An Empirical Study on Human Resoureces' Attitude Towards Manufacturing Digitalization

Nataliya Koleva
Faculty of Management
Techinical University of Sofia
Sofia, Bulgaria
nkoleva@tu-sofia.bg

***Abstract*—Nowadays, the environment of industrial enterprises changes dramatically. The Fourth Industrial Revolution (Industry 4.0) reveals new horizons for business development and generating added value for customers. In order to benefit from the new digital technologies and increase their efficiency, businesses should undergo a comprehensive transformation that affects both the business / manufacturing processes and the workforce. The present paper discusses the attitude of people / workers to the changes and challenges that digitalization of production, as part of Industry 4.0, puts them to.**

Keywords—empirical study, manufacturing digitalization, industry 4.0, human resources

I. INTRODUCTION

In recent years, the problems accompanying the processes of digital transformation of business are discussed in depth in the scientific and business circles. Enterprises from different industries at different speeds are paving the way for the digital transformation. They face a number of difficulties of financial, technological, social character, etc., which are manifested with different power in view of the specificity of activities performed, as well as the anticipation, the motivation and the willingness of workforce to adapt to the new production environment that is imposed by Industry 4.0.

Industry 4.0 requires a new vision for the „human-machine" interaction, which becomes an essential prerequisite for faster, more flexible and more efficient manufacturing processes, and for creating high-quality products at low cost.

People will have to take on more activities requiring knowledge, experience, intuition, creativity and decision-making in complex and precarious situations. This implies a tremendous change in the workforce requirements of future businesses. The human factor is one of the most important for the competitiveness of the organizations [12].

The purpose of this publication is to investigate the attitude of human resources to the role of the new digital-intensive production model that enterprises seek to implement in order to maintain their market position and operate successfully in the conditions of a modern competitive market environment.

II. PROBLEM STATEMENT

The term Industry 4.0 introduces a modern concept of automation and data exchange that creates the opportunity for a new, "smart" way of interacting and communicating between elements throughout the whole supply chain [5,10,15]. Industry 4.0 requires enterprises to focus on digital transformation of processes, which implies the merging of the physical assets and processes of design, production, logistics, etc. so as to provide decentralized production and real-time value generation. With digital technology, a close interaction between the physical world and the virtual one is achieved, which in turn represents a fundamentally new aspect for the business / production processes and is expressed by the so called Cyber Physical Systems (CPS) [1,4,6,7,8,9]. Given this, in the new cyber-physical production environment, the interaction "human-machine" takes place at a new "intelligent" level and can be seen as an interaction of "Man – Cyber Physical System"[3]. On the other hand, the training of the employees of the high-tech organizations has its specific peculiarities [13].

Building cyber-physical production is not an easy task. In addition to investing in the development of a suitable technological infrastructure, one of the most important tasks is that the vast number of computational engineering hardware and software tools should be integrated and harmonized with respect to the form and amount of data they are going to process. However, in order for the cyber-physical system to work as a homogeneous whole, it is necessary to solve another very important task, namely "*How to achieve an effective "Human-Cyber-Physical System" interaction in the already built or in being in a process of building Cyber-Physical Production Environment".* According to a survey of [2], the implementation of Industry 4.0 into the industrial manufacturing will lead to a significant change in the requirements for the labor and work environment over the next 10 to 15 years in ten directions:

(1) *Big-Data-Driven Quality Control* – Algorithms based on historical data identify quality issues and reduse product failures;

(2) *Robot-Assisted Production* – Flexible, humanoid robots perform other operations such as assembly and packaging*;*

(3) Self-Driving Logistics Vehicles – Fully automated transportation systems navigate intelligently within the factory*;*

(4) Production Line Simulation – Novel software enables assembly line simulation and optimization*;*

(5) Smart Supply Network – Monitoring of an entire supply network allows for better supply decisions*;*

(6) Predictive Maintenance – Remote monitoring of equipment permits repair prior to break down*;*

(7) Machines as a Service – Manufacturers sell a service, including maintenance, rather than a machine*;*

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(8) Self-Organizing Production – Automatically coordinated machines optimize their utilization and output;

(9) Additive Manufacturing of Complex Parts – 3-D printers create complex parts in one-step, making assembly redundant;

(10) Augmented Work, Maintenance, and Service – Fourth dimension facilitates operating guidance, remote assistance, and documentation.

At first glance, it may seem that people's responsibilities and workload are declining as machines take up an essential part of their functions. However, it should be borne in mind that the cyber-physical production environment is characterized by a high degree of technological complexity that is increasingly growing, which in turn implies the fulfillment of the tasks of the people / workers in the process of their interaction with the system has changed and is somewhat complicated [5,11,14]. The cyber-physical system with which the person will interact directly imposes the necessity of employing specialists with interdisciplinary knowledge [2,6,10]. Complicated structure and interaction between the man and the machine makes the efficient functioning of the system dependent both on IT professionals and on those with in-depth knowledge in the field of operations management who jointly design and implement processes in a network environment.

