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Influence of the Characteristics of Young Logisticians on the Level of Acceptance of Work in an Automated and Robotic Environment – A Survey Study

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Abstract:

Purpose: *Analysis of the impact of selected characteristics of young logisticians on the acceptance level and the level of anxiety related to working in an automated and robotic environment.*
Design/Methodology/Approach: *The study was conducted using a questionnaire in which the questions were divided into two main sections. The first section was used to identify the individual characteristics of the respondents, the second section concerned the direct relation to work in an automated and robotized environment.*
Findings: *Logistics students point to more positive aspects of using automated solutions and robots than negative ones. There are also features of these people determining the level of acceptance and the level of fear of working in an automated and robotized environment.*
Practical Implications: *Knowledge of the features that predispose an employee to work in automated and robotic systems will allow for more effective recruitment and training, which will give a chance in an increase in the efficiency of processes.*
Originality/Value: *The conducted research completes the research gap in the form of the lack of research on the relationship between the characteristics of young logistics professionals and the level of their acceptance of work in an automated and robotized environment.*

Keywords: *Logistics 4.0, sustainable development, acceptance of work in a robotized environment.*

JEL codes: *J21, J24.*

Paper Type: *Research paper.*

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1. Introduction

The development of automation and robotization technologies and the pressure to reduce costs mean that industry 4.0 solutions are increasingly used in logistics processes. Effective implementation of technology is possible only if employees are able to cooperate with it. This is also reflected in the postulates of sustainable development. They also pay attention to the social dimension of work and its acceptance by employees.

The main aim of the study is the analysis of the impact of selected characteristics of young logisticians on the acceptance level and the level of anxiety related to working in an automated and robotic environment. In order to achieve this goal, it is necessary to achieve the auxiliary goal, which is to identify the opinions of people studying (at a higher level - EQF 6) in the field of logistics about working in an automated and robotic environment (cooperation with robots).

The authors also developed a research hypothesis, as, there are features of young logisticians determining the level of acceptance and the level of fear of working in an automated and robotic environment. The hypothesis will be verified using statistical methods based on the results of the survey.

2. Industry 4.0 & Logistics 4.0

The term Industry 4.0 originated from a German government project in 2011. In this project Industry 4.0 was referred to as such “the fourth industrial revolution in manufacturing and industry and the growing intersection of people, new technologies and innovation”. Nowadays, the term Industry 4.0 is often shortened to I4.0 or just I4. In the literature review, the term Industry 4.0 listed many components and applications of Industry 4.0. Based on Adamczak *et al.* (2019), Chen *et al.* (2017), Culot *et al.* (2020), Ghobakhloo (2018), Hermann *et al.* (2016), Hossain and Muhammad (2016), Ivanov *et al.* (2016), Kagermann *et al.* (2013), Kamble *et al.* (2020), Kang *et al.* (2016), Kolberg *et al.* (2017). Kosacka-Olejnik and Pitakaso (2019), Lasi *et al.* (2014), Li *et al.* (2020), Müller, Buliga, and Voigt (2018), Oesterreich and Teuteberg (2016), Pfohl *et al.* (2015), Posada *et al.* (2015), Ramirez-Peña *et al.* (2020), Sadeghi *et al.* (2015), Schmidt *et al.* (2015), Stachowiak *et al.* (2019), Szajna *et al.* (2020), Tiwari and Khan (2020), Thoben *et al.* (2017), Vogel-Heuser and Hess (2016), Xu *et al.* (2018), Wan *et al.* (2016), Wollschlaeger *et al.* (2017), Wu *et al.* (2013), Zawadzki and Zywicki (2016), Zhong *et al.* (2017), there are many applications of Industry 4.0, the main are as follows:

- Advanced robotics. Especially these robots that can carry out the tasks autonomously, exchange information with other robots and other devices to cooperate. Modern robots are usually equipped with numerous sensors. To easier the staff operating the devices. It is common to use standardized interfaces.

