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MODERNIZING THE MANUFACTURING PROCESS IN THE CONTEXT OF INDUSTRIAL DYNAMICS CHALLENGES

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Abstract. In the context of globalization, fast-moving technologies and a rapidly evolving economy have triggered a new wave of change. Generally known as the Industry 4.0, it has been announced to underline the new industrial revolution. Many industrial, production organizations and companies are exploring this concept, but the criteria for achieving Industry 4.0 are still unclear. This article focuses on the fundamental concepts of the Industry 4.0, the structure of current production systems. The key concept of production, the structure of the supply chain and the impact of customer service on production is also be reviewed to understand how digitalisation and manufacturing are related. The biggest focus in on formulating the Industry 4.0 concept aiming to distinguish and articulate the main characteristics of digitization. On the basis of scientific literature, the concept of manufacturing process and "Industry 4.0" will be analyzed, comparing Lithuanian production trends in the context of digitization.

Keywords: manufacturing processes, supply chains, customer service, digitalisation, industry 4.0., modernization, production systems.

INTRODUCTION

The ongoing globalization is causing massive changes in the current economic situation forcing manufacturing companies to develop and change. Various journals state that companies are investing heavily in digitalisation. According to Straitstimes (2017), a German semiconductor manufacturer, investing $105 million in factories in Singapore to turn them into smart mills. In the coming industrial revolution "Industry 4.0", companies are beginning to digitize to stay on the market. Such technological initiatives fundamentally changing the life and habits of society. Industrial revolutions have always changed the way of production, transport and everyday life.

According to Schumacher (2016), the current production systems could be described as focused on increasing efficiency in manufacturing processes. These are: LEAN thinking, and

lower-value tech robots and mechanisms. Improving the efficiency of production processes was a feature of the third industrial revolution. In the fourth revolution, it brings a completely different approach to the production system. Desires to digitize all processes horizontally (through all components that create value) and vertically (through all levels of automation). Fully bonded factories, machines, and products will have the ability to work and interact independently without human intervention. Concepts such as the Internet of Things, a smart factory, cyber systems, cloud production, enable the implementation of the fourth revolution. It is perfectly understandable that such a vision is complex and complicated. It requires large investments and high-quality experts. Small and medium-sized enterprises in particular are unaware of the financing of these technologies and how they will affect their current business model.

In scientific articles, authors emphasize the importance of digitization in production (Wang, 2016; Qin & Liu, 2016; Ugerman, 2018; Heiner, 2016; Friederichsen, 2014; Brettel. 2014). They claim that companies need to implement the latest technology. A non-innovative, non-innovative company is doomed to be pushed out of the market. Innovation is becoming a necessity for the success of a company. The fourth industrial revolution is already beginning to change production processes, business models, and personal life.

The article reviews the concept of production as well as analyses the concept of the fourth industrial revolution.

Research aim is to evaluate the complexity of the digitalisation process in production during scientific literature and comparative analysis.

Research Objectives:

1. To analyse the concept of production process and its complexity on the basis of scientific literature.
2. On the basis of scientific literature to analyse the concept of "Industry 4.0" and present its complexity.
3. To analyse trends in Lithuania in the context of digitization by comparative analysis.

MANUFACTURING PROCESS

It is essential to understand what production is and why it is important. Zinkevičiūtė (2013) describes production as a complex system that covers the whole process, from the supply of raw materials to the production company, their role in the product production right through to the distribution. Other authors, such as Shekhat (2014), say that production uses resources to create products or services that are right for the market economy. This may include production, storage,

transportation, packaging. Caves (2014) in Can They Make it Better says that the production of products and services include the transformation of resources such as labor, electricity, pure materials, services supplied by other companies, and machines into manufactured products, but a different view Wang et al. (2016) claim that production is part of a larger scheme known as operations The term "operations" covers all the systems needed to perform the job, including all services related to supply and production itself. authors have different thoughts, but they are similar and overlapping, otherwise it could be argued that production is not a specific process, but a set of processes that include areas such as material supply, distribution of finished products, distribution of raw materials. , which would be difficult to manage without the necessary tools It is possible to improve the quantity of production, reduce production time and reduce the amount of broke in the company.

