

The Adaptation of the Logistic Industry to the Fourth Industrial Revolution: The Role of Human Resource Management

Author(s)

Parham, Shohreh; Tamminga, Harm-Jan

Publication date

2018

Document Version

Final published version

Published in

Journal of Business Management & Social Science Research

License

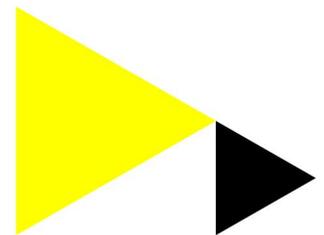
CC BY

[Link to publication](#)

Citation for published version (APA):

Parham, S., & Tamminga, H-J. (2018). The Adaptation of the Logistic Industry to the Fourth Industrial Revolution: The Role of Human Resource Management. *Journal of Business Management & Social Science Research*, 7(9), 179-191.

<http://borjournals.com/a/index.php/jbmssr/article/view/2493>

**General rights**

It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations

If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please contact the library: <https://www.amsterdamuas.com/library/contact/questions>, or send a letter to: University Library (Library of the University of Amsterdam and Amsterdam University of Applied Sciences), Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.



The Adaptation of the Logistic Industry to the Fourth Industrial Revolution: The Role of Human Resource Management

Shohreh Parham, Assistant Professor of HRM, Management and Economics, Amsterdam School of International Business, Amsterdam, Netherlands

Harm-Jan Tamminga, BSC, Management and Economics, Amsterdam School of International Business, Amsterdam, Netherlands

Abstract

The world is on the verge of the fourth industrial revolution that will considerably influence society and human life. Today human being is surrounded by technological advancement and every day we face new sophisticated technological systems that affect our daily lives. The business environment is being influenced by Industry 4.0 significantly and a massive transformation in labour market can be observed. The digital economy has become a disruptive factor in several sectors and it has shown a major impact on the logistic industry in terms of workforce transformation. The question that arises is that to what extent the logistic sector is ready for the digital transformation in Industry 4.0 and what factors should be considered by industry players, governments and multi-stakeholders in order to simplify workforce transformation. This study followed a qualitative approach using Grounded Theory to explain the phenomenon of workforce transformation within the logistic sector in Industry 4.0. Furthermore, a literature review was used to explain the role of human resource management in simplification of this process. The findings show that there is a lack of adequate awareness about the impact of the digital transformation on labour. Furthermore, it discusses the role of human resource management as an agent of change in Industry 4.0. The current research presents recommendations for different stakeholders on how to prepare the current and future workforce for the upcoming changes. This study is significant in the sense that it will add to the existing literature and provide practitioners with vital information that can be used to simplify the digital transformation of logistic industry by preparing labor market.

Keywords: Digitalization, Logistic Industry, Industry 4.0, Human Resource Management, Workforce Transformation

Introduction

Today human being is surrounded by technological advancement and every day we face new sophisticated technological systems that affect our daily lives. The business environment is being influenced by Industry 4.0 significantly and a massive transformation in labour market can be observed. The digital economy has become a disruptive factor in several sectors and it has shown a major impact on the logistic industry in terms of workforce transformation.

The new technological developments in logistics are considered as an important phenomenon due to many expectations these developments have caused. It is expected that the digital transformation of logistics and transportation processes result in cost reduction as well as social and environmental improvements (Caballini, Sacone & Saeednia, 2016; Kuhlmann and Klumpp, 2017). For instance, autonomous driving is one of the major outcomes of the digital transformation in road transportation and global supply chain which is believed to cause a significant economic growth as well as environmental sustainability (Rodriguez-Castano, Heredia & Ollero, 2016; Bazilinsky and de Winter, 2017). Although the upcoming changes will greatly affect work-

force (e.g. truck drivers), there is hardly any attention is being paid to preparing current and future workforce for new technological developments. Technical and economic aspects of the fourth industrial revolution are significantly addressed in research papers, however the impact of this revolution on labor is not adequately discussed (Koo, Kwac, Ju, Steinert, Leifer & Nass, 2015; Klumpp, 2017). The question that comes to mind is how can executives prepare current and future workforce for the digital transformation in logistics? What is the role of external and internal human resource management in an effective workforce transformation?

This study applies a qualitative approach using Grounded Theory to explore and explain the features of workforce transformation within the logistic sector in Industry 4.0.

Literature Review

Despite the digitalisation in logistics and production processes, it is still important to have the human factor present, as human beings have superior cognitive and sensorimotor skills in comparison to machines (Becker, 2015; Günthner, Klen and Tenerowicz-Wirth, 2014). Also, human beings have the ability of association, which makes it easier to react on modifications and to be



reskilled to other tasks (Schließmann, 2014). On the other hand, it is expected for the worker requirements to change based upon the technological advancements. Becker (2015) argued that the way humans and machines interact will have to be redefined, and that work tasks and processes will change. It is expected that in the future there will be work contents with high technological and IT-specific requirements, as well as work for low qualified workers (Becker, 2015; Tödter et al., 2015). Hirsch-Kreinsen (2015) pointed out that working places with low qualification requirements and easy, repetitive work will be substituted by machines, and that higher qualified workers will only be needed in decision-making and controlling functions. Nevertheless, the requirements for such workers will also change due to the increased complexity of the new activities. Therefore, it is vital to emphasize the role of human resource management in simplifying the digital transformation of logistics sector and identify the key factors that should be considered by multi-stakeholders including governments, policymakers and executives in preparing the workforce for the digital transformation in the sector as well as protecting them against the negative effects of the fourth industrial revolution. To achieve this objective it is of crucial importance to understand the drivers of Industry 4.0 and the process of adaptation of logistics industry to the fourth industrial revolution as well as its implications for the labour.

Drivers of Industry 4.0

Morrar, Arman and Mousa (2017) related Industry 4.0 to the “smart factory”, a concept that is a virtual copy of the physical world, and where the physical systems can cooperate and communicate with humans. The concept of Industry 4.0 finds its origins in Germany, but over the years other leading nations have started to recognize, albeit under different names such as “Connected Enterprise” in the United States, or “The Fourth Industrial Revolution” in the United Kingdom. Industry 4.0 builds upon the three preceding industrial revolutionary transformations: steam power, electricity, and the era of computer beginning (Cordes & Stacey, 2017).

