

THE EFFECT OF AUTOMATION ON THE HUMAN BEHAVIOR*Daiana Mihaela FLORIAN¹*

ABSTRACT

The interaction between human workforce and fully automated facilities is a key issue in today's and tomorrow's development of technology. Considering the industrial age in which we are working nowadays, specialists in the robotic and automation field have made statements regarding the interaction between human workforce and fully automated production lines. This paper focuses on some important aspects regarding the interaction between human workforce and fully automated production lines and examines the effects produced by introduction of robots in factories all over the world. This approach can make some of the effects of automation on the human behavior, transparent and visible. Both positive and negative facts about automation have shown promising results for improving the upcoming technologies.

KEYWORDS: *Automation, production facilities, human workforce, robots, innovation, human-robot interaction.*

JEL CLASSIFICATION: *A20, L23, O31.*

1. INTRODUCTION

Earlier articles offered information about the implementation of the robotic force and studied closely the behavior of robots in their production cells and plants. The main objective of the present paper is to determine in which measure automation can affect human's behavior in a production facility, taking into consideration the fact that in the 21st century, human's work depends on robots and different types of automated equipment.

Studies suggest that robots are actually increasing our wages, not stealing our jobs. On the other hand, some of the positions in big companies are decreasing in volumes, but other more qualified ones are published on a large scale. This shows that automation has a strong impact on the future qualification of human workers, making them to aim a better paid and higher qualified job. However, this new mentality is pushing the limits and encourages humans to develop new ideas and work for innovative purposes.

Human workers are affected by introduction of automation in the past twenty years, and it has been shown that a part of them feel insecure, concerning their future in the companies they are working for. Along with the development of new concepts and production methods, employees are either used for another tasks, or encouraged to enrich their practical and theoretical backgrounds by taking over new tasks and following training periods within the companies. Most of the companies provide specialized trainings on a long term, for incorporation both their human workers and the robots they invested in. Through that, the companies are able to grow their own employees in the way that their abilities can be used to reach the expected amount of production capacity and progress in their business. As a matter of fact, there are employees who manifest resistance to a changing environment, in which they think they aren't capable of handling things. This main fear could be manifested through anxiety and a significant decrease in the daily volumes processed. When

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speaking about introduction of robots in Romanian industrial environment, this could be at least challenging. More industrially developed countries are actually trying to implement new technologies, and anyway, the problems do appear in both ways. The effects produced by introduction of automation can be observed while the employees are producing goods along with robots, and it's not a conclusive fact, but an interpretable one.

1.1. Automation, an instrument towards continuous improvement

By trying to understand that automation is rather a better way to produce goods and until now has not been proven to have a negative impact both on worldwide economy and the employees, the overall markets can develop themselves easily and employees can contribute with ideas of improvement. In fact, automation could affect humans in a positive way, because they want to reach a higher ground using new technologies and resources. A key point in all these improvements is the technological advancements and better human-robot collaboration.

An instrument of raising the trust in automation could be the usage of high skilled employees who are capable of sustaining the innovative working methods. Once getting the process known, it might become a chain of continuity towards a strong competitive advantage between global companies.

2. INFORMATION

2.1. Robotic workforce and its usage

Based on written articles, inquires and visits in various working fields for gathering information, some of half automated, fully automated production and project-based organizations, such as KUKA Romania, Eckerle Automotive Group Romania, Sc Evopro Systems Engineering, Blue Projects, Ecolor - Furniture Factory, Apulum S.A, CSI Romania, BeerBev LLC have been a solid base for this study, taking into consideration their production methods and rankings on the global market (Kuka-Robotics, 2015).

Automation means actually solutions to problems, higher production volumes, increased profits, lower costs, economical benefits for companies and recognition on the global markets. It's made concrete by going forward in all actions that organizations all around the world perform to challenge themselves for a better future.

Developing new technologies through implication and interest, in the direction of sustainability, implicate higher power of creativity, flexibility, resistance, even awareness of existing and ongoing risks (Endley, 1996 cited in Parasuraman & Mouloua, 1996). Automation has been playing a crucial role in our lives since the beginning of 1946, when companies started to generate new ideas for their production lines, implement shortcuts in the production systems, applying low-cost alternatives and trying to work as efficient as possible to fulfill customer needs properly and in a big range. Nowadays, automation is basically a need. Since the beginning of mankind, we have been trying to find better ways of doing our jobs, based on technology. When talking about "automation", robots, computers, production lines, airplanes, trains, futuristic infrastructures, cross our minds. This is nothing but an idea of humans, on how to make their daily work easier. It is basically a never ending story to continuous improvement. It's always about finding a better solution to problems, develop countermeasures, and most important, see it done in a proper way and through a positive attitude towards change. In the 21th century, the overall production markets would have been actually frozen without automation's benefits.