- Additive manufacturing. Using 3D printers to create in small scale spare parts and/or prototypes but also using 3D printers in bigger scale building houses.
- Augmented reality. Usually, in this application of Industry 4.0, special glasses or smartphones are used. Viewing different objects through these devices can display additional information e.g. best before date, weight, destination, to-do list. Augmented reality is commonly used in maintenance, logistics, warehouse, production departments.
- Simulation. This part can use artificial intelligence and automatic/manual tests to illustrate e.g. the workflow of items in the production area. Simulation is often used to lower the costs of testing because it can check many variations faster and does not need to rebuild the real environment to verify the simulation. Using artificial intelligence can lead to out-of-the-box solutions. Simulation can be run not only before making decisions but can also support decision-making processes in real-time.
- Horizontal/vertical integration. Creating transparent supply chains in addition to data integration between companies is the basis for a fully automated value chain, from supplier through shops, delivery, and finally to customers. Integration can refer to systems and data standards in the cross-companies networks.
- Industrial Internet. That Network enables communication and sharing data between objects i.e., machines and products. This data can also be shared with managers.
- Cloud. Containing a huge amount of data, that can be accessed, based on restrictions, from within the company or any place on the Earth is a must-have for companies right now. Cloud computing also provides real-time communication.
- Cybersecurity. In many cases, our data is more valuable not even for us, but our competition. Any leak of data can cause significant loss of trust from our partners, economic loss, and even shutting down of the whole company.
- Big data and analytics. Having a lot of data is not enough to decide. All systems can give raw data that needs to be analyzed first in the decision-making process. In this application of Industry 4.0, it is common to use self-learning algorithms and artificial intelligence to support and optimize the analysis process.

In this article, authors are mainly focused on a part of Industry 4.0 – Logistics 4.0. Logistics 4.0 refers to supply chains, production, delivery, customer care channels, and warehouses. Integrating supply chain logistics leads to transparent supply chains that are open and flexible for the market (Bateman and Bonanni, 2019). Supply chains, in Logistics 4.0, need to be globally planned and controlled. Big data and analytics are used, in Logistics 4.0 in predicting inbound logistics to make the management inventory more suited for the needs of customers. Inventory management needs to be autonomous, however certain areas can be managed manually, it depends on economic profits. In Logistics 4.0 there is a trend of rejecting local warehouses for creating supply chain warehouse networks, that is not local but rather regional. In warehouses or production departments, the delivery is autonomous, using real-time designed routes steered by production machines.

Delivery to customers is evolving from, most common nowadays, active delivery management, where customers' orders are input to start the manual delivery through automatic delivery, where most tasks are assigned to robots or autonomous vehicles to predictive delivery management, where based on simulation, big data analytics, and evolution algorithms companies can anticipate orders from customers few days forward. Moving on to logistics routing, similar to using autonomous vehicles in production and warehouse departments, also autonomous transportations vehicles and equipment are used (Fechner and Szyszka, 2018).

3. Sustainable Development

The second area of research in this article focuses on sustainable development, especially the social aspect. UN has listed 17 goals toward sustainable development.

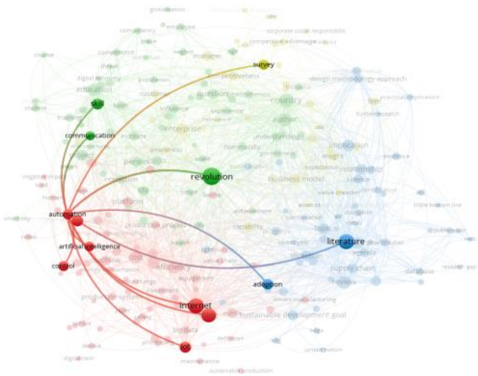
In this article main focus will be on the industry in terms of factors influencing employees working with automated logistics systems, and how does the personality of employees affects their attitude to technology in the workplace. It is also connected with decent work. According to the UN in terms of Employment, decent work for all and social protection, is Sustainable Development which aims to *"promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all"* (https://sdgs.un.org/topics/employment-decent-work-all-and-social-protection).

It mainly concerns "the need of generating employment for vulnerable groups, specifically women, urban poor, unemployed rural labor as well as low-income urban residents." However, Industry 4.0, especially Logistics 4.0, and sustainable development for employees working with automated logistics systems are left on their own. Authors suggest that in sustainable development also the employees that are working for robots should be taken care of.

4. Literature Analysis Conclusion

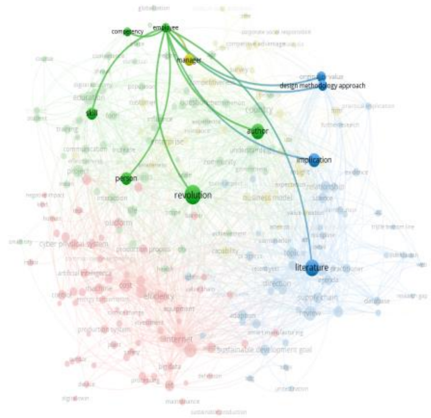
As a summary of the literature analysis, it can be noted that there is no direct link between automation (Figure 1) and employee (Figure 2) or sustainable development (Figure 3) in the relationship. One shared part is the term revolution, referring to the Industrial Revolution 4.0. The term related to an employee in the context of literature analysis is related to competencies and abilities, which largely reflects the need to acquire new skills to adapt employees to work in an automated environment. This is confirmed by the connection from the point of view of automation, which is also linked to skills. Revolution (Figure 4) as the most general term is connected with the employee, competencies, education, skills, sustainable development, and automation. Based on literature analysis, it can be concluded that there is a research gap in the form of the lack of research under the industrial revolution, logistics 4.0, and the development of employees in terms of ability to work in an automated environment while maintaining sustainable development, especially the social aspect.