To understand the impact of Industry 4.0, it is advisable to first understand what drives the current developments. Schmidt, Möhring, Härting, Reichstein, Neumaier and Jozinovic (2015) conducted a quantitative research in the DACH region and collected data through performing a survey questionnaire among Information Technology specialists (n=133) to explore the drivers of Industry 4.0. The results disclosed that the main drivers of Industry 4.0 are mobile computing, cloud-computing, and Big Data. However, as stated by Schmidt et al., “the importance of cloud computing and mobile computing for Industry 4.0 lies not so much in providing scalable compute capacity, but rather in the provision of services,

which can be accessed globally via the Internet” (2015, p5). The collection of data, on the other hand, is something that has been going on since before the rise of the internet and has been growing over the years, resulting in a phenomenon called Big Data (Chen, Chiang and Storey, 2012)

Oguro (2016) described Big Data as the key to achieving success in the Industry 4.0 initiative. The development is key to the development of Artificial Intelligence (AI), as AI will be programmed based upon amounts of data from the past. He further stated: “AI, Big Data analysis, 3D printers, robots, and all such contemporary high technology products are based upon data sets. Their active application in a wide range of business and life purposes would mean “data” rule the world, and this is what we call the Data-based Industrial Revolution” (2016, p24).

In a study done by Sauter, Bode and Kittelberger (2015) the potential benefits of Industry 4.0 were identified. These include cost reduction, flexibility, stability/ quality assurance and increased turnover. Findings of this study show that “the possibility of cost reduction” is the main driving force, which is mainly expected to be achieved through an improved efficiency. Increased flexibility is another expected outcome of Industry 4.0 which will lead to higher customer satisfaction. It is expected that the upcoming technological developments lead to an increased turnover and profitability in the long run. The question that arises here is as to what extent each sector will be affected?

The focus of current study is on logistics sector and the impact of Industry 4.0 on logistics processes as well as workforce. Human Resource Management plays a crucial role in simplifying the process of adaptation of logistics to Industry 4.0 through preparing current and future labour. Still, it is vital to understand how the on-going changes and trends in the logistics are perceived by industry players. Are they ready for the digital transformation?

Trends in Logistics and the Emergence of Logistic 4.0

The current trends in the logistics processes can be categorized in three different areas: IT and software, robotic and sensor technology, and networking. The combination of those three elements builds the foundation for trends in the logistics industry, which can be structured and distinguished in further categories (Kuhlmann & Klumpp, 2017). This section aims to identify how the trends can be categorized, and how they are perceived by relevant players in the industry.

Zijm and Klumpp (2017) structure the technological trends in four categories: business process management,



competitive advantage, strategic management, and network structure. Business process management focuses on the management of activities that aim for output supply, such as reverse logistics. Competitive advantage entails all innovations that can distinguish companies from their competitors, such as information technology or sustainability. Strategic management involves all aspects of efficiency and efficient resource allocation, such as human resources. Lastly, network structure contains information that can enhance collaborations, either horizontally or vertically, such as supply chain integration.

A further distinction between global trends, basal trends, customer trends, and economic cycle trends is made by Kuhlmann and Klumpp (2017). Global trends can be globalization or corporate social responsibility (CSR), whereas basal trends focus more on the technological and organizational developments. Customer trends involve the trends in services, such as mass customization, and economic cycle trends, lastly, there are trends like GDP or demand cycles.

DHL (2016) make a distinction between social & business trends on the one hand, and technology trends on the other. Social & business trends focus on trends that satisfy the public, such as fair & responsible logistics, or on-demand delivery. Technology trends, on the other hand, are focused on trends such as augmented reality, or self-driving vehicles. Such technology trends could offer a wide range of support in the logistics sector, such as autonomous forklifts or driverless trucks. However, those trends would then also create new aspects regarding safety, efficiency and quality (DHL, 2016; zijm & Klumpp, 2017).

Other researchers narrow the topic down to specific technological developments and describe how the industry expects certain developments to work out and how they could influence companies. In a study by Dills (2018), the focus is on the blockchain, a high-demand technology that not many know what it means. He argued that blockchain will have significant impacts on logistics, from which it could be referred to the use of "smart contracts", which will eliminate the necessity of an attorney. Eliminating the third-party in such contracts would generate substantial financial benefits for both parties. The blockchain could also help carriers by including information on insurance, inspection data, and other relevant information for transactions.

Exploratory research on the effect of Industry 4.0 on the logistics industry has been performed by Hofmann and Rüsç (2017). Their focus was to investigate the background of Industry 4.0, and to identify the key components of Industry 4.0. Additionally, they investigated potential implications on the management of logistics. In this study four components of Industry 4.0 were identi-

fied such as Cyber-physical systems (CPS), Internet of things (IoT), Internet of services (IoS), and Smart factory. CPS is described as systems that can bring the digital and physical world together. "In the manufacturing context, this means that information related to the physical shop floor and the virtual computational space are highly synchronised" (p24). IoT is one of the initiators of Industry 4.0 and holds, compared to conventional internet, significantly higher amounts of network nodes. IoS holds the thought that, like the IoT, services can now also be transformed into an IoS, where services will be easily accessible through web technologies. Finally, smart factory is seen to be the link between all three previous components. The link between CPS, IoT, and IoS results in a smart factory, which holds the idea that humans can communicate with machines and resources as if they are part of a social network.

Several researchers have studied the impact of Industry 4.0 on Logistics and discussed challenges as well as opportunities. However, there is hardly any attention being paid to the impact of mentioned technological development on workforce and the role of human resource management in simplifying this transformation. The next section will discuss the implications of the emergence of Logistics 4.0 for workforce.

Implications of Logistics 4.0 for Workforce

Considering the ongoing trends in logistics processes, it is of crucial importance that organizations reassess their training systems to prepare workforce not only for working with new technologies but also dealing with the new context in which the physical internet and or Cyber-Physical-Systems are its main features (Zijm and Klumpp, 2017). Despite the rapid pace of technological developments in logistics and digitalization of production and processes, still human factor plays a key role (Becker, 2015). Cognitive and sensorimotor skills of human beings as well as their creativity and problem-solving capabilities make them a superiority compared to machines. Therefore they will be still needed in the future context of Cyber-Physical-Systems (Günthner et al., 2014). Schließmann (2014) argued that a machine can only accomplish what it is made for although with high accuracy and faster than humans still human beings are superior to machine due to their ability to adapt to a new environment and respond to changes.

Still it is important to consider that in the future employees will work in an environment in which human-machine interactions will take place. The question that comes to mind is that which tasks humans will be responsible for? Kuhlmann and Klumpp (2017) believed that planning, controlling, managing and scheduling activities will still be the responsibilities of human beings. However, the nature of works, tasks, work processes and workplace conditions will considerably change. Moreo-



ver, job requirements will change which means that human resource departments should not only rethink their training systems to prepare the current workforce but also develop a concrete plan for preparing the future workforce.