The effect of automation on the human behavior needs to be treated in detail, in order to offer the expected values for a better understanding of the new technologies impacts overall. The main topic is concluded in a simple question, "Could/does the automation affect our lives?": It helps realizing that humans struggle to develop methods, in order to improve their daily work. This question can offer a better understanding why the automation is important, and how is it going to affect the

mentalities of humans, being both workers and consumers. The first step to search out the details is to see the bigger picture out of it.

The employees are seen as investments or key resources, closely linked to the automation. But most of them must be trained to work along with robots and really understand their usage. The automation of different processes is quite inevitable on a long term, because of the increasing quantity demands of end-customers. For a mass production, companies must provide more and more products and maximize their production capacities. Employees are necessary even in a fully automated production environment to supervise the production process. All robotic plants can be fully automated but that requires large budgets thus making some investments unfeasible. Human workers are seen in the same way as the robots, as a strong part of the company. But the difference is that robots are tools that help the production increase and employees are the one who use these tools in the best way to make them count in a company's interest.

Theoretically, within capitalism and especially since market switched from local to global regardless activity employees are seen as valuable resources for companies built-upon a solid ethical code aiming for high quality of delivered product or service and socio-economical-environmental sustainability. It's human art to make mistakes, but it can affect the working field through interruption or discontinuity. In automated production cells, the robots are automatically detecting problems in a certain range according to the implemented code, and the solution found for this immediately stops the production line, in order to eliminate or solve the error encountered. While solving the problem in one line, the system can function properly as a whole, by continuing the activities until the line affected is ready to produce again. Again, all the error handling done by the robots needs to be pre-programmed by the programmers. The solutions for the new errors or for unseen situations exist and this is why supervisors of the system need to be in the factories together with programmers and other members of the staff. People cannot be totally removed from factories because they are and they will remain the most intelligent part of the system.

2.2 Human workforce versus robots

Human workforce can be seen as an obstacle in the way of fully automation, especially because it's about resistance to change, to do things in another way that they did until now. Nowadays it's easier to accept that humans cannot work independently from this kind of machines, and together they obtain the best results on target markets. For instance, KUKA Robotics doesn't have a large scale of employees, due to the fact that they subcontract a lot of what robotic production involves. The number of employees in a factory is considerable way smaller as in the past, due to increasing number of automated cells.

The volumes of demands wouldn't have been reachable without robotic work-force. Having a big various order of products lead automatically to automation, but literally speaking, using only human work force, the quantity and the quality can't be achieved. It is a constantly need of improvement even in the robotic production.

Some companies like Fanuc Robotics (2015) actually build robots using robots, and from this point of view it can be only a meter of time until almost all workers could be replaced by robots.

In a globalized market enterprise success is measured in how fast the product can reach targeted market, fulfilling market requirements in terms of quantity and quality. Therefore robots abilities namely speed, precision, and not only, can deliver desired competitiveness and as a result increased financial incomes.

Robotic systems can achieve performances unparalleled by conventional production processes. They affect quality, production time and general safety. A robot will never be late to work, don't require lunch breaks, or sickness leaves.

For companies that produce goods in large scale the orders have to meet a certain deadline. This can be achieved by robots working 24/24 compared to employees, meaning that the financial result is better and will be very satisfying on a long term. In smaller companies that use one to two robots or

even none, the orders are smaller and the production could be for special purposes: unique parts and specific products for a single sector. In both ways, the management and how demands are received and processed can make a difference.

Using robots in manipulation and other field of industry where this machines are able to do the hard tasks human can't, are more easily to use and more cheaper in compare with humans. From the position of an investor, buying a robotic technology will have some cost with implementing the technology and make it work. The robot can work 24Hrs/24Hrs, 7 days by 7 days with no salary paid and an increased speed in manipulation. Furthermore, the quality produced by the robots is constantly better, in comparison to the one produces by the employees, which can vary. Robotic technology has a significant advantage in such case, so, whoever is implementing this technology aims good financial results and continuous improvement.

The engineers are skeptic and could rather say that robots won't affect the human worker's in any way, because they need the robots to make precise and fast procedures which can't be done by a simple worker. There are also some activities that are really dangerous to perform, for instance duct cleaning, fix oil spills, analysis of hazardous environments or extremely dangerous polluted environments, space exploration or risky drilling operations that can be done exclusively by the robots or other intelligent equipments.

Engineers worldwide think also that deployment of robots and process automation within factory facilities has also a negative impact upon worker mentality, and could generate a decrease of self-esteem, felling of not being useful anymore and of course resistance towards new technologies and changes.