It can be summed up that although the question for the extent to which robots / machines will replace human labor remains open and in the process of debate, we are already witnessing jobs dropping out. From one hand side, robots are used in many operations to replace humans in dangerous and heavy physical work and efforts, as well as in those with a routine character. From the other, collaborative robots bring out men again in a leading position with a focus on shared working space and the new order for prioritizing and allocating the tasks among the team. Robots can also provide competent technical support, physically replace people in some tasks, and facilitate decentralized decision-making process. In the center of this novel manufacturing order, the convergence between human qualities and robot abilities is put [2,6].

This is an expected stage in the development of the industry, based on the combination of unique human qualities (analytics, innovation etc.) and robots/machines abilities (impeccable accuracy, high productivity).

A current survey of Massachusetts Institute of Technology (MIT) on the collaborative work of people and robots in a BMW factory shows that mixed teams consisting of a man and a robot are coping much more precisely and effectively in comparison with teams of two workers or two robots. The survey also shows that due to the collaboration, the time wasted by the humans (doing nothing) decreases up to 85%.

In fact, robots / machines should be seen not as a threat to the people / workers but as their assistants, who share a workspace together and complement each other. It is precisely this convergence of human qualities (analytic, innovative, etc.) and robot / machine capabilities (flawless accuracy, high productivity) that is based on this new production model imposed by Industry 4.0.

Given the above, it can be said that for the efficient transformation of the production system into a "Cyber-Physical Manufacturing System", it is of particular importance the collaborators from all the levels of organizational the management structure to be open to change and to have the willingness and motivation to adapt to new roles and new working environments and to develop skills for continuous interdisciplinary learning and *lifelong learning* …

III. A Study on Human Resources' Attitude Towards Manufacturing Digitalization

For the purposes of this empirical study, the companies in the machine-building sector have been selected, as in the opinion of the author, the issues in question are actual and can be fully investigated in depth.

A. Methodological Aspects of the Study

For the implementation of the empirical study, two questionnaires were developed, with which interviews were conducted with the workers at the lowest (operational) level, as well as with managers from the higher and middle level. Their distribution in accordance to their position hold in the enterprise can be seen on Figure 1.

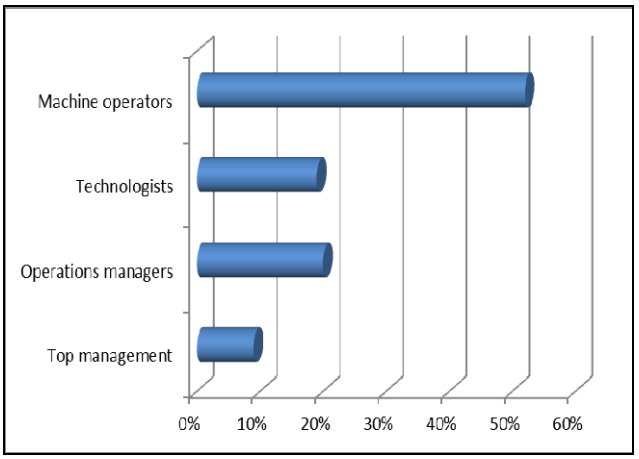

Fig. 1. Distribution of the respondents according to their position in the enterprise

It is also necessary to specify that the survey is aimed at studying the production subsystem of the enterprises and the problems of the workforce stemming from the pursuit of its digitization.

IV. Main Results from the Empirical Study

The field survey took place in the period of 12.08.2018 ÷ 23.08.2018, with a total of 23 mechanical engineering companies visited. Higher-level managers, as well as specialists involved in the preparation and organization of production, were selected for respondents. The total number of respondents is 115.

The distribution of the enterprises surveyed is presented on Figure 2, according to their size. Obviously, for the biggest portion (52%), they fall into the group of Medium Sized Enterprises.

However, it should be pointed that the issues addressed in this paper are equally valid for all surveyed enterprises regardless of their size.

Two of the companies surveyed (8%) indicated that they have not yet started working towards the digitalization of production (Figure 3), which is why they are removed from the sample surveyed. In addition, the number of machine-building enterprises surveyed is reduced to 21 and the number of the respondents – to 105.