According to Tödter, Viereck, Krüger-Basjmeleh & Wittmann (2015) although more jobs will require employees with high technological and IT-specific capabilities, there will still be jobs for low-skilled workers. Jobs with manual and routine tasks will be done by machines while monitoring activities will be the responsibility of employees. Hirsch-Kreinsen (2015) pointed out that the main problem for low-skilled employees in the future working environment is how to deal with interference. This problem can be solved if workers possess both theoretical knowledge and practical experience.

As the nature of jobs will change due to increased complexity and decentralization of decision making processes as well as coordinating activities, high-qualified workers will need to meet the requirements of the new context. Employees will need to demonstrate good knowledge of all processes as well as social competences which results in a high integration of different working teams (Kuhlmann and Klumpp, 2017). Therefore it is of crucial importance that organizations emphasize the role of human resource department as a change agent which helps employees not only to understand the purpose of digital transformation but also learn to properly respond to the upcoming changes. To achieve these objectives human resource departments of companies will need to reformulate their HR policies in order to prepare workforce for the aforementioned changes.

Research Methodology

The purpose of this study is to explain the phenomenon of adaptation of logistics sector to the fourth industrial revolution with the significant influence of human re-

source management on the process. Therefore the current study used a Grounded Theory (GT) approach for explaining the phenomenon and a literature review to disclose the role of human resource management in this case. Data collection was performed through in-depth interviews with logistics experts and literature review.

GT was developed by Glaser and Stratus (1967) as a research strategy. It is a systematic approach in qualitative research that involves development of theory in order to explain a phenomenon (Glaser, 1992; Alan, 2003). In using GT approach, new theories could be generated through applying analytical strategies to the research therefore researchers should avoid using the existing literature as a theoretical background to explain the phenomenon under investigation (Gibbs, 2008; Creswell, 2012, Parham 2017).

Sampling method for this research was judgmental sampling and experts in fields of logistics were chosen to participate in an in-depth interview with the researcher. The reason for using judgmental sampling method in this study was the necessity of possession of specific knowledge by interviewees that can accurately explain the phenomenon.

Findings of these interviews are presented under four different themes, including: drivers of Industry 4.0, trends in logistics, workforce transformation and roles and responsibilities in preparation of workforce. Table 1 shows the positions of the participants in the in-depth interview.

After interviewing these experts and based on their perception of the digital transformation of logistics a critical review of literature was done in order to explain the key role of human resource management in simplification of this transformation.

Table 1: Positions of participants in the interview

Country of Origin	Career in Logistics	Academic Position
Kuwait (R1)	X	X
Poland (R2)	X	X
Germany (R3)	X	X
Germany (R4)	X	X
Netherlands (R5)	X	X
Netherlands (R6)	X	X
Palestine (R7)	X	X

In the next section, first the phenomenon of digital transformation of logistics will be explained and then the role of human resource management in the process

will be discussed.



Results And Findings

Digital Transformation of Logistics

To understand and explain the phenomenon of digital transformation of logistics, seven experts in logistics were interviewed. The results and findings are presented under four different themes.

Drivers of Industry 4.0

Through personal interviews, experts of the industry were asked to describe what drives the technological change in Industry 4.0 considering the fact that technical change happens through both a “technology push”, as well as through a “demand pull”.

Technology Push

The technology push concept is believed by some to be the main driver of Industry 4.0. Within this concept, the technologies such as Big Data, Internet of Things, and Artificial Intelligence are widely recognized. *“The push category is the one that is mostly happening right now, as it consists of technologies such as Big Data, Artificial Intelligence, Internet of Things, etc. Such technologies push change and are therefore important drivers of the Industry 4.0 (R1).”* Additionally, one respondent named the growth of internet related technologies. *“One of the drivers is the fast growth of ICTs (basically internet) in the last two decades (R7).”* What is also recognized is the fact that the logistics sector might be further ahead than different sectors, which leads to the implementation of new technologies, as the industry is ready for it. *“Artificial Intelligence, through Big Data, drives Industry 4.0 as well. I believe logistics is further ahead than many different industries and is therefore already ready to implement those technologies (R5).”* Other respondents take a wider angle, and discuss the concepts of cloud technology, robotics, and other technological changes. *“In my opinion the most important drivers are technological development solution: big data analytics, cloud technology, autonomous robots, virtual reality, industrial use of the Internet of things, cybersecurity (R2).”*

Demand Pull

On the other hand, respondents believe in the demand-pull of Industry 4.0. Some account the demand-pull as a demand for higher productivity. *“It can be observed that productivity growth has slowed down over the past years, and that especially Western Europe suffers from that. An industrial revolution is therefore needed (R1).”* This higher productivity would then be achieved through efficiency. *“The main driver is efficiency. And efficiency happens through blockchain and IoT (R6).”* Others see a shift in the mind of the consumer and observe a demand for more flexible production. *“In my opinion, the high cost of labour is the main driver, especially in Western Europe. It calls for a change in technology, and therefore drives Industry 4.0. Additionally, the demand for a*

low delivery time and flexibility calls for change (R5).” *“I think it is driven by customers. New players on the market see the need from the customers, and I believe that drives change, especially in logistics (R3).”* *“The growth demand for high-individualized products and services which push industries to use new innovation and applications, mainly in logistics (R7).”* One of the respondents clearly states the demand pull in logistics and draws a line between the need for flexible and customizable production and logistics. *“I believe the main driver is the need for individualisation, customisation, personalised manufacturing. If customization is key, you cannot store all products around your manufacturing line, and that is where logistics comes into play. You need to adapt your logistics to the manufacturing, and these two should work together as a combination. That is why logistics is an essential part of Industry 4.0. If you want to become more flexible in production, you also need to change logistics and the role of logistics (R4).”*

It can be observed that the experts in the logistics industry believe there to be both a technology-push, as well as a demand-pull that drive the technological advancements of Industry 4.0. The technology-push could be enhanced through policies such as government sponsored R&D, or tax credits for companies that invest in R&D. On the other hand, demand-pull could be stimulated through rebates for consumers of new technologies, regulatory standards, or through taxes on competing technologies.

