technicians and operators, more than 70% have been benefited to their towers of the training but they did not exceed 5 times.

Figure 4 reveals that the majority of technicians and operators have been less trained in comparison to managers. It thus shows the willingness in agents to train in order to progress in their careers. With the technological development, the agents of the automated systems are the most vulnerable by the dismissal and especially if they had not versatile skills.

Training topics: In Morocco, small and medium-sized enterprises interested by continuing training (Fig. 5) in the new technologies and IT in the first place by 33% and then the thematic of the hygiene, safety and condition of work by 19% and that of industrial techniques by 18%. In contrast the trade, the sale and marketing attract the

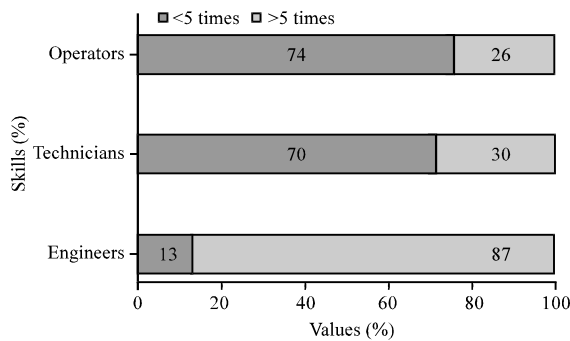


Fig. 4: Distribution of the training of managers, technicians and operators

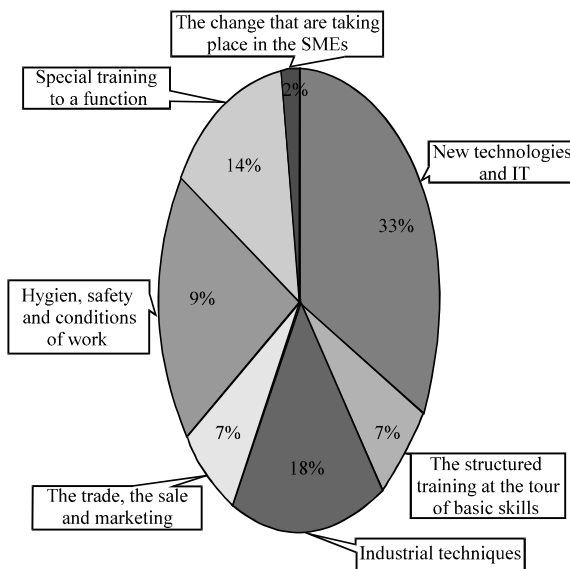


Fig. 5: Training topics

attention of the Moroccan SMEs by 7% but this is not enough in addition to the structured training at the tour of basic skills has the same rate as the last thematic. The specific training to a function 14% is done only from time to time by this that the SMEs rely on the initial training of employees or on their experiences. The changes that are taking place in the SMEs are not very important of SMEs to make a training, a low percentage of these enterprises 2% that organize training courses associated with changes in the organization.

Training modes: Figure 6 reveals the variety of training methods is not fair in Moroccan SMEs. The internal training is the more dominant by 85% compared to other modes of training. In contrast, the external training in any organization is low with a rate of 12% which explains that SMEs do not prefer to send their employees elsewhere and fear the decrease in productivity. The training by alternation is rarely found in the Moroccan SMEs, there is that 3% of training by alternation and this is due to the conventions with other companies.

Impact of continuing training: In an industrial context where fierce competition is increasingly, the trainer SMEs want to have a direct and a positive impact of the continuing training. Figure 7-9 present the impact of the training on three aspects (the personality, the employment and the company) in all combined sectors.