According to Mattsson and Gullander (2011), many companies today suffer from high demands on productivity, flexibility and sustainability, combined with the introduction and application of new products. This increases the complexity of production system. The company can gain a competitive advantage, meet the needs of its customers (time, cost, added value) and profit in the company by employing good management of its internal operations, production process, and external activities. There are also different types of production. Mahmoud (2014) describes 4 types of production:

- Individual;
- Serial;
- Small series;
- Bulk.

Meanwhile, LaMarco (Bizfluent, 2018) also distinguishes 4 types, but they are slightly different from types mentioned above:

- Individual (single);
- Serial;
- Bulk;
- Flexible.

The latest production system is the most up-to-date production system that emerged at the start of Industry 4.0. It requires a lot of investment, but in theory using such a system it should be possible to can be a personalised orders manufacturer with mass production costs. Manufacturing companies strive to generate high quality products quickly and at low cost. Digitization offers the

potential for quality improvement, flexibility and productivity (Hoellthaler & Braunreuther, 2018). Therefore, it could be concluded that digitization is inevitable in order to achieve flexible production.

SUPPLY CHAIN CONCEPT IN MANUFACTURING

The issue of improving production is: how to improve productivity. Rakickas (2010) argued that one of the ways to increase labour productivity is the paradigm of supply chain processes. Figure 1 shows the traditional supply chain model. From this picture and the author, we can say that the supply chain is an integral part of the production process and should also be considered.

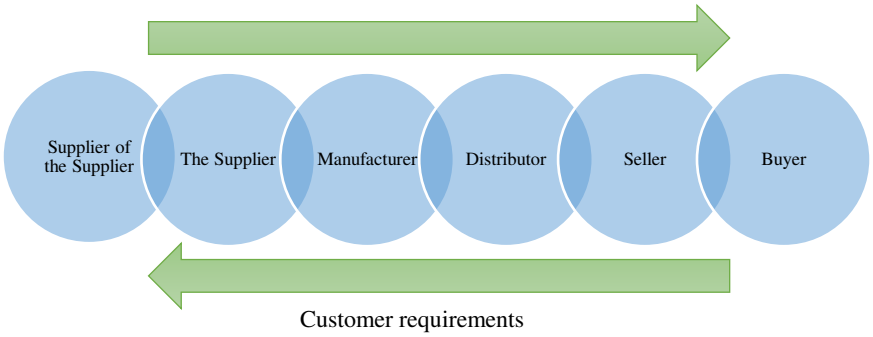

Figure 1. Traditional Supply Chain (Lu, 2011)

Lu (2011) argues that the supply chain is intertwined with participating companies that add value to the current, which transforms resources into end products or services required by the end customer. A similar view is held by Reiner (2014) and Ingra (2016), who claim that the supply chain is systematic access to item management, ranging from pure raw material through manufacturers to the end customer. From this it can be understood that the supply chain is not just the supply of raw material. The supply chain operates in manufacturing companies in many ways: manages the availability of the raw materials needed for the processes, their prices, the profitability of the produced objects, the company's infrastructure, and the ways in which companies communicate with their suppliers. In addition to these opinions, we may also include the opinion of Zinkevici (2013), which writes that the supply chain is a set of entities directly or indirectly related to the needs expressed by the customer. The opinions of all authors are the same and it is clear that the supply is understood as a whole rather than the individual components.

Industry 4.0 can have a major impact on supply chain operations, business processes and models. Luthra and Mangla (2018) discuss about the impact of digitization on the supply chain. Schlüter (2017), contributes to the opinion of the latter and argues that digitization will develop strong trends in businesses, especially in manufacturing environments. Duarte and Luthra claim that manufacturing will have a major impact on the supply chain modernization. It can be assumed that the modernization of supply is also important for the digitization of manufacturing and must be included in the whole concept.