Trends in logistics

This section discusses the view of the respondents on the expectations and trends of logistics sector in Industry 4.0. These trends can be observed in the industry, on the job market, but also within the technologies itself. Some experts see the biggest trends in the industry, and especially in the customer demands. *“I mostly see the trend of customers demanding higher amounts of flexibility (R5).”* *“Building a car is hardly connected to sensor technology, but knitting a customizable shoe, such as Nike, is suddenly about involving the customer in the building process. It is about flexibility, and then IT is one of the major issues. Flexibility and customization is therefore the biggest trend, and that automatically connects to technologies that can reveal information, but still guarantee privacy (R4).”* Such technologies could then for example be the blockchain, where information can be accessed by all parties involved, but it can still be protected from outsiders. However, it should also be considered that there is a distinction between the old-school players in logistics and the new players. Many current players might not be able to catch up at the fast pace of Industry 4.0 and will need a simpler version of the digitalisation process. *“I believe Internet of Things and Blockchain are a bit ahead of us. In logistics we need simple digitalisations, and IoT and Blockchain*



might be step number 10 in that process. There are new players that use such technologies, but for the old-school players it might be too big of a step to suddenly use all those technologies (R3).”

Others see trends in the role logistics businesses try to change into. One example is in companies that try to facilitate flexibility by making sure different parts in a process are aligned and required sources are as quickly available as possible. What can then be observed, is that there is also room for cooperation and sharing between corporations. For instance, a question that may come to mind is: how inventory sharing can satisfy a demand in case a local facility is out of stock. By working together with other location, the service can still be performed within the time window that has been agreed upon. Additionally, delivery time can be reduced, as the overall time to deliver will be lower. In addition, one respondent noted a trend where firms will go to further extents to lower the time to deliver a product, to minimize the waste of unused space, and to keep their competitive advantage. “The biggest trend I see now is companies trying to predict what orders will come in, so they can already fill up a truck and let it leave the warehouse before the order is even in, saving time on delivery (R5).” “Information sharing in supply chain is done by different parties. When they combine the information available and share it with one another, things would be far more efficient. For instance, in transportation, if transportation companies would share the information about half-empty trucks and could find a way in combining their efforts in transporting, that would mean that prices for transportation would be far lower, and that’s efficiency (R6).”

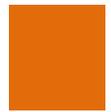
When corporations can save time and money by working together, that automatically means there is an increased need for facilitators. “There will be a great role for booking and optimization platforms. If you look at the cap market, all companies are losing money by trying to solve the problems on their own and competing with each other (R3).” Involving optimization platforms in the logistics industry, will influence the efficiency of the sector. One respondent confirms that and names different concepts as well. “The idea of Industry 4.0 is to use ICTs to increase organization efficiency and its level of competitiveness and so to decrease the cost of production ... This was evidenced by the emergence of new concepts and applications which accompanied the logistics sector and supply chain management such as Enterprise Resource Planning (ERP), Warehouse Management Systems (WMS), Transportation Management Systems (TMS) and Intelligent Transportation Systems (ITS) (R7).”

When respondents were asked about the rise of autonomous vehicles and robotics in warehouses, some argued that logistics sector is ready for such developments. “I believe logistics warehouses are already far ahead. There are many warehouses that are fully automated and are ready for the future. Of course, there will always be room for improvement, but I think it will mostly be a case of old-school warehouses having to catch up (R5).” Other respondents see the benefits of robotics but believe that is still necessary to prepare both the environment and employees for such developments. “Robotics is expensive, but it will take over a lot of production. However, robotics still needs programming, and there will be an increase in Artificial Intelligence in this world. By cutting out the human error, you will ensure product quality (R6).” “In the spirit of Industry 4.0, behaviour tree technology will get used to define basic behaviours for objects, characters, and environments which come together to bring an interactive world to life (R7).” One of the respondents additionally noted that the latest development is not the use of autonomous vehicles, as that has been used for years now, but the fact that these vehicles communicate and function in connected systems. “For me the biggest development is the fact that robots are now talking to each other. The workplace, and especially logistics locations, will start to look like a beehive of robots, where every robot will be programmed to know what to do, and to fulfil its tasks. The human factor will be taken out, and the robots will be taking decisions (R1).”

On the other hand, some respondents do not completely believe in such fully automated warehouses but prefer there to be a mix of humans and robots. “I’m quite sure that in logistics there will come a mixture of autonomous systems collaborating with humans, and that it will become teamwork. Nowadays, there is a huge fence between humans and machines, but if we combine them, we can optimize essential qualities (R4).” Additionally, multiple respondents acknowledge the openness of Industry 4.0 to technologies, and different business models. The goal of this evolution is to increase efficiency, and technologies and models that support that, are welcomed within the evolution. “I believe there will be room for whole different business models, where companies can work together, share trucks, share space, and thereby increase productivity (R5).”

Workforce Transformation

It can be observed that all respondents expect the logistics industry to become automated to a certain extent, soon. This automatically leads to the question to what extent human labour will still be needed, and how humans will be affected by the changes in terms of task requirements, stress levels, and communication. This section, therefore, discusses the opinions of the experts



on the changes in workforce resulted by the fourth industrial revolution

In general, most respondents agree that there will be a shift in the employment in the logistics sector. *"Industry 4.0 raises workers' concerns about their employment in the new conditions of robotic production and services. It provides the demand for new professions; it also redefines the labour market and changes all the rules that are known so far (R2)."* The extent to which this shift will happen, however, is not agreed upon. Some respondents believe that overall, the shift will not be quantitative, and will mostly be in the content. *"I think the jobs for people will change in content. They will not be packing boxes anymore, but they will be building software to help these robots do their job. So, there will be a shift, but there will still be jobs for humans. The requirements will not be higher, it will be different (R6)."* *"Some jobs will disappear, and others will grow, mainly the high-skilled jobs in computer, networks, IT. The expected increase in unemployment will be tackled by the expected growth in new jobs (R7)."* Some respondents take it as far as wanting to fully automate all logistics warehouses. This would then automatically lead to fewer jobs in logistics, and different task requirements for the remaining employees. *"In general, I expect there to be fewer jobs in the logistics sector, and different jobs. If it were up to me, all warehouses would be fully automated, which leaves room for IT specialists (R5)."* However, despite the change in task requirements, Industry 4.0 is believed to have many benefits for employees, as stated by another respondent. *"Industry 4.0 will make lives easier. Employees will have to handle less on their own, as more will be done by systems, and it might even lower the level of knowledge required in logistics. Still, it will depend on the job, as employees on the work-floor will suddenly need to work with cloud technologies, which drives the demand for IT expertise (R3)."*

Some experts believe that the human factor should not be completely taken out. *"We need to make sure that the humans will still be an important part in logistics. One of the biggest strengths of the human is its ability to be flexible. A robot will not be that flexible or will be extremely expensive (R4)."* For robots to be fully flexible and independent, powerful sensor systems are required to help them learn by observing human actions, which is very costly for companies. Logistics experts believe it is therefore more advisable to keep a combination of humans and robots in the system, which will enhance one another's strengths, and will take away weaknesses. *"We should help humans to understand autonomous and virtual processes. We should set up projects that demonstrate what the possibilities are and how the world could look like through such innovations. You can for example see how a HoloLens will visualize for the human how to*

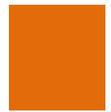
put stuff on the pallet. Robots (algorithms) are great at determining what the best pallet load is, but the human is better at putting it on the pallet in the right way. Humans and machines should work together, not against each other (R4)."