Figure 1. Links from automation term



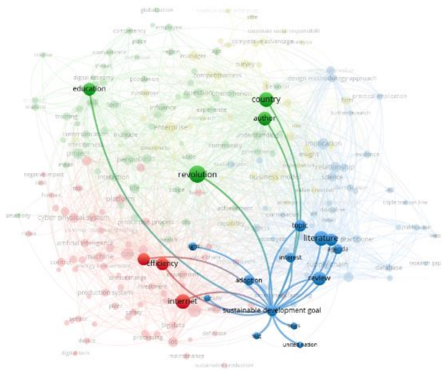
Source: *Own creation. (VOSviewer)*

Figure 2. Links from employee term



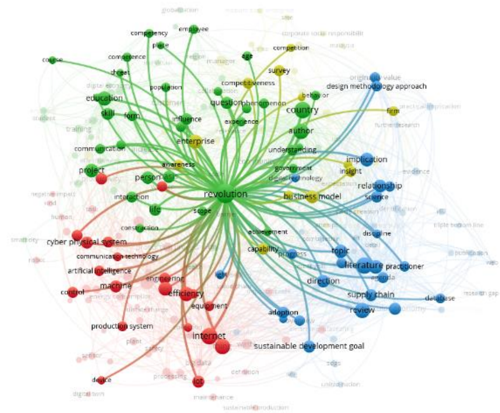
Source: *Own creation. (VOSviewer)*

Figure 3. Links from sustainable development goal term



Source: *Own creation. (VOSviewer)*

Figure 4. Links from revolution term



Source: *Own creation. (VOSviewer)*

5. Methodology of the Study

The survey was conducted in Poland in May and June 2021 among people studying in the field of logistics and related fields (age 20-23). The selection of the surveyed population was intentional and took into account the fact that in the near future it will be people of this generation who will decide on the use of technology in logistics processes. Assuming the population size at the level of approx. 65 000 - the number of students (on logistics and similar fields of study) in Poland in 2017 (Fechner and Szyszka, 2018; Logistics in Poland 2017 - report), the significance level at $\alpha = 0.05$ and the permissible error at the level of 10%, the research sample size was 86 people. The characteristics of the research sample are presented in Table 1.

Table 1. *Research sample characteristics*

Characteristics of young logisticians	Leyers	n	%
Gender	Female	41	47%
	Male	46	53%
Did you cowork with robots?	Yes	12	14%
	No	75	86%
For what purpose do you use electronic devices and the Internet (more than one answer possible)	Entertainment	84	97%
	Work/School	87	100%
	Shopping	81	93%
	Contact with freinds	86	99%
	Official matters	60	69%
How often do you buy online:	On average once a week or more	9	10%
	Several times a month on average	52	60%
	Several times a year on average	24	28%
	About once a year or less	2	2%
Do you use electronic banking:	Yes, both via a computer and a mobile application	63	72%
	Only via the mobile application or via a computer	21	24%
	I don't use it	3	3%
Do you use social media and messagers (except SMS):	Yes, I have accounts on various social networks (messengers) and I use them continuously	68	78%
	Yes, I have an account on one social network (messenger) and I use it extensively	18	21%
	Yes, I have an account on a social network (messenger) but I rarely use it	1	1%
	I don't use it	0	0%

Source: *Own creation.*

The aim of the survey was to identify the opinions of people studying (at a higher level - EQF 6) in the field of logistics about working in an automated and robotized environment (cooperation with robots). In line with the research methodology developed, the respondents were not asked about it directly. Five indicators of positive and negative effects of work in a robotized environment were defined. The respondents answered each of the questions using the seven-point Likert scale. Positive opinions on robotization:

- Automatic machines will relieve us in work that requires strength or monotonous work;
- Artificial Intelligence makes better decisions because it is emotion-free;
- The use of automated solutions and robots is beneficial for the environment;
- The use of automated solutions and robots is the only option in the further development of enterprises;
- Thanks to automation and robotization, completely new possibilities of using the skills of employees arise.

Negative opinions on robotization:

- Working in an automated environment and with robots deprives you of contact with other people, which is so necessary at work;
- Robots can be dangerous and pose a threat to health and life;
- It is difficult to trust decisions made by algorithms;
- Working in an automated environment is much more difficult than in a traditional environment;
- People will lose their jobs through automation and robotization.

