Automation of Jobs in Production and Sales—The Current Status and Transformation Prospects

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Keywords: work automation, job automation, production workers, sales workers

ABSTRACT

This article aims to present opinions on problems and consequences of changes in psychophysical strain sustained by employees as a result of the anticipated work automation. Next, theoretical development trends were described, and it was surveyed whether the specific nature of the job, i.e. focusing on the object (production operative) and focusing on the customer (salesperson) is relevant in the context of automation, nowadays and in the short-term horizon of 3–5 years. The analysis applied the criteria for studying strains and risks (occupational risk) as well as work automation parameters, according to the criteria of Frey’s and Osborne’s concept. The survey of the opinions on the present and future occupational risk in production and sales positions has shown a decrease in occupational risk. In the respondents’ opinion, the most desired outcome of the anticipated work automation is decreased mental strain. The last part of the article contains conclusions derived from the analysis.

WORK AUTOMATION AND ITS EFFECTS ON OCCUPATIONAL SAFETY

Contemporary trends in job automation

Based on the results of the pilot studies on employee opinions, this article presents answers to the following research questions:

- What is the current status of automation like, and what are the automation development prospects like in the short-term horizon (3–5 years)?
- Does the specific nature of the job, focused on the object (production operator) and on the customer (salesperson), have an impact on their views regarding automation (digitization) of their work?

Based on the academic literature research, it is possible to specify the main trends in job automation. Technical progress connected with the intensively growing technical possibilities of information gathering and processing, as well as development of tools used in information processing and application (software), result in new forms of work and its organization. New forms of work pertain to the use of computer programs to perform, in whole or in part, tasks at a given workstation, such as for example the processes of controlling the operation of machines and equipment.

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keeping data records and recording the phenomena [1]. It is based on the need to copy the technological process by means of human work, which results in increased efficiency [2].

Another trend in job automation is the increasing use of new technologies in organization of the work as such and in the job organization. The internet of things makes it possible to construct the said solutions that extend the scale of employee surveillance (databases, black boxes in cars, GPS, analyses of productivity and of the use of working time, etc.) to the level that enables not only full control of their functioning at the workstation, but also simultaneous enhancement of the employee motivation by exerting an influence by means of appropriate data. This is manifested by the results of research studies involving Uber drivers [3].

The aforementioned trends are analyzed at the designing as well as functioning stage, and in the process of restructuring the organization of jobs and workstations.

**Trends in changing the work-related psychophysical strain**

Labor as human activity undergoes changes as a result of progress in technology, knowledge, and culture. Onerous factors are those which may lead to decreasing the physical and mental ability of an employee.

Harmful factors, in turn, may cause poisonings, and even death. Comparison of various approaches to job design, modifying the conditions of the material environment in which the work process takes place, shows the importance of setting appropriate criteria for employees and employers [4].

Due to the transformations in the area of labor it is also worth noting that the length of occupational activity of people is being extended due to the population ageing process. Thus, the changes taking place in technology are also used at workplaces by older and older employees. The assumption that application of IT at work will help reduce physical strain and improve working conditions for mature age people is probably correct. However, on the other hand, elimination of physical strain may have an adverse effect on a human organism, e.g. leading to muscular dystrophy [5], whereas the amount of processed information and stress may contribute to increased mental strain [6].

Research studies conducted by EU-OSHA have shown that currently half of employees consider mental strain and resulting work-related stress to be a serious problem. Apart from mental health related issues, the results of stress experienced by employees include serious problems connected with physical health, which are manifested e.g. by the circulatory system diseases and complaints related to the muscular and skeletal system. The specialist literature more and more often focuses on analyzing the effects caused by stress.

**RESEARCH METHODOLOGY AND JOB DESCRIPTIONS**

**Research tools**

The research study was carried out using the originally developed questionnaire called WAQ (Workplace Automation Questionnaire) [7]. The questionnaire contains four parts with content-related questions. Part One contains data that enable computation of the time needed to perform the particular kinds of actions and tasks being part of the job. Part Two is aimed at acquiring information about the work requirements as well as organization of the studied workplace. This part also contains the employee opinion on the current level of computerization of the activities and anticipated changes in the time horizon of 3-5 years.
Part Three contains the features of Frey’s and Osborne’s concept regarding computerization of jobs. The computerization bottlenecks were then divided into subdomains. The set includes: perception and manipulation (comprising the following subdomains: finger dexterity, manual dexterity, cramped work spaces and/or awkward positions), creative intelligence (with originality and fine art) and social intelligence, comprising social perceptiveness, negotiations, persuasion, assisting and caring for others [8].