CUSTOMER SERVICE IN MANUFACTURING COMPANIES

According to Šaulinskas (2013), if it is still possible to say that today the loyal client is a happy customers, then this is not always the case in reverse order. Today, acquiring true customer loyalty is much more difficult than giving them instant satisfaction. Customer service is another very important component of the existence of a manufacturing company. With customer service, Zinkevičiūtė (2013) advocates, that no matter how attractive the product is, the most important part is that it meets customer expectations. Customer servicing has a direct impact on the company's profitability. In addition to this, Mitrović (2015) writes that customer service indicates the desire of manufacturers or sellers to deliver the right product at the right time. According to the author, customer service directly generates the value of the product and sells it to the client. Product's material properties (production process): quality, product physical characteristics, style, usage characteristics; The product's intangible features (customer service): order simplicity, post-transaction service, reliability of delivery, flexibility, consistency of supply. All the above-mentioned authors argue that customer service is directly related to manufacturing and that in the near future the customer will have a direct connection with the manufacturing process.

THE CONCEPT OF THE INDUSTRY 4.0

The industry is part of the economy producing material goods that are mechanized and automated (Lasi, Kemper, Feld & Hoffmann (2014). Automation and moving components have started to develop in a steam machine, which have enabled additional manufacturing functions. The third industrial revolution was based on the emergence of logical controllers, which allowed for automation of the mechanisms, thus eliminating physical work. The future vision of the fourth industrial revolution includes modular and efficient production systems, characterized by scenarios in which products control their own production processes. The idea should realize

individual production in small series, while maintaining the same economic benefits as mass production. According to Brettel and Friederichsen (2014), the products in the factories will communicate with the environment and will affect the configurable systems that will be distributed according to the current situation.

Heiner (2016) states that there are two main factors that determine the development of the new industrial revolution. The first factor is the "pull" of application, driven by the need for change. This factor is caused by social, economic and political factors:

- Individualization on demand: market breakthrough from seller to buyer. This trend increases the individualization of products. In extreme cases factories are producing even one individual product.
- Flexibility: The new system requirements require a flexible product development process. The manufacturing cycle must be adaptive and flexible.
- Short development times: new technology, product development time must be shortened. The ability to innovate becomes a success factor for many companies (time to hand). Ugerman (2018) also adds that this factor must improve and even change technology, but also people's thinking.
- Decentralization: faster decision-making by companies to cope with specific tasks requires the abandonment of a hierarchical organizational system (Figure 2)
- Resources management: Shrouf, Ordieres, & Miragliotta (2014) argue that resource management needs to be more sustainable in managing resource depletion, increased prices, as well as changing social attitudes towards ecology. The goal is to manage resources more efficiently economically and ecologically.

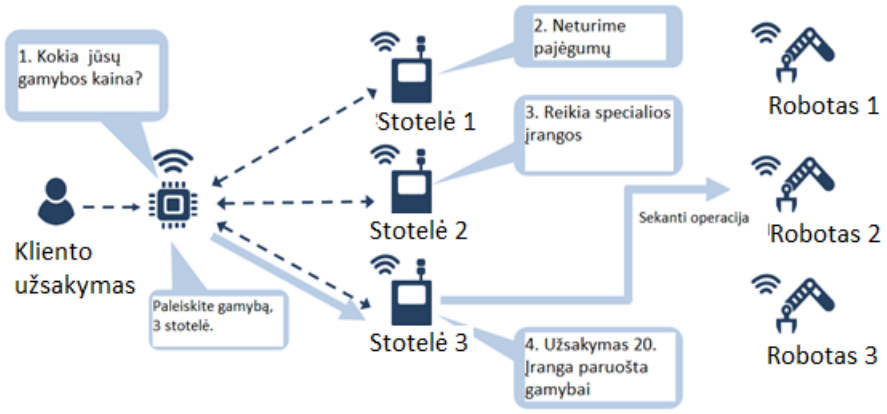

Figure 2. Decentralized Production System (Almada-lobo, 2017)

On the other hand, the industry is also undergoing a technological boost. This technological push has already affected people's personal lives (Smart phones, laptops, 3D printers, apps.) However, in an industrial context, innovative technologies are just beginning to enter the value chain, therefore we are able to identify technologically-driven advancement methods:

- Digitization and Networking: The ever-increasing digitization of production and production tools leads to an increasing database of actuators and sensors that supports control and analysis functions. Digitization processes, as well as evolving, in parallel with networking between technical components, also develop a link between products and services. All this leads to a fully digitized environment. Lee and Kao (2014) describe products as information carriers that are linked to other product modules and to the production process itself. All these are driving components, new technologies like simulations, cyber security, augmented reality.
- Increase in automation and mechanization: more and more technical assistance will be used in the work process to facilitate physical work. Automation solutions will adapt to various operations. Strandhagen (2017) suggests that automation will also have a major impact on transport, such as automated stand-alone chassis that will transport products under the factory, as well as stand-alone workstations with disposable, analytical components that can operate and optimize production processes without human help.
- Miniaturization: There is a tendency to minimize everything. Even 15 years ago, in order to be able to control robots, controllers and computers occupied a lot of space in workplaces, now computers with high-speed speed and responsibility can be plugged into a human pocket. This enables new applications, especially in the context of production and logistics. While all of the above factors are clear and known to everyone, they have the potential to affect the industrial sector in full.

Experts highlight four areas for which digitization technologies will have the greatest impact: productivity, revenue growth, employment and investment (Rußmann et al. 2015) (Table 1).

Digitization will have a significant impact on both manufacturing companies and the workforce and on companies supplying new manufacturing systems. The German example presented illustrates the potential impact of the fourth industrial revolution on the global economy.

Table 1. Impact of digitization on German macroeconomics

Area	Scale
Productivity	Over the next 10 years, more and more companies will have to deploy digital technologies, which will increase the productivity of the manufacturing sector by 90-150 billion. Eur. A 6 percent increase in productivity will be achieved.
Income	The demand for new products, new personalized products will increase revenue growth by about $ 30 billion. Eur per year or about 1% of German GDP
Employment	Over the next 10 years, production growth will increase employment by around 6%. Over the same period, the demand for engineering in the engineering sector will increase by 10%. Accelerating automation will replace low-skilled workers. The growing demand for software, communications and analysts will increase the demand for employees with competencies in the IT sector.
Investment	By adapting production processes to Industry 4.0 trends, Germany manufacturing companies should invest around €250 billion.

Source: Industry 4.0: The Future of Productivity and Growth in Manufacturing Industries, 2015

OPERATIVE ANALYSIS OF LITHUANIA IN RELATION TO INDUSTRY 4.0

While Lithuanian manufacturing industry is enjoying a period of dynamic growth, rapidly rising labour costs and lagging productivity as well as dominance of low value-added technology sectors in manufacturing systems in Lithuania's put considerable pressure on the competitiveness of the Lithuanian manufacturing sector. Strengthening automation processes in EU industry can lead to additional competitive pressure on Lithuanian manufacturing companies.

In order to prepare specific actions / recommendations for the digitalisation and automation of Lithuanian industry, it is beneficial to analyse the existing digital industry cases in other EU Member States. Therefore, a short list of EU countries whose industry's digitalisation / automation experience will be analysed and developed in the framework of the EU Digital Scoreboard.

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The EU Digital Scoreboard assesses the activities of the EU and its Member States in many areas, from communication and digital skills to the digitization of businesses and public services. The Digital Scoreboard includes data from the Digital Economy and Society Index (DESI) and the European Digital Progress Report. Overall, the Scoreboard analyzes the country's performance through over 150 different digital economy and societal indicators.

Following the selection of the 20 most popular countries that dominate the top ten position indicators (i.e., these countries show a very high digitization potential), the following