Based on the answers to the above questions, the degree of positive attitude to cooperation with robots (degree of technology acceptance) and negative attitude (degree of fear of technology) was determined. Both indicators could range from 5 to 35 (5 questions on a seven-point Likert scale).

6. Survey Study

The analysis of the results began with the measurement of the internal consistency of the questionnaire (Cronbach's alpha). Cronbach's alpha was 0.5873 for questions about positive attitudes (acceptance level) and 0.6175 for questions about negative attitudes to working with robots (fear of technology). Cronbach's alpha is low but allows further analysis of the results. In the next step of the analysis, the normality test was made. For this purpose, Anderson Darling's tests were carried out. Assuming the significance level ($\alpha = 0.05$), it was shown that the distribution of positive opinions is not normal (p-value <0.005), while the distribution of negative opinions has a normal distribution (p-value $= 0.085$).

Due to the lack of normal distribution in all results, the Kruskal-Wallis test was used to compare the attitude to cooperation with robots. The test result showed that among the tested sample, positive opinions on robotization and automation of the work environment prevailed (median 22 for positive opinions and 20 for negative opinions).

To achieve the aim of the study, a more detailed analysis of the results and comparison of groups (groups developed on the basis of the layers of the studied sample) are necessary. After finding that the distribution of the variable is normal (in the case of negative opinions), it is necessary to check the variance to see if the variances of the samples are equal. Comparing variances was made with the Bonnett test. The test results (assuming a significance level of $\alpha = 0.05$) are presented in Table 2.

Table 2. *Results of the study of the variance of the results*

	Gender	Did you cowork with robots	For what purpose do you use electronic devices…	How often do you buy online	Do you use electronic banking	Do you use social media and messagers…
Test type	Bonett's test	Bonett's test	Bartlett' test	Bartlett' test	Bartlett' test	Bartlett' test
Test result	The variances are equal	The variances are equal	The variances are equal	The variances are equal	The variances are equal	The variances are equal

Source: *Own creation.*

Checking the variance of the samples allows the selection of a method for testing statistical hypotheses. Based on the results of positive and negative opinions regarding work in an automated and robotized environment, it was checked whether the degree of acceptance and fear were related to the selected characteristics of young logisticians. The results of hypothesis testing are presented in Table 3.

Table 3. *Hypothesis testing results*

		Gender	Did you cowork with robots	For what purpose do you use electronic devices …	How often do you buy online	Do you use electronic banking	Do you use social media and messagers …
Positive opinion	Test type	Mann-Whitney	Mann-Whitney	Kruskal-Wallis	Kruskal-Wallis	Kruskal-Wallis	Kruskal-Wallis
	p-Value	0.402	0.882	0.250	0.012	0.094	0.094
	Test result	no impact	no impact	no impact	impact	no impact	no impact
Negative opinion	Test type	t-test	t-test	Anova	Anova	Anova	Anova
	p-Value	0.660	0.033	0.804	0.730	0.802	0.586
	Test result	no impact	impact	no impact	no impact	no impact	no impact

Source: *Own creation.*

As a result of the conducted analysis, it can be concluded that only experience with working in an automated environment and the frequency of online shopping have an impact on the degree of acceptance (positive opinion) and the level of fear (negative opinion).

7. Conclusions

The conducted research allowed to state that people studying logistics see more positive aspects of the use of automatic solutions and robots than negative ones. Thus, the level of acceptance of the use of these technologies in logistics processes is higher than the level of anxiety. Due to the study was conducted on a representative sample, it allows us to state that soon logisticians with a positive attitude to logistics 4.0 solutions will appear on the labor market.

The research also allowed to verify the hypothesis, *"There are features of young logisticians determining the level of acceptance and the level of fear of working in an automated and robotized environment".* Features that have a significant impact on the perception of the possibility of working with robots are, the frequency of online purchases and previous experience of working in such an environment. People who shop online very often (on average once a week or more often) are characterized by the greatest enthusiasm for working in an automated and robotic environment. People who have already worked there see more negative effects of working in an automated and robotic environment than those who do not have such experience. These people still remain advocates of these technologies, but see more negative effects.

The limitations of the conducted research should be considered in two dimensions, a limited number of features characterizing the group of young logisticians and including into study only people studying at the EQF6 level.

The direction of further research will be related mainly to the extension of the set of characteristics of people who express their opinion on working in an automated and robotized environment. By distinguishing a larger number of features (including personality traits), it will be possible to identify the relationship between specific features and the level of acceptance of cooperation with robots.

The results of these studies are particularly important in the context of shaping the human resources of logistics companies willing to use the solutions of Industry 4.0 and Logistics 4.0. Knowledge of the features that predispose an employee to work in automated and robotic systems will allow for more effective recruitment and training, which will give a chance to an increase in the efficiency of processes.

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