Part Four comprises employees’ evaluations of factors identified in their jobs, which may cause a decrease in their mental and physical abilities, or an injury, and which may lead to developing an occupational disease.

The questionnaire contained instructions explaining how to complete it and how to use the individual scales [7].

The research was a pilot study. It included a survey of 124 employees who filled in the provided questionnaires out of which 100 were verified as internally coherent and correctly completed. The internal coherence level was very high for the studied population, as Cronbach’s alpha ranged from 0.74 to 0.78 with regard to the job.

The following criteria were taken into account during the sampling: the organization size, the kind of job, the sector according to Clark-Fisher model, and the social/ demographic factors. Application of the multi-dimensional procedure meant multiple verification of the sampling, and 93% compliance with the adopted criteria sets was achieved [4]. Among the respondents, the dominating group were employees working in organizations employing more than 50 people, i.e. large workplaces that are outside the SME classification of the European Union [9]. Their opinions are valuable, because their workplaces are leaders in the area of work automation.

Despite the application of the qualitative method, the study is quantitative in its nature. The method of structural analysis was applied. The study involved two groups of occupational specializations, so it was possible to apply the Wilcoxon nonparametric test to determine the test statistics and verify the hypothesis. The analysis of the opinions on the future of automation was complemented with the analysis of the variance (ANOVA), whereas Kolmogorov–Smirnov test was applied to compare the distributions of the statistical variables.

RESULTS AND DISCUSSION

Selection and characteristics of the research sample

The respondents were selected on a targeted basis. The production group included 45 workers in operating positions, such as machine operators, locksmiths, dressmakers, carpenters, welders or warehouse operatives. The sales group, in turn, was represented by 55 respondents, including representatives of store-based sales (shop assistants, call center consultants, waiters, mobile phone services sellers, cashiers, mail order salespeople, etc.) and mobile sales, such as door-to-door sellers, sales representatives, merchandisers, etc.

The generic structure of actions performed in production and sales positions, as declared by the respondents, shows a larger share of actions performed manually and with the use of machines and equipment in the production group (totaling 57.3%) compared to the sales group where it accounts for 45.5% of the working time (Fig. 1). Handling the computer software takes similar amounts of time, but sales people take twice as many business-related decisions on their own (focus on managerial actions).
Transformation trends in automation

The first element being the object of the study was evaluation of the current state of automation by the respondents, and the possibilities of further computerization of their tasks in the time horizon of the next 3 to 5 years.

Table 1. Trends in automation of jobs in the 3–5 year horizon.

|                   | Production operative | Salesperson |
|-------------------|----------------------|-------------|
| Currently is      | 10.3                 | 7.1         |
| May be            | -1.5                 | 1.6         |
| Won’t be          | -1.8                 | -12.3       |

It can be inferred from the data shown in Table 1 that employees in production positions anticipate a 10% increase in application of computer software or other work automation tools in the time horizon of 3–5 years.

With regard to the “potentially (may be)” or “no such possibility (won’t be)” categories, this group showed regressive responses at the level from -1.5 to -1.8%. Employees very much appreciate solutions that replace an operator’s manual work, which increases the precision of workmanship, facilitates obtaining the required quality level, making it independent from the manual and intellectual ability of the operator.

An opposite trend can be observed in the opinions of the operating workers from the sales sector. Following a comparison of the current and anticipated future states of affairs, it can be inferred that in the next several years the employees anticipate a 7.1% increase in the possibilities of applying computer software or automation, however, the dominating opinion with a 12.3% share is the one stating there is no possibility of increasing automation in these operating positions. The expressed opinions lead to a conclusion that in this area of activity any forms of supporting the sale process and work organization were perceived by the employees negatively—as onerous and complex. Although using databases in sales management systems (quantitative and qualitative data, customer preferences, prices, etc.) was appreciated by the employees as the tools that facilitate their work, the work organization itself gave rise to a number of critical opinions. Most frequently the complaints regarded controlling the use of the working time, current activities, and the employee location (GPS).
Table 2. The statistical variables of the work automation level over the next 3–5 years, anticipated by production and sales employees.