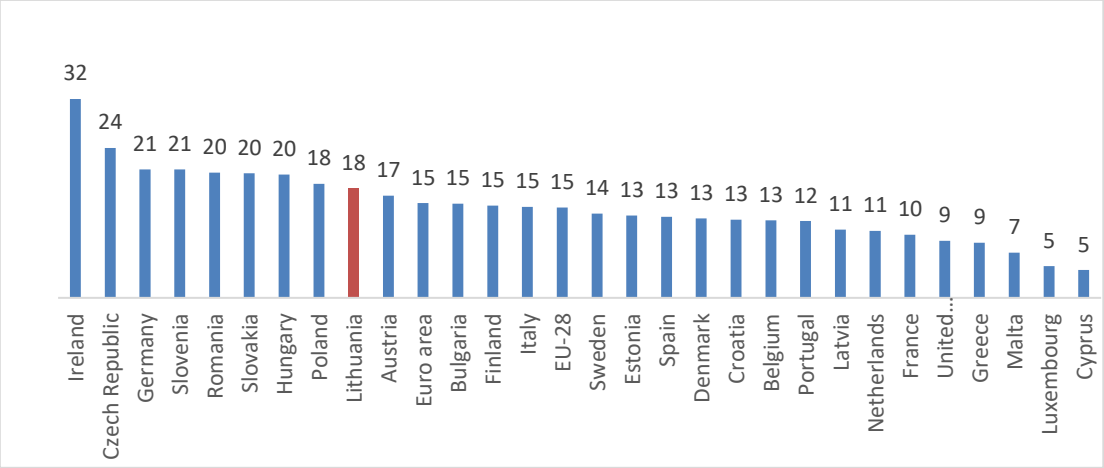

Figure 3. Share of manufacturing sector in GDP,%. Source: Eurostat, 2017

comparisons can be made.

This graph (Figure 3) shows the performance of GDP share of production. The share of the manufacturing sector in GDP is used as an indicator to determine how the manufacturing sector has developed.

Given the size of the manufacturing sector, Ireland, Germany and Lithuania occupies a leading position in which the share of the manufacturing sector in GDP exceeds the EU average (15%). Ireland has the largest share of the EU economy as a whole. In Finland, the share of production in GDP also exceeds the EU average, albeit slightly. The remaining economies are less dependent on the manufacturing sector, depending on the EU average.

There are obvious differences between Lithuania and selected economic benchmarks when monitoring the structure of the manufacturing sector (taking into account its technological development). The analysis reveals that Lithuanian manufacturing is dominated by medium and low value-added technologies in the manufacturing sector, which in 2014 accounted for more than 80% of total production. In Germany, Sweden, the Netherlands, Ireland and Denmark, close to or just over 50% of total production output comes from medium and high value-added technology in the manufacturing sector.

Thus, while Lithuania has a stable share of production in GDP, with the rapid growth of production in Europe, Lithuania's production lags behind the selected countries due to the

implementation of "innovative production". In fact, Eurostat data shows that in 2014 Lithuania had the lowest share of high value-added tech in manufacturing industry in the EU (Figure 4).

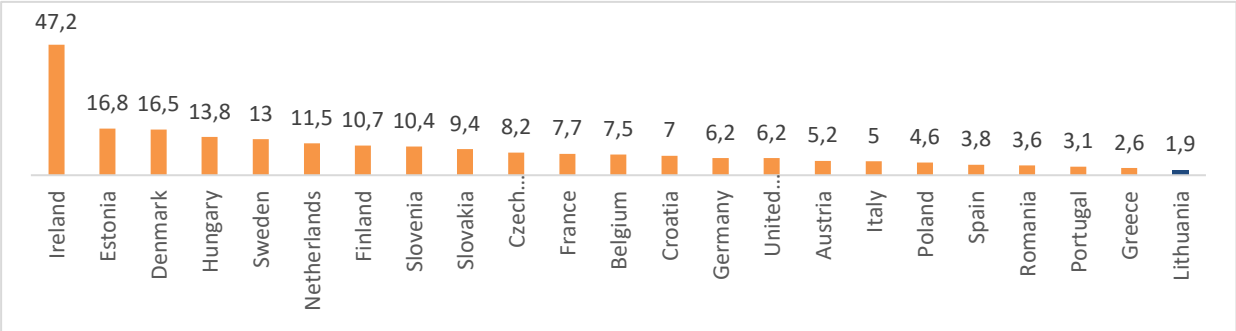

Figure 4. Some highs will add a technology sector,%. Source: Eurostat, 2014

.As can be seen in Figure 5, Lithuania lags behind the selected manufacturing sectors in terms of wages: hourly wage in the Lithuanian manufacturing sector in 2017 was 3.5 times lower than the EU average