A shift in the workforce will however not go unnoticed and without consequences. It is important to realise the risks that come with it, and the effect it will have on different factors, such as communication skills. *"I am afraid that direct interpersonal communication will decrease and that engagement in IT will disadvantage social skills. There is also the danger of human resources exclusion as a part of automatization process (R2)."* Exclusion of human resources is feared by some experts, but also the increased level of stress that will come upon the remaining employees. *"I believe stress will increase in low-skilled jobs, as people will suddenly get additional task requirements. On the other hand, human emotions and the human aspect will be difficult to compensate, especially in a high tech environment (R1)."*

Roles and responsibilities in workforce preparation

The aforementioned discussions show that there will be a significant change in logistics sector as a result of the fourth industrial revolution. It is of crucial importance to understand how the world should prepare for the emergence of logistics 4.0 (logistics affected by Industry 4.0), respondents were asked about their opinions on how executives should prepare for this, and whether governments should interfere in the development and preparation of workforce or not.

One of respondents believes the solution to be rather simple. *"Of course, traditional approach suggests some training, but I think that for those big changes, it is not a good solution. It can be easier to replace some human resources with younger people growing up naturally with modern IT. For them, this development will be easier to learn and accept (R2)."* Others, however, do see a more severe need for changes, and call for different solutions on a short-term. *"Low-skilled jobs will disappear, but on the other hand, a new market for high-skilled jobs will open up (R1)."* *"It is important that humans keep their roles in logistics, and therefore we should make sure that humans are part of the process and understand what is going on, especially the virtual processes we don't see. We should help humans understand what the possibilities are of autonomous and virtual processes (R4)."* For the transition to be smooth, institutions should help the public understand what the options are, and what will change for them in the future. *"The key to the success is acceptance. It should therefore be a collaborative process with dialogues instead of monologues*



(R4).” However, the question is: who should be responsible for this?

Some of the respondents believe there to be a role for governments. Governments should prepare the future workforce through training and education. *“I believe the government should act upon this and invest in training and education for employees to relearn their capabilities. In the end, companies only care about profit, and you can’t blame them for that, so the government will need to take care of its citizens by creating different programs and encouraging citizens to reschool. The government should then also create a buffer to account for missed income, which could be solved through the Basic Income initiative, which I believe to be truly effective (R1).”*

On the one hand, basic income is expected to turn into a paternalistic system where constant supervision is required. On the other hand, a basic income is expected to enhance “real freedom”, the freedom to do whatever one might want to do. However, other experts then argue that such a concept will enhance freedom without responsibility, which might lead to unnecessary laziness from the public. A basic income would allow individuals to survive through periods where their income is lower than usual and this is an expected situation in Industry 4.0 as robots will take over some jobs or employees will need to acquire new skills to be able to perform well in the new context. Based on the above observations it can be noted that the government could play a major role in the workforce preparation for the effects of Industry 4.0, mainly by supporting educational institutes, providing significant education, and by granting the public the opportunity to attend such education, which is agreed upon by respondents. *“Here, the role of the educational system is crucial to deal with the change in labour market needs, and the new skills and knowledge required in the era of Industry 4.0 (R7).”* Still it is important to consider that traditional educational systems may not be the best option to be implemented in Industry 4.0 but there will be a need for more flexible approaches such as online learning, on-the-job training and webinars. Digital technologies are often still kept out of the basic practices of teaching, even though those technologies do dominate the way people think outside of the classroom. Thus, current means of education needs to change based on the requirements of Industry 4.0. *“Industry 4.0 sometimes is a little bit difficult to get your head around. It requires a lot of data processing techniques (R6).”* Alternatives to the classical in-class education should help the future workforce. *“There should be training on the job to help them see what the options are (R4).”* Business cases and on-the-job training would help students understand the effects of the digitalisation better, after which it can be supported with theoretical education in the classroom. *“Business life is the experimental world where things*

happen, and then education picks up and validates the experiment (R6).” The educational system requires a paradigm shift through Industry 4.0 and should incorporate a mix of both theory as well as practical experience through workshops, trainings, and business cases.

Most respondents have expressed the opinion that the main difference that should occur is to teach students to be flexible and innovative, so they will be able to keep up with the new technologies. *“Education should focus on two main issues 1) empower students to be more creative and 2) more “human”. Since the ability to innovate and emotional intelligence will be very important survival skills in industry 4.0 context (R1).”* *“The changes we’ll see will differ per study, but it is crucial that we prepare students for a fast-changing world. The continuous changes in logistics should be the key of every study (R5).”* One respondent also states that no extra courses may be needed, but that teachers with different mindset and qualifications will be needed. After all, the key to the success of this revolution is the mindset of the players involved, and that includes teachers at educational institutions. *“I think teaching students should not only focus on a topic from a certain perspective (e.g. logistics) but teaching a topic with an open mind will be the key. And therefore, no extra courses are required from my perspective, but a different way of thinking. The students themselves will force changes in the educational system, but different professors that are open to the future and not stuck in old habits will be needed (R3).”* Additionally, institutions and professors should work together and encourage the students to work with their peers from different educational backgrounds. Integrating different disciplines into combined studies will help students learn to collaborate, to improvise, and to see the bigger picture in today’s globalized world. *“I think that it will be more important to cooperate with each other across different domains. And this could of course change the way of current teaching, because there are still no integrated methods, courses or even tools so that computer scientists can work together with engineers. They both have their own “worlds” and use their own language (R4).”*

On the other hand, not all respondents believe that governments can achieve the highest results, through changes in educational systems. Some respondents would rather see executives push for change and expect that to be the best solution. *“I personally don’t have much faith in the government trying to teach people, so I see the biggest role for executives of companies having to push this change (R3).”* *“I don’t believe in central regulation. As long as the common good is not damaged, the government shouldn’t interfere. That means that businesses are also responsible. They need to educate their own employees through, for example, extra courses*



(R6).” It is generally believed that executives will have the largest influence on the preparation of the workforce for Industry 4.0. If logistics executives then invest in training for their employees, it will not only prepare them for Industry 4.0, but will also increase job satisfaction and decrease employees’ turnover rate. To achieve these objectives in logistics 4.0, significant changes will need to be made. However, some respondents foresee trouble, as they believe the mindset of executives to not fit in with the recent developments. *“The mindset is the biggest problem. People that have worked in logistics for 40 years and will retire in 2 years will not care about change and might not even understand it. And if you don’t understand it, you don’t want it. Around me I see people that simply close their eyes for the developments and don’t care about the problem. People are against change (R3).”* *“We sometimes have to push companies in the right direction (R6).”* The question that comes to mind here is; what is the role of human resource departments in making employees accept the upcoming changes? How companies can overcome employees’ resistance against digital transformation of logistics?