Still the key words for solving such issue are long term social-economic-environmental sustainability and re-training of workers to provide auxiliary tasks required by these new technologies.

But companies still need employees to maintain and supervise the robotic production lines and it's going to be this way until real artificial intelligence is discovered and implemented. If employees manifest fear of losing their jobs, it could cause damage to a company, through inside tensions and even intentional damage to existing technology from the work place. This might be one of the concerns at this level, and companies can come up with solutions for the human workers such as job enrichment or job rotation, in order to keep them motivated. An important thing that employees should realize is the fact that automation could generate other vacant positions within their companies.

2.3 Changes due to automation

The concept of automation not only should change the behavior of human workforce it could change the behavior of human workforce to the so called knowledge worker for the upcoming digital revolution of industry.

In Europe, due to abruptly demographic changes, the knowledge of skilled workers will become the most important resource of any industry. Since the beginning of first industrial revolution workforce behavior was restricted by applying standards, workflows and internal regulation meaning to achieve systematization, discipline, safety and other industry required "behaviors".

One thing is certain. Humanity should adapt to the changes and make the best of it, redistributing work force to other fields.

Once the processes are more automated, less workers are needed in production and more workers are needed in other areas, where education is more important, so this could lead to higher demand for education, or implication in programming the systems and developing a better design for goods. Automation can mean a migration from actual production, to maintenance, operating, engineering, integration, sustainability and continuously improvement.

The level of the changes depends by the actual level of the behavior (as an example, a worker from Germany will switch faster and easily to the concept of knowledge worker, compared to a worker

from Romania – because of the higher level of automation and of course due to a higher adaptability to new technologies).

The employees have the opportunity to work in a modern futuristic factory/company and beside this they can feel that they have a more challenging job that meets the 21st century's companies that have to keep up with the technology.

2.4. Automation – Pros and cons

Based on different studies, the automation could attract also both negative and positive actions along its development. Starting with the negative part, the automation is thought to lead to unemployment, because new machineries seem to be more efficient rather than human labor. It is also because most company owners don't want to spend so much money on employee's wages, when they can use machinery rather than human labor. In the near future, robots could be able to function similar as human. One way it's exactly what we need, and on the other hand, the fear of losing jobs grows day by day. Stephen Hawking express his doubts about automation, by saying: "Creating artificial intelligence will be the biggest event in human history... it might also be the last." It seems that a notion has developed that robots and the future artificial intelligence behind them are out to get human's jobs (Alana, 2011).

2.5. Advantages of automation

The positive effects of automation could be in a significant number more that the negative ones. At the moment, these digital assistants are just assistants – helpful when asked to be helpful, and certainly, not freethinking.

With so many logistical calculations that need to be made in the service industry, the risk of human error is always going to be high. Employing a central artificial intelligence function takes some of this risk away. It can crunch numbers immediately and assimilate critical information more accurately to arrive at optimal decisions. This can be done more quickly and frequently than humans can. Is artificial intelligence therefore replacing the human element? Not at all – it is simply taking a laborious task away from an employee who can add more value tackling a more challenging and subjective problem. It is highly unlikely that artificial intelligence will ever be able to display the creative and intuitive capabilities needed to match humans at the tasks we exceed in, those that are not always black and white, right or wrong. Fundamentally, the service industry is about people solving problems for people. Human issues need human solutions. Robots will only ever be able to support the problem-solving structure. It cannot replace it. Modern technology is considered to be just a tool that needs to be used efficiently in order to gather the maximum amount of value.

Technology will dramatically change the nature of our jobs, but it won't take them away. Rather, it will free up individuals to focus on higher value challenges that can only be tackled by a human mind.

The workforce of the future should need to focus on new ways to apply and leverage skills so workers can add greater value. This workforce of the next generation could be defined by jobs that embrace and make sense of data and smart machines. It's all about changing perceptions of not only what is needed but what is most valuable for us to dedicate our lives to (Rossi, 2015).

Technology is proved to make humans smarter. In the near future, the entire human workforce could gain confidence through using of robots and automation, could find answers to questions and solutions to problems. A machine has no ability to asset situations and cannot look at a set of transactions and provide an overall picture of what they could mean. The human-robot interaction should produce positive effects, taking into consideration their practical cooperation. For example, humans are not able to search for something in a wide amount of data, but they use algorithms and machineries to help them do this job. It's less time-consuming are very efficient. The machine finds

patterns and indicates different activities and situations. Humans do usually the best thing that can be done: analyze the situations, think at a probable solution and then respond to it in an appropriate way. The new technologies provide humans access to intelligent systems that ultimately allows them the freedom to become smarter in how they work.