| Data          | Mean  | N   | Std. Deviation |
|---------------|-------|-----|----------------|
| Sales         | 27.47 | 55  | 28.61          |
| Production    | 24.84 | 45  | 26.08          |
| Total         | 26.29 | 100 | 27.40          |

ANOVA Table*

|                      | Sum of Squares | df  | Mean Square | F    | Sig  |
|----------------------|----------------|-----|-------------|------|------|
| Between groups (combined) | 170.970        | 1   | 170.970     | 226  | .636 |
| Within groups        | 74157.620      | 98  | 756.710     |      |      |
| Total                | 74328.590      | 99  |             |      |      |

|                      | Eta            | Eta squared |
|----------------------|----------------|-------------|
| Data * g             | .048           | .002        |

Two-Sample Kolmogorov-Smirnov Test

|                      |                |              |
|----------------------|----------------|--------------|
| Most Extreme         | Absolute       | .105         |
| Differences          | Positive       | .079         |
|                      | Negative       | -1.05        |
| Kolmogorov-Smirnov Z | .523           |              |
| Asymp. Sig. (2-tailed) | .948          |              |

*With fewer than three groups, linearity measures for AAA * g cannot be computed

Table 2 presents the statistics for the anticipated work automation level over the next 3–5 years. The analysis of the variance (ANOVA) and Two_Sample Kolmogorov- Smirnov Test were applied in the study. They were used to check whether the distribution of the dependent variable was close to normal, without any preliminary assumption on the distribution of variables. The received data show considerable variability, which results from the fact that the study covered diversified ranges and types of work performed by the respondents. The high AS (Asymptotic Significance) value shows that it is not possible to reject the zero hypothesis that the analyzed data present the normal distribution.

Table 3. The statistics of the variables regarding the work automation level at present and over the next 3–5 years, using Wilcoxon signed ranks test.

|                      | Production |             | Sales    |             |
|----------------------|------------|-------------|----------|-------------|
|                      | N          | Mean        | Sum of Ranks | N          | Mean        | Sum of Ranks |
| Negative Ranks       | 4*         | 8.38        | 33.50     | 11*        | 18.05       | 198.50       |
| Positive Ranks       | 22*        | 14.43       | 317.50    | 27*        | 20.09       | 542.50       |
| Ties                 | 19*        | 17*         |           |            |             |              |
| Total                | 45         |             | 55        |             |             |              |

Test Statistics

|                      | Z             | Asymp. Sig. (2-tailed) |
|----------------------|---------------|------------------------|
|                      | -3.611*       | .000                   |

a opinions on the future dimension 3-5 years < opinions regarding the present dimension
b opinions on the future dimension 3-5 years > opinions regarding the present dimension
c opinions on the future dimension 3-5 years = opinions regarding the present dimension
d Wilcoxon Signed Ranks Test
e based on negative ranks

Table 3 presents the statistics of Wilcoxon nonparametric test regarding the contemporary and anticipated work automation level. The obtained results show that there are significant differences in the distribution of variables consistent with the adopted assumption. The AS values point to greater possibilities of work automation in the case of production workers rather than sales workers.

The obtained research results confirm that the studied kinds of operating positions were of heterogeneous nature. This is manifested by the varied trends in perceiving the directions of changes in automation level, expected kinds and intensity of changes, and the occurrence of conformist and introversion opinions.
Table 4 presents the results for the work automation criteria assumed in the research methodology developed by Frey and Osbourne. Three research dimensions are distinguished here. The first one covers perception and manipulation, which includes finger dexterity, manual dexterity and appropriate work space. The fast development of sensors and lasers as well as introduction of supporting solutions such as barcodes, enabled robotization of many simple and repetitive tasks. Problems with achieving at least the level of human dexterity include difficulties with object identification, cooperation with people and the environment, as well as data retrieval in atypical situations e.g. when an object falls down [8].

The second dimension covers the traits of creative intelligence, embracing originality and creative skills [10]. The contemporary concept of creativity defined as an ability to devise new ideas and artefacts is connected with obtaining reliable information that enables computer programs to create sensible combinations of ideas. Such examples are already functioning in the process of creating music, drawings or data statistics for model designing [8]. Finally, the third dimension covers the most often represented area of social intelligence, as it comprises the subdomains: power of observation, negotiations, persuasion and taking care of other people. Computerizing such tasks, despite the achievements connected with development of the Affective Computing trends [11] and social robotics [12] requires advancement of works on perception of emotions and intelligent reacting to emotions. For this reason, it is considered that this area is rather unlikely to be computerized in the next several years [8].