Next section will discuss the role of human resource management in simplifying the emergence of logistics 4.0 and workforce preparation.

The Role of Human Resource Management

The fourth industrial revolution is causing significant changes in many sectors including logistics. Logistics 4.0 is characterised by digitalised processes, robotics and intelligent transportation systems. The new context of logistics will significantly affect current and future workforce. Therefore, it is essential for industry players to prepare workforce for upcoming changes. Human resource department is referred as the agent of change in organization and expected to help employees not only accept unavoidable changes but also use new opportunities to create value for their companies.

In this section the important role of Human Resource Management (HRM) in simplification of digital transformation in logistics will be discussed, as effective HRM will help companies in all sectors to benefit from the fourth industrial revolution and create sustainable value. It is of crucial importance that companies rethink their recruitment and selection strategies, redesign their training and development programs and review all their HR policies to ensure a successful workforce transformation.

Recruitment and Selection Strategies

In the fourth industrial revolution the focus of companies should be on recruiting and selecting candidates who not only possess variety of skills but also have a flexible mindset. There are three basic recruitment strategies in-

roduced by Price (2016) which include “right person” approach, “cultural fit” model and “flexible person” approach. Nowadays many companies use a combination of the first two strategies and either they search for the right person or they put their focus on finding candidates whose values and culture fit with the organizations culture. However, in the new era, requirements of Industry 4.0 forces organizations to demand employees with flexible mindset. This is due to the necessity to coping with upcoming changes and creating value by using emerging opportunities.

Organizations should spend considerable time and effort to recruit and select “flexible” and “creative” candidates for new jobs through extensive recruitment and selection procedures (Chang, Gong & Shum, 2011). For instance, identifying innovative candidates will require recruiters to use selection methods that can help them in finding candidates who show necessary attributes for innovative behavior such as openness to experience, which can be identified either through psychometric tests or assessment centers in the selection process (Costa & McCrae, 1992, Price 2016). Employees with openness to new experience demonstrate active imagination, intellectual curiosity, creativity, variety of preferences, positive attitudes towards learning and flexible thinking (Barrick & Mount, 1991; Costa & McCrae, 1992).

In the new recruitment and selection process, one key point that should be taken into account by recruiters is the goal orientation of candidates. Potential candidates for vacant positions can have learning orientation or performance orientation. Organizations that embrace the fourth industrial revolution demand candidates with high learning orientation as individuals with such characteristic would engage more in challenging tasks and are willing to develop new sets of skills (Button, Mathieu & Zajac, 1996; Kim & Lee, 2013).

Training and development

To prepare current and future workforce for the challenges of Industry 4.0 and adaptation to the new context in different sectors including logistics, organizations should redesign their training and development programs. Government support and cooperation with educational institutions are also essential factors for a successful workforce preparation.

When designing training programs, the focus of organizations in Industry 4.0 should be on enhancing innovative capabilities. Furthermore, it is important that employees learn to be multi-task in the new context which means that they should learn and improve variety of skills. However, these training programs should be closely related to employee job (Chang et al., 2011). Since in the new context decision making is a decentralized



process, new training programs should be considered to improve employees decision making skills as well as problem solving capabilities (Chen & Huang, 2009 ; Ma Prieto & Pilar Perez-Santana,2014).

As discussed in the findings to prepare the future workforce it is of crucial importance that educational institutions put their efforts in developing “flexible mindset” among students. People with “flexible mindset” strive for continuous learning and are not afraid of taking risks. They believe that intelligence; skills and competencies can be developed by learning and practice (Harvard Business Review Staff, 2014). To develop such mindset, it is essential that companies establish connections with educational institutions in order to provide students with learning opportunities through experiments and dealing with business cases. This way of learning will help students to combine theoretical knowledge with practical knowledge in order to make informed decisions.

On the other hand, development of different competencies that can meet the requirements of jobs in Industry 4.0 should not be forgotten. Researchers have classified competencies into four main categories including : technical competencies which refers to job-related knowledge and skills, methodological competencies which contains decision making skills and general problem solving abilities, social competencies and personal competencies which include motivations, individual values and attitudes (Graßmann, 2005; Becker, 2013).

Performance Appraisal

Chen and Huang (2009) argued that a performance appraisal system that matches Industry 4.0 in general and Logistics 4.0 in particular should focus on employee behavior based approach, employee development and learning approach as well as result based approach since these approaches can facilitate continuous learning and innovation. Ideally, employees should receive feedback on regular basis. Moreover, performance appraisal should be objective and evidence based to assess the performance quantitatively. An effective appraisal process is characterized by defining performance standards, communicating performance expectations, measuring the actual performance on regular basis , comparing the actual performance with the defined standards, discussing the appraisal with employees and initiating corrective actions where necessary (Decenzo & Robbins, 2010). Management by objectives (MBO) is an appraisal system which is getting more attention and popularity in organizations. MBO is defined as a performance appraisal system that works based on setting objectives within a company and evaluating the progress of individual employees towards achievement of those objectives (Price, 2016). According to Shamim, Cang, Yu & Li (2016, p.5313) “MBO is a good approach of performance ap-

praisal to be compatible with Industry 4.0”. A typical MBO system includes specific goals that clarify expected outcomes within concise statements (Decenzo & Robbins, 2010). In the new context of Logistics 4.0, decision making is a decentralized process, therefore to use a MBO system goals should be defined not only by managers but also employees. Timeline for achievement of each goal will be also defined and there will be an ongoing review process.