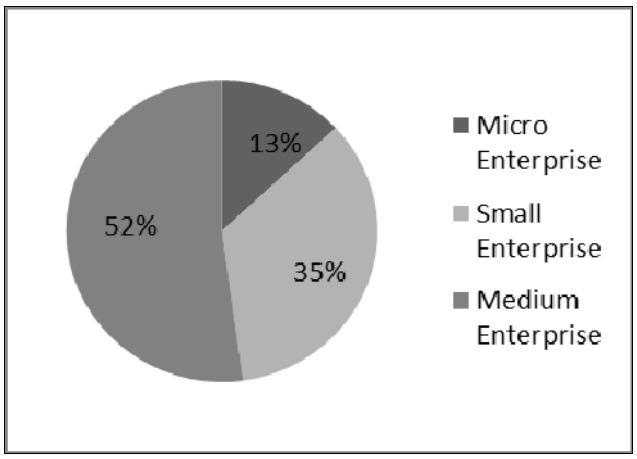

Fig. 2. Structure of the enterprises, according to their size

The results discussed further on therefore refers to them. As can be seen from Figure 3, the remaining 82% have begun to walk the path to digitization.

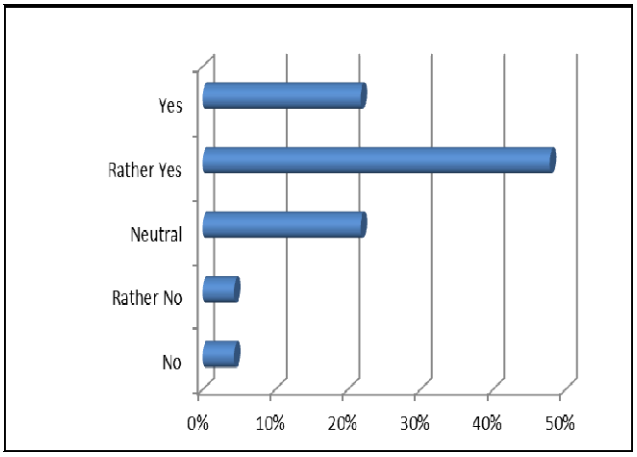

Fig. 3. Are you in process of implementing digitalization of production?

The author's opinion is that this result shows a good trend and a prerequisite for the development of the machine-building sector, although for the most part the enterprises evaluate their progress towards the introduction of digitalization as "low" to "medium" – Figure 4.

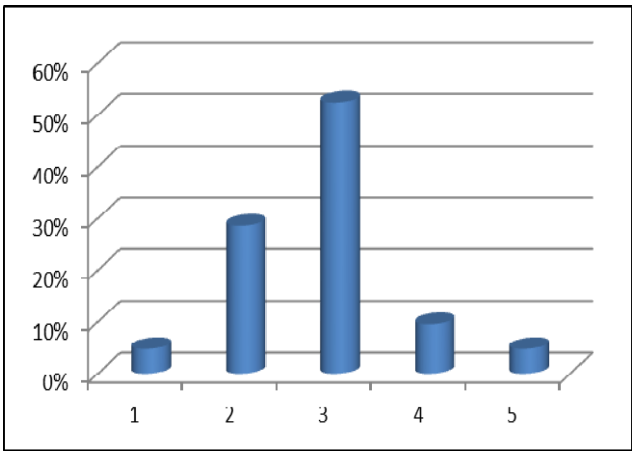

Fig. 4. Progress achieved in digitalization of production (1-very low, 2-low, 3-middle, 4-high, 5-very high)

As a result of the digitization of production, an average 21% of the workers involved in the preparation and organization of production have taken entirely new workload functions in the enterprise, on average 11% were partially affected by the changes and 5% have been fired.

The study also found that the employees did not feel sufficiently informed and had no clear perspective on the future of their current location in connection with the changes brought about by the digitization – Figure 5. That is why relatively large proportion of workers believes that they will lose their jobs as a result of digitization processes – Figure 6.

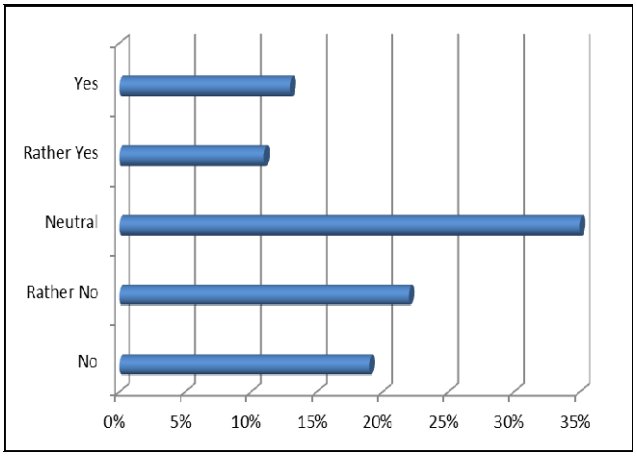

Fig. 5. Do you have any clarity about the future of the job you are currently occupying?