2.6 Automation – a strong base for defining the future

Both positive and negative impact could bring the mankind forward, and could generate even bigger ideas, dreams, suggestions and forecasts for the next generations. How big companies see their success on European continent it's quite interesting, taking into consideration human capacity to develop new technologies. Those companies are in fact rather "unsatisfied" with the output, hoping to achieve even more power, profit and recognition as expected. Once a company has reached its expectations of sales and production capacities, it has to intensify the competition on global markets, pushing the limits again and again.

A robotic device is made to work in collaboration with humans. The principle is to re-create a co-worker. One that will help the human worker to execute tasks considered to be way too hard on his body, such as lifting heavy weights or doing repetitive tasks. A virtual infinity of applications can be done by robotic co-workers. Robots are coupled with the idea of breaking the usual barriers between them and the end user by: Making robotic programming as intuitive as possible for the people on the plant floor and by making the robot itself an accessible tool in the production process. Having a robot to work safely alongside humans can improve the production flow, allow the automation of new processes by using the best of robots and the best of humans. Collaborative robots are now designed to work alongside humans without any fencing (Bélanger-Barrette, 2015).

Generally, the concept of automation and its effect on the human behavior can be observed from different perspectives, for instance, based on the Lean Six Sigma principle: "Go and see for yourself": in big industrial environments it let us know exactly how do humans interact with machines and automotive workforce, and it's quite enjoyable! Of course this principle of Lean is not always applicable, especially when it's about finding more about one company's intern procedures and working strategy.

Observing the human reaction to change can provide answers on a large scale. Do customers react to a better quality of products? In most of the cases, the consumers make their decision based on new ways of producing goods, because through this, consumers can define a product such as "the best one" taking into consideration the principle: "better quality at a better price, or excellent quality at reasonable price".

Furthermore, the focus is still on the human workforce. Humans are the basic resources that can build an entire production system from zero, capable to add and switch components, replace damaged equipment, who are always aware of errors within an organization.

Robots can detect errors, but in the moment, they just can't repair or sustain themselves. Artificial intelligence will not be developed without the "real thinking machines".

2.7 Robots are increasing our wages, not stealing our jobs

In fact, the development of automation encourage thinking on a large scale, it's basically like a big circle. Human generate new ideas, provide solution to problems and thinking "outside the box" comes in the front line. Once automation is implemented, it becomes clearly a battleground of new concepts. The big advantage is mutual. As a response, automated workforce can deliver a higher quantity of visions to humans. For instance, in the automotive industry, the way that robots work can produce a positive effect in a plant, simply through the fact that human workforce is clearly aware of their potential and new concepts are always developed, futuristic designs are on the role.

Advantages have of course a bigger impact than disadvantages, because it's about the dynamic structure of living, power of innovation, excellent quality, better products, good service and on-time delivery, maximized productivity, competitive advantage, rapidity in execution and handling

materials. Standardization of work plays also an important role, along with the increased capacity of production.

AUTOMATION	
PROS	CONS
<ul style="list-style-type: none"> • Higher level of production • Better quality • Productivity • Safety • Precision • 24/24 Hrs production • Few time-consuming activities • Less waste • Handle quickly huge amount of materials • Working in hazardous environments • Greater access to goods and services • Increased freedom and flexibility • Allows tremendous amounts of work to be done with little human effort 	<ul style="list-style-type: none"> • Possible break-downs and system errors • Bigger costs of implementation and maintainance of robots and automated lines • Additional trainings for employees generate extra costs • Machine-made products replace handmade goods • Higher rate of unemployment • Loss of traditional skills

Figure 1: Pros and Cons of automation

Source: adapted from Solis (2011)

3. CONCLUSIONS AND FUTURE WORK

There are two main ideas can be extracted from this study. It is also undoubtedly that automation produce both positive and negative effect on the employees. Some engineers have come to the conclusion that employees could be partially left aside. But this refers strictly to the one that can't or even don't want to learn new things and perform new set of tasks, trainings and requalification.

Those are represented by the employees who manifest resistance to change and can cause tensions and misunderstandings, throughout negative financial impact for companies. For the young employees, the new concepts could not be hard to understand and implement, taking into consideration their openness, ingenuousness and desire to affirm themselves. Working for better solutions and for their future qualification, can be also better paid with every step they make towards technology.

Automation mean sustainability, increased creativity, ability to anticipate changes, quick change-over, higher grade of flexibility and resistance of equipments, during error detection and solving existing problems. Optimization, standardization, raised volumes / production cell, removal of defects, fulltime production and excellent quality are through the most important benefits of automation.

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