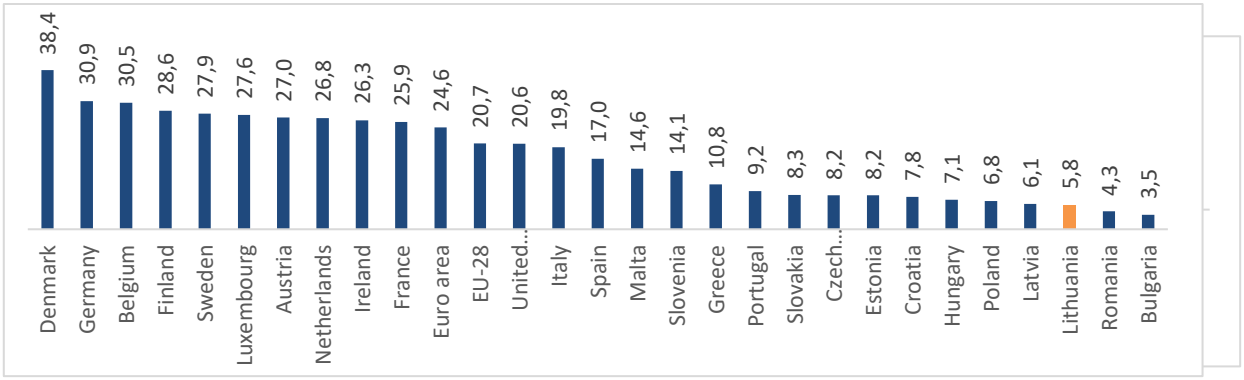

Figure 5. Wages in manufacturing sector, EUR / h. Source: Eurostat, 2017

The difference between Lithuanian and the selected economies is even greater, as most of the selected countries occupy leading positions in the manufacturing sector. An important factor that determines such noticeable wages differences is the significant difference in the production structure in terms of innovation, as Lithuanian manufacturing sector is still dominated by low value technology manufacturing and contracted manufacturing. The above-mentioned study also mentioned that in Lithuania 85 percent of the respondents said that they were not. workers in manufacturing are in medium and low-tech sectors. Eurostat data also show that in terms of employment in the high-tech industry, Lithuania lags behind other EU Member States, as shown in the chart below.

It can be stated that Lithuania ranks quite high up in terms of the size of the manufacturing sector, and holds a leading position with Ireland and Germany. Moreover, only these three countries have managed to maintain or increase the share of manufacturing to the GDP, but taking into account the structure of the sector, manufacturing in Lithuania is dominated by the medium and low value-added technology, therefore it is necessary to pay close attention to digitization of production and understanding of its implementation in Lithuania.

CONCLUSIONS

This academic article focuses on understanding the concept of production and digitization. After analysing the literature, the understanding was reached of the manufacturing system complexity and the concept, as well as identifying the main possible digitization implementation routes. The acceleration moment gained by both initiatives states, that manufacturing industry and manufacturing industry research is changing their paradigms. Digitization describes the shift towards data-focused technologies, large network information integration, communication technologies, and increased automation in keeping people in control. Enterprise goals are different, from energy storage, enterprise sustainability (social, economic) to enterprise flexibility, while maintaining quality and efficiency in the centre.

The analysis shows that Lithuania ranks relatively high in terms of the size of the manufacturing sector and, together with Ireland and Germany, holds a leading position (15% above the EU average). In addition, only these three countries managed to maintain or increase the share of production in GDP, but taking into account the structure of the manufacturing sector, production in Lithuania is dominated by the production of medium and low technology (80% of total production in 2014), while in other selected countries half of production is generated. from medium to high technology. Also, Lithuania has the lowest share of high-tech manufacturing in the EU. It can be added that the average salary in Lithuania is one of the lowest among selected countries, which has a direct impact on digitization.

It could be assumed that Industry 4.0 is to replace the entire manufacturing system, from organizational structures to products, services, and business models. The development and application of digitalisation is expected to grow and last. Companies that are not be able to acquire knowledge of these technologies and are not going to invest in projects are likely to lose their competitive edge and miss out the opportunity to lead the transformation that is just beginning.

More detailed research is needed focused on a detailed view, how Industry 4.0 technologies can be adapted to manufacturing in SMEs and in which enterprise chains digitization technologies are most relevant and profitable. Furthermore, a survey should be conducted to understand the digitization potential of companies and whether manufacturing companies are willing to digitize.

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