Compensation

In industry 4.0 a fair compensation system that can improve employees’ satisfaction should be based on employees’ contribution to the company. Individual, group and organizational performance should be objectively reviewed and every employee should receive compensation based on their achievements (Ma Prieto & Pilar Perez-Santana,2014). It is of crucial importance that companies establish a close link between performance and the reward system (Price, 2016). “Such a compensation system has the potential to facilitate the climate of innovation and learning in organizations”. (Shamim et al., 2016, p.5312)

Job design

Job design is defined as the process of organizing tasks and responsibilities within one job and defining the timeline and conditions under which the tasks should be fulfilled (Decenzo & Robbins, 2010). Innovation and continuous learning are key features of Industry 4.0, therefore job design should be characterized by flexible assignment in multiple areas , job rotation and the sharing of tasks and responsibilities between employees. Such a job design will promote the climate of innovation and learning within companies (Ma Prieto & Pilar Perez-Santana,2014).

Employees Retention

Motivation is a key factor in employee retention however there are still controversies over this topic and its effect on employees retention (Mak & Sockel , 2001). Maslow and Herzberg have developed the most prominent theories on motivation.

Maslow’s theory focuses on physiological aspects of motivation which are categorized into five different levels including physiological (lowest level), safety, social, esteem and self-actualization (highest level). To keep employees motivated these needs should be fulfilled in a hierarchical way (Myers, 1989; Mak & Sockel , 2001).

Herzberg Theory, on the other hand, explains the instruments that can be used by companies as incentives or motivators for employees. In Herzberg theory motivation factors are divided into two different groups of five motivators and eleven hygienic factors. He believed that



although hygienic factors (e.g. health insurance) are necessary but they are not enough to motivate employees, therefore there must be other motivators combined with these factors to increase job satisfaction amongst employees (Garske, 1996).

In the advent of Industry 4.0, it is expected that employees will suffer from increased “mental stress” due to significant changes in the work processes and nature of tasks. Under the view of Maslow’s theory which focuses on meeting physiological needs of employees it is of crucial importance that HR managers come up with strategies to reduce the stress level of employees and enhance their well-being. Mental stress can lead to human errors and low performance as well as high employee turnover (DIN, 2015).

A framework of six standards was introduced by the Health and Safety Executive (HSE) to help organizations identify and reduce causes of stress in the workplace. This framework is a best practice approach that has been applied by many companies and proved to be effective. It includes standards for identification of main risk factors that cause work-related stress, surveys to evaluate the current working situation, and benchmarking guidance to help companies in measuring their own performance as well as addressing stress related issues. Furthermore, large organizations can work in partnership with occupational health departments and give their employees the opportunity to benefit from counseling services offered through employee assistance programs (Balaji, 2014). Apart from employees’ well-being that should be considered by organizations, other factors such as employee recognition, employee empowerment through decentralization of decision making process and a fair reward system play an important role in job satisfaction and employee retention.

Conclusions

The fourth industrial revolution is changing the business world rapidly and all sectors including logistics are being affected. Although the upcoming changes bring some benefits to organizations such as efficiency, lower operational costs and higher profitability but there are also challenges that companies will face in the new era. Therefore, it is of crucial importance for the companies to be prepared for Industry 4.0 and come up with concrete plans to ensure a successful transformation in the new context.

This study particularly focused on the adaptation of logistics industry into the fourth industrial revolution and explained the key role of human resource management in this process. Findings of the study showed that there are many challenges that industry players will face in coming years and it is essential to prepare the current and

future workforce ready to overcome these challenges. Human resource management plays a crucial role in workforce preparation and transformation.

The data for this study was collected through in-depth interview and literature review by using a qualitative approach. Still the study has some limitations from which it can be referred to the small number of interviews. Although the researchers put their efforts to reach out more experts in the topic for participating in the in-depth interview but the time limit of the target group in logistics industry and lack of sufficient knowledge about the topic “Industry 4.0” led to only few successful interviews at the end. On the other hand, the researchers did not succeed to get any statistical information in logistics sectors linked to Industry 4.0 (to be used as facts and figures) which can be due to lack of information or preparation for the new era. It should also be noted that the current study focuses only on the logistics sector and clearly different sectors will experience the fourth industrial revolution in different degrees. Although the role of HRM as the agent of change is obvious across all sectors but some human resource policies in the new era may be more context-specific.

In future studies one might use a quantitative approach to seek the extent to which specific jobs are affected in the industry and explain management approaches that can simplify the transformation in those particular jobs. It can also be suggested that researchers put more focus on educational systems and explore the changes that should take place in curricular in order to preparing younger generations for digital transformation in different sectors and dealing with different challenges.

References

- [1]. Allan, G. (2003). A critique of Using Grounded Theory as a Research Method, *Electronic Journal of Business Research Method*. Volume 2(1), pp. 1-10
- [2]. Balaji, R. (2014). Role of human resource management in managing stress of employees in manufacturing concerns, *International Journal of Innovative Research in Science, Engineering and Technology*, Vol 3(4), pp. 11070-11073
- [3]. Barrick, M. & Mount, M.K. (1991). The big five personality dimensions and job performance: A meta-analysis, *Personnel Psychology*, 44(1), pp.1-26.
- [4]. Becker, M. (2013). *Personalentwicklung - Bildung, Förderung und Organisationsentwicklung in Theorie und Praxis*. 6th ed. Stuttgart: Schäffer-Poeschel.
- [5]. Becker, K. (2015). Arbeit in der Industrie 4.0 - Erwartungen des Instituts für angewandte Arbeitswissenschaften e.V. *Zukunft der Arbeit in Industrie 4.0*, 23-29.
- [6]. Bazilinsky, P. and de Winter, J.(2017). Analyzing crowdsourced speech-based takeover requests for