Impact of the training on the personality: The first advantage of the continues training on the personality is the punctuality (Fig. 7), a rate quite remarkable 98% by SMEs in the three sectors which is considered as positive index for employers. The ability to communicate and be sociable is an uncommon skill in the staff, it reached 80%

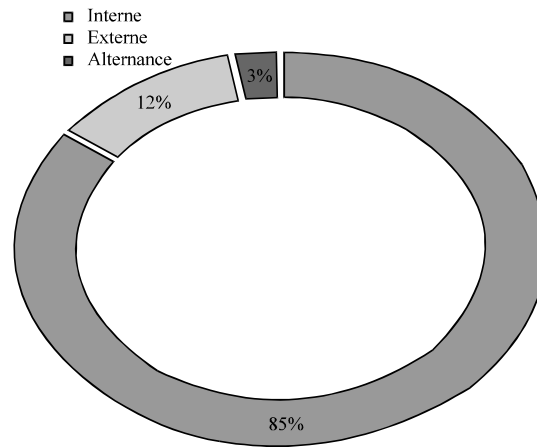


Fig. 6: Modes of training

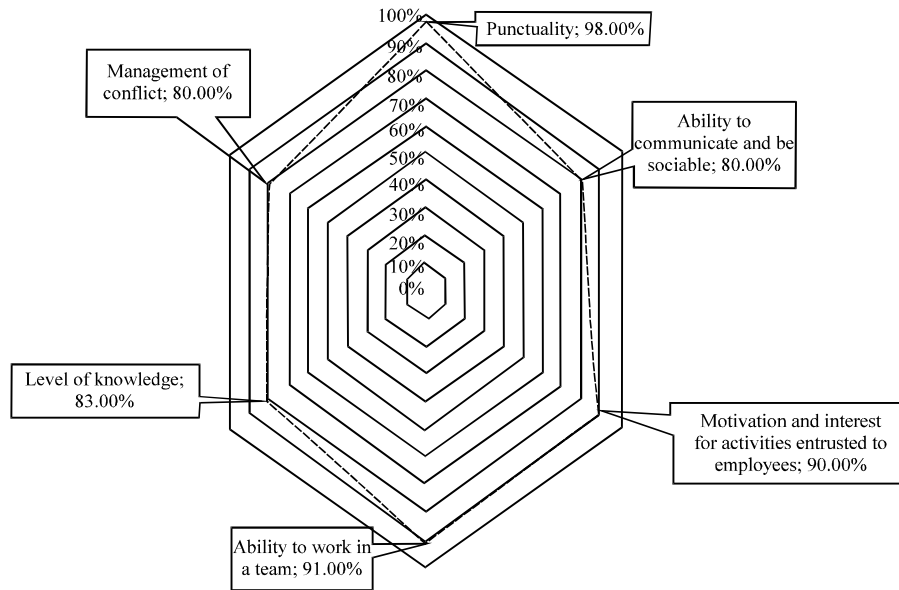


Fig. 7: Impact of the training on the personality

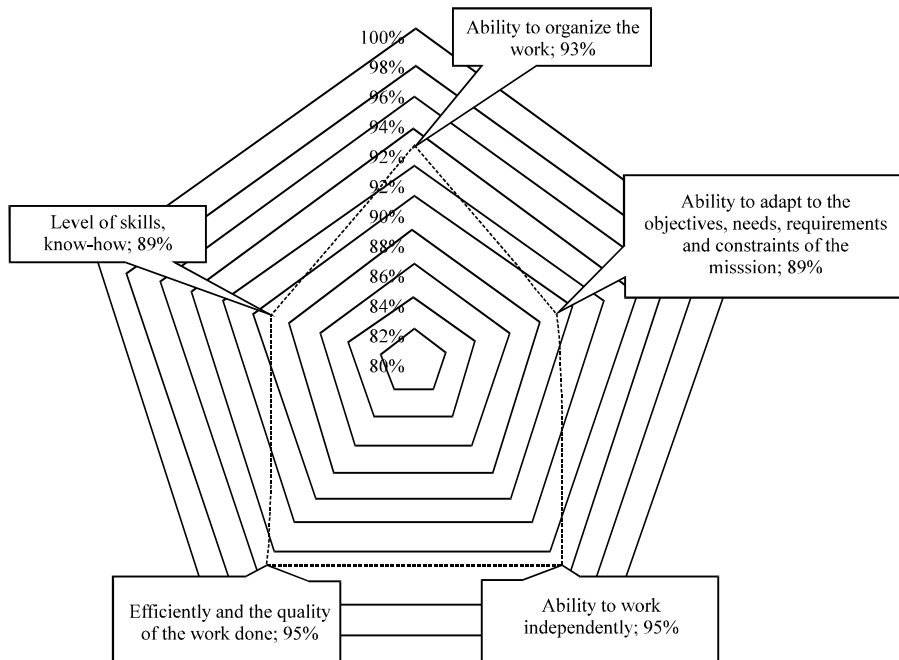


Fig. 8: Impact of the training on the employment

after the training. The motivation and interest for the activities entrusted to employees are important enough with a percentage of 90%. In addition, the ability to work in a team 91% of which it is the art to help colleagues in a common activity and the management of conflict 80% are skills very estimated by the employers. Thus, the level of knowledge is enhanced by the training 83%.