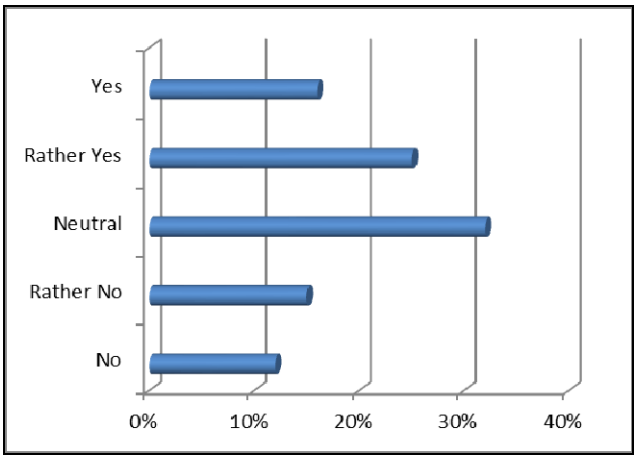

Fig. 6. Do you think that you will lose your job in the enterprise as a result of digitization?

In the author's opinion, these results (shown in figure 4 and figure 5) are partly due to the lack of a strategy to adapt the workforce to the new production environment (Figure 7).

It is also noteworthy that for the majority of surveyed managers (72%), the development of appropriate infrastructure for digitization purposes is of higher priority. Emerging changes in the work environment and changes in the workforce are addressed when the need arises. The author is of the opinion that this is the reason why the results of how the employees refer to the changes in the working environment and their functions (Figure 8) are not so positive. It can be seen that only 37% of the respondents feel confidently positive about the changes concerning themselves, as well as about the working environment. Relatively large is the share (28%) of those who express a "neutral opinion on the issue" and 35% are more likely to have a negative attitude.

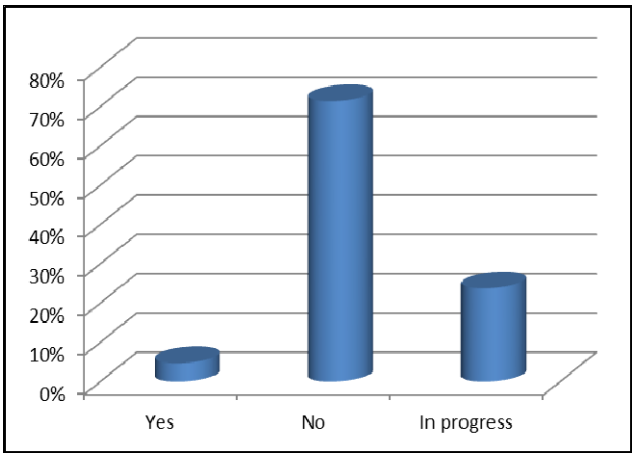

Fig. 7. Do you have written strategy for adapting the workforce to the changes brought about by the digitization of production?

However, it is positive that 46% of workers who have been re-qualified and have taken on new functions in the process of organization and management of production accept positively the change as an opportunity for career development and support digitization processes.

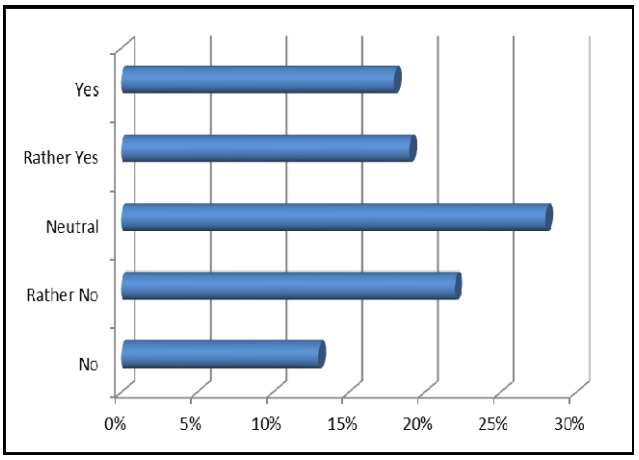

Fig. 8. Are you positive about the changes that have occurred to you as a result of the processes of digitization of production?

Relatively high remains the percentage (37% on average) of those who accept the re-qualification as the only option to keep their jobs and an average of 17% would start working in another enterprise if possible to preserve their current functions.

The results obtained by the present empirical study are interesting and indicative of the level of orientation of enterprises towards digitization and their ability to adapt to the demands of the modern dynamic market environment.

V. CONCLUSION

Businesses have a long way to go in order to achieve the targeted efficiency of production digitization. It is also necessary to devote a deeper insight to adapting and enhancing the workforce in making changes. This would lead to a better understanding of the changes and the causes of the change, which in turn will positively affect their attitude and motivation for the change. According to the author's oppinion, the promotion of a positive outlook for change among the workforce will be essential to quickly adapt people to the new conditions and challenges imposed by Industry 4.0 to meet the desired performance.

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