- automated driving, *Applied Economics* 64, pp.56-64.
- [7]. Button, S.B., Mathieu, J.E., Zajac, D.M. (1996). Goal orientation in organizational research: a conceptual and empirical foundation. *Organizational Behaviour and Human Decision Processes* 67 (1), pp. 26–48
- [8]. Creswell, J. (2012). *Qualitative inquiry and research design: Choosing among five approaches*. Los Angeles, CA: Sage.
- [9]. Caballini, C., Sacone, S. & Saeednia, M. (2016). "[Cooperation among truck carriers in seaport containerized transportation](#)," *Transportation Research Part E: Logistics and Transportation Review*, Elsevier, vol. 93(C), pages 38-56.
- [10]. Chang, S., Gong, Y. & Shum, C. (2011). Promoting Innovation in Hospitality Companies through Human Resource Management Practices. *International Journal of Hospitality Management*, 30, pp. 812–818.
- [11]. Chen, C.J. & Huang, J.W. (2009). Strategic human resource practices and innovation performance—The mediating role of knowledge management capacity. *Journal of Business Research*, 62(1), pp. 104-114
- [12]. . Chen, H., Chiang, R. H. L., & Storey, V. C. (2012). Business intelligence and analytics: From big data to big impact. *MIS Quarterly: Management Information Systems*, 36(4), 1165-1188.
- [13]. Costa, P.T.J. & McCrae, R.R. (1992). *Revised NEO personality inventory and NEO five-factor inventory professional manual*. Odessa, FL: Psychological Assessment Resources.
- [14]. Cordes, F., & Stacey, N. (2017). *Is UK Industry Ready for the Fourth Industrial Revolution?* Boston, MA: The Boston Consulting Group.
- [15]. Decenzo, D.A. & Robbins, S.P. (2010). *Fundamentals of human resource management*. John Wiley & Sons.
- [16]. Dills, T. (2018). The coming of Blockchain. *Overdrive*, 22-25.
- [17]. DHL. (2016). *Logistics Trend Radar*.
- [18]. (Garske, G. G. (1996) The Relationship of Self-esteem to Levels of Job Satisfaction of Vocational Rehabilitation Professionals. *Journal of Applied Rehabilitation Counselling*, 27(2), pp.19-22.
- [19]. Gibbs, G. (2008). *Analysing qualitative data*. London: Sage
- [20]. Glaser, B.G. (1992). *Emergence vs Forcing: Basics of grounded theory analysis*. Mill Valley, CA. The Sociology Press.
- [21]. Glaser, B.G & Strauss, A.L. (1967). *The Discovery of Grounded Theory: Strategies for qualitative research*. New Brunswick & London: Aldine Transactions-A Division of Transaction Publishers.
- [22]. Graßmann, H.(2005). *Qualifikation, Kompetenz und Personalentwicklung - Zum Einfluss der Informations- und Kommunikationstechnik auf Bankmitarbeiter*. 1st ed. Mering: Rainer Hampp Verlag.
- [23]. Günthner, W., Klenk, E., & Tenerowicz-Wirth, P. (2014). Adaptive Logistiksysteme als Wegbereiter der Industrie 4.0. *Industrie 4.0 in Produktion, Automatisierung und Logistik*, 297-323.
- [24]. Harvard Business Review staff (November 2014). How companies can profit from a “growth mindset.” Harvard Business Review. Retrieved from <https://hbr.org/2014/11/how-companies-can-profit-from-a-growth-mindset>.
- [25]. Hirsch-Kreinsen, H. (2015). Entwicklungsperspektiven von Produktionsarbeit. *Zukunft der Arbeit in Industrie 4.0*, 89-98.
- [26]. Hofmann, E., & Rüsck, M. (2017). Industry 4.0 and the current status as well as future prospects on logistics. *Computers in Industry*, 23-34.
- [27]. Kim, T.T. & Lee, G. (2013). Hospitality employee knowledge-sharing behaviours in the relationship between goal orientations and innovative work behaviour. *International Journal of Hospitality Management*, 34, 324-337.
- [28]. Klumpp, M. (2017). “Artificial Divide: The New Challenge of Human-Artificial Performance in Logistics”. In: *Innovative Produkte und Dienstleistungen in der Mobilität*. Ed. by H. Proff and T. M. Fojcik. Wiesbaden: Springer Fachmedien Wiesbaden, pp. 583–593.
- [29]. Koo, J., Kwac, J., Ju, W., Steinert, M., Leifer, L. and Nass, C. (2015). “Why did my car just do that? Explaining semi-autonomous driving actions to improve driver understanding, trust, and performance.” In: *International Journal on Interactive Design and Manufacturing 9.4*, pp. 269–275.
- [30]. Kuhlmann, A., & Klumpp, M. (2017). Digitalization of Logistics Processes and the Human Perspective. *Digitalization in Maritime and Sustainable Logistics*, (pp. 118-135).
- [31]. Mak, L. B., and Sockel, H. (2001), A Confirmatory Factor Analysis of IS Employee Motivation and Retention, *Information and Management*, Vol. 38, 265-276.
- [32]. Ma Prieto, I., Pilar Pérez-Santana, M. (2014) "Managing innovative work behavior: the role of human resource practices", *Personnel Review*, Vol. 43(2), pp.184-208, <https://doi.org/10.1108/PR-11-2012-0199>
- [33]. Myers, M.E., (1989). An examination of motivations in the information systems profession, unpublished doctoral dissertation, University of Texas, Austin.



- [34]. Morrar, R., Arman, H., & Mousa, S. (2017). The Fourth Industrial Revolution (Industry 4.0): A Social Innovation Perspective. *Technology Innovation Management Review*, 12-21.
- [35]. Oguro, K. (2016). Big Data - Key to the 4th Industrial Revolution. *Japan SPOTLIGHT*, 24-27.
- [36]. Parham, S. & Wang, Z. (2017). Budget deficit and challenges of knowledge management in higher education: A case study of two international universities in the Netherlands, *Information and Knowledge Management*, Vol 7(8), pp.1-13
- [37]. Price, A. (2016) *International Human Resource Management*. Custom: Cengage Learning AMEA.
- [38]. Rodriguez-Castaño, A., G. Heredia, and A. Ollero (2016). "High-speed autonomous navigation system for heavy vehicles". In: *Applied Soft Computing* 43, pp. 572–582.
- [39]. Sauter, R., Bode, M., & Kittelberger, D. (2015). *How Industry 4.0 Is Changing How We Manage Value Creation*. Horvath Partners.
- [40]. Schließmann, A. (2014). iProduction, die Mensch-Machine-Kommunikation in der Smart Factory. *Industrie 4.0 in Produktion, Automatisierung und Logistik*, 451-480.
- [41]. Schmidt, R., Möhring, M., Härting, R-C., Reichstein, C., Neumaier, P., Jozinović, P. (2015). Industry 4.0 - Potentials for Creating Smart Products: Empirical Research Results, in: *W. Abramowicz (Ed.), Business Information Systems, Springer International Publishing*, pp. 16-27
- [42]. Shamim, S., Cang, S., Yu, H. & Li, Y. (2016). Management approaches for Industry 4.0: A human resource management perspective. *IEEE Congress on Evolutionary Computation*, pp. 5309-5316.
- [43]. Tödter, J., Viereck, V., Krüger-Basjmeleh, T., & Wittmann, T. (2015). Steigerung des Autonomiegrades von autonomen Transportrobotern im Bereich der Intralogistik - technische Entwicklungen und Implikationen für die Arbeitswelt 4.0. *Zukunft der Arbeit in Industrie 4.0*, 69-75.
- [44]. Zijm, W., & Klumpp, M. (2017). Future Logistics: What to Expect, How to Adapt. *Dynamics in logistics*, 365-379