Impact of training on the job: Regarding the impact on the work performed as shown in Fig. 8, the results show that the ability to work independently, efficiently and the quality of the work done, both reached a large percentage (95%). However, the level of skills, know-how and ability to adapt to the objectives, needs, requirements and constraints of the mission also do not

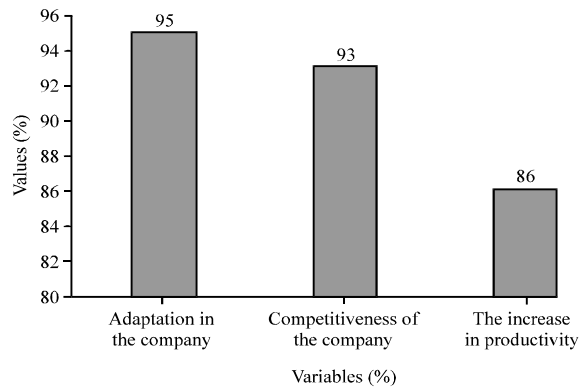


Fig. 9: Impact of the training on the company

exceed 89%. In addition, 93% is the ability to organize the work which explains a rather important productivity.

Impact of the training on the company: The change felt by employers, after the training of their employees is in the first place the competitiveness of the company by 93% (Fig. 9), then the increase in productivity of their employees by a rate of 86% which is very significant for the company and in the end adaptation in the company by 95%.

The training provided by companies for their employees and investments in automated systems generally aim to increase productivity 86%, reduce the cost of operations 98%, reduce waste 95%, increase safety at work 73% and of course, better product quality 97%.

CONCLUSION

In this study, the skills of the agents of the industrialized automated systems and their types as well as the continuous training in the Moroccan small and medium enterprises were treated based on the data collected via a questionnaire. It is obvious that every investment of SMEs in the training of their employees, makes the company more and more competitive and productive. In addition, continuing education allows employees to acquire new skills.

Despite the modest interest of SMEs by continuous training, agents of automated systems do not benefit from training in a fair way (by gender and the professional grade) compared to their colleagues which makes their jobs more vulnerable by this that the new technologies require very high skills. With the advent of the industry of the future called industry 4.0, the machines will be more connected, therefore, the human intervention will be at the strict minimum, the employees who do not

have flexibility and versatility will suffer the consequence of this technological progress, that is to say that these employees will have to acquire new skills to not be lay off.

Several researches show that the continuous training of employees has had positive effects in different areas on the three aspects the personality of the employee, the manner of the work and the company. In addition, a study (Fujiwara, 2012) has demonstrated the advantage of training continues on the health of the trained person, a monetary value is assigned by person and by training which means that the employee must pay an amount for the improvement of its health through training.

The automation makes the industrial physic tasks of employees very relieve, counterpart it puts their jobs in high risk due to their substitutions by these systems and in addition it makes the mental and cognitive task more complex (Nazir *et al.*, 2015a, b). The role of agents of automated systems will reside on the analysis of data and the intervention in the appropriate time with more correct decision, therefore, the training on similar case will be an asset for these agents.

In our study, we found that the continuous training has positive impacts on these three aspects which coincides with the majority of the research on the training (Barrett and O'Connell, 2001), despite the preference of men to women to benefit from the training. In addition, the majority of training is carried out in internal to the company and the themes of training are in relation with the information and the communication technologies.

These results present a modest interest by SMEs to the training of their employees, we hope that the employers of these SMEs attach more investment in the training of their employees by what the positive benefits (Hanhart, 2007) will be in favour of both: employees and companies.

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