The research results indicate similar value levels for all domains and subdomains. Average ratings of physical capabilities (manipulation and perception) and creative intelligence were found at the level from 1.9 to 2.0. Possibilities of manual work automation were ranked higher by operating workers involved in basic operations, whereas traits of creative intelligence were more appreciated by those working in sales. This is due to the fact that a wider range of activities in sales is based on solutions that gradually minimize the human effort, such as transport, information sourcing and processing, (tele)communications, etc. Nevertheless, it is the level that does not exceed 40% of the automation possibilities. A slightly higher level was achieved for traits of social intelligence, where the possibilities of work automation almost reached 46%. The differences between the average ratings for both studied groups amount to 2% in all the domains and subdomains, which in practice means convergence of the opinions, and which confirms the reservation about the possibility of conformism in employee opinions and attitudes.
Postulated changes in employee workload as a result of automation

The respondents also expressed an opinion that work conditions in production positions would improve as a result of work automation. As shown in Table 5, both mental and physical strains suffered by employees will decrease. This will also help minimize the risk of developing occupational diseases, and—to a slight degree—the incidence of injuries, which as shown in statistics is caused mainly by the human factor.

Table 5. Employees’ opinions regarding the current state and the prospects of changing the work conditions in production and sales positions.

|                  | Production operative | Salesperson |
|------------------|-----------------------|-------------|
|                  | Now       | In the future | Now       | In the future |
| Mental strain    | 4.1       | 3.2           | 4.0       | 3.1           |
| Physical strain  | 4.3       | 3.6           | 3.7       | 3.2           |
| Injuries         | 4.2       | 3.7           | 3.5       | 2.9           |
| Occupational diseases | 3.9   | 3.2           | 3.3       | 2.9           |

The survey of the opinions on the present and future occupational risk in sales positions has shown a decrease in occupational risk. In the opinion of the respondents, the most desirable change resulting from work automation is reduction of mental strain. Next, as shown in Table 2, they expect a reduction in physical strain, a partial reduction in incidence of occupational diseases and a slight reduction in incidence of injuries.

CONCLUSIONS

Despite its pilot character, the research study shows a number of interesting aspects regarding processes and outcomes of job automation in production (in a broad sense). It describes, on the one hand, production workers, and sales positions (sales workers) on the other, which in aggregate pertains to core operations workers. The research results make it possible to answer the question: What is the current status of automation like, and what are the automation development prospects like in the short-term horizon (3–5 years)? These results have shown upward trends in work automation levels over the time horizon of 3–5 years: from 48% to 57% in production operator positions, and from 49% to 58% in sales positions. This means that a specific state of convergence was achieved, concurrently showing the perceived possibilities of growth in the short-time perspective of 3 to 5 years.

This growth is achievable due to expected fast changes in the organizational and technical forms of sales. The fast growing e-commerce also leads to regressive opinions. The employees anticipated that in the time horizon of the next 3–5 years the automation rate should decrease by 12%, which will make it possible to constrain redundancies. This provides the answer to the following question: Does the specific nature of the job, focused on the object (production operator) and on the customer (salesperson), have an impact on their views regarding automation (digitization) of their work? The emerging trend of unification of views makes it possible to formulate an opinion that regardless of whether the job is focused on the object (production operator) or on the customer (salesperson), this does not have an impact on the workers’ views regarding automation (digitization) of their work.

Job automation in production and sales was perceived by the respondents as a possibility of improving the work conditions in terms of reducing the occupational risks. Reducing the level of mental and physical strains as well as the incidence of injuries and occupational diseases does not make the employees aware that the
process in the future may lead to elimination of humans from the work process. Few people think that in the time horizon assumed for the study their jobs might be liquidated.

The presented research study results indicate that the above described processes of changes related to the employees’ situation, their position in a workplace or their conformist attitudes are not accompanied by the employees’ awareness of increased mental strain caused by information pressure. Also the convergence of automation anticipations, which was shown in the study, requires more detailed research. Both issues are the basis for taking further, more systematic and complex, multidirectional research studies on the directions and outcomes of automation, especially in the context of Industry 4.0 concept [13].

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