DIGITALIZATION OF SUPPLY CHAINS

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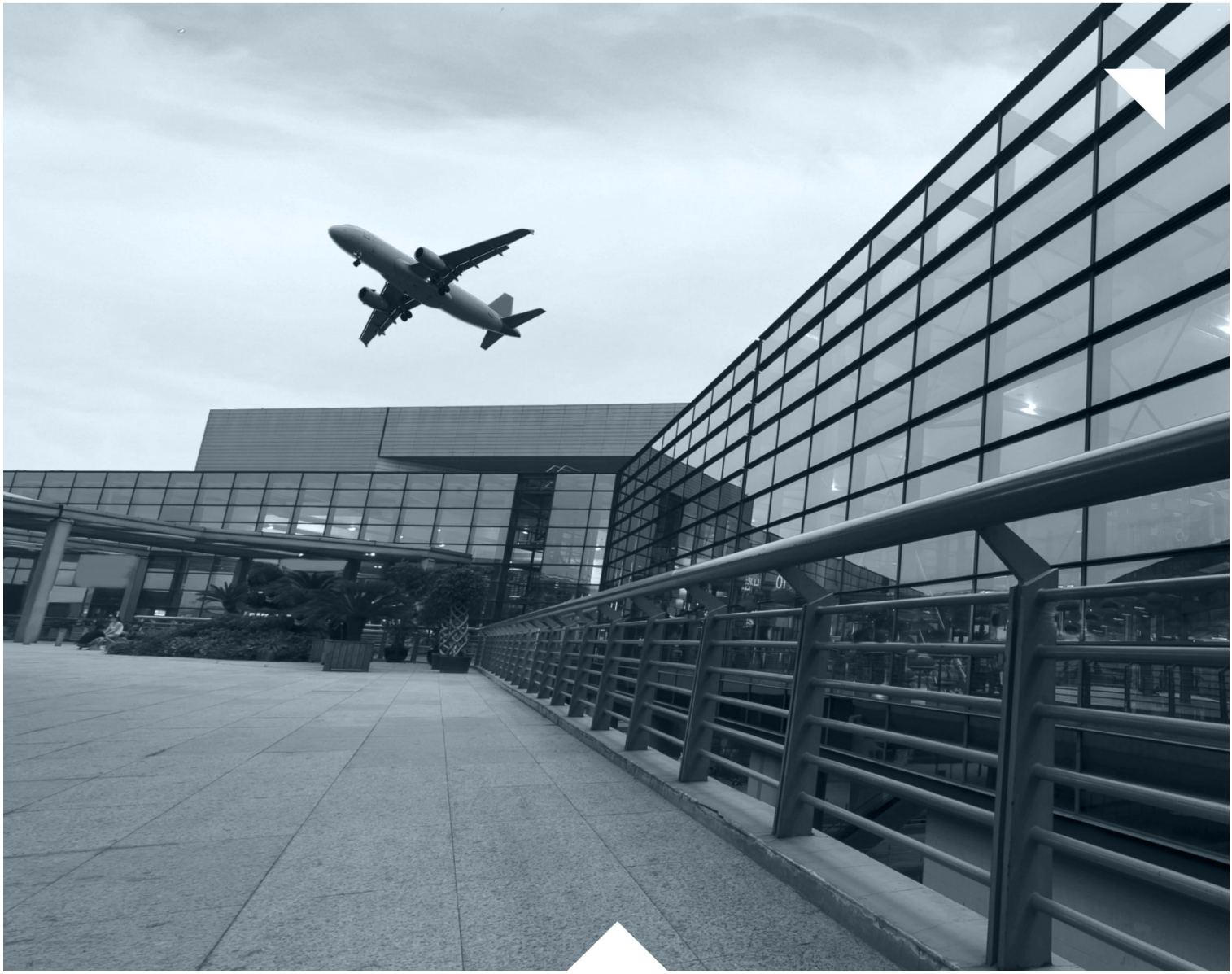

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CONTENT

Preface

The main topic of this monograph is the digitization of supply chains and the requirements places on the competence of logisticians. Digitization can now be called the strongest trend perceived in the development of supply chains. The rapid development of digitization is supported by factors that can be divided into two groups: technological and organizational. The technological factors include: the dynamic development of ICT, the availability of broadband internet (4G as well as the developing 5G network), cheaper electronic components (i.e. sensors). Organizational factors include first of all: accelerating the flow of information and access to it, but also reducing the number of mistakes, shortening process time, reducing control costs, and the ability to create new products and services.

In the monograph, the authors of individual chapters raise the most important issues in the field of digitization of supply chains. They present the implementation of elements of the Industry 4.0 concept in supply chains, the developing concept of Logistics 4.0 and how to determine the level of maturity of the implementation of these tools in enterprises. The monograph also presents the concept of Physical Internet aimed at a revolution in building transport networks and the Internet of Things that allows ongoing monitoring of processes.

Process management is a very important field for implementing digital solutions. The process approach as one of the current paradigms allows the wide application of modern solutions in order to constantly improve the processes implemented in the organization. This aspect is included in this monograph too. The authors draw attention to an important issue which is process awareness in organization. Process awareness is the beginning of implementing changes in the organization aimed at digitalization of processes. The combination of process approach and digitization of the supply chain is the text on the concept of communication integration for automated production processes regarding Logistics 4.0. Implementation of these issues would not be possible without tool support, in particular ERP systems and supporting tools such as spreadsheets and dedicated applications.

The summary of this part of the monograph is a chapter on technologies used in supply chains consist of international companies.

The competences of logistics industry employees are just as important as the digitization of supply chains itself. Digitizing supply chains would be meaningless without employees who

can analyze data, transform it into information, and make accurate business decisions based on this information. That is why it is necessary to shape new competence models of logistics specialists. These models must be adapted to the requirements of the changing supply chains of their environment and the technologies used in them. In the face of such rapidly changing technologies, shaping competences becomes a challenge. Training logisticians due to its interdisciplinarity is a long-term process. It is therefore necessary to shape competences that respond not only to current needs but for the future too. Thanks to this, it will be possible to prepare employees for effective work. The authors in this monograph present concepts of logistics competence in the conditions of a changing economic and technological environment. They pay particular attention to transversal competences and dual-mode education combining university studies with internships in logistics companies. The monograph also contains a text about the assessment of the level of maturity of competences and plans for their further development.

We encourage you to read and contact the authors of individual chapters. One of the goals of the monograph is to present the results of the authors' work, which will enable establishing cooperation, building new scientific teams and conducting research relevant to the development of the logistics field.

Special thanks to Piotr Cyplik and Szymon Strojny, reviewers of the monograph.

Michał Adamczak, Aleksander Niemczyk, Adam Koliński, Adrianna Toboła
Editors

I. SUPPLY CHAINS IN 4TH INDUSTRIAL REVOLUTION

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SUPPLY CHAIN IN INDUSTRY 4.0

ABSTRACT

Background: The changes taking place in enterprises under the influence of the Industry 4.0 concept place new requirements not only for enterprises but also for supply chains. We can assume that as time passes, more and more enterprises will undergo changes consisting in adapting their operation to the requirements of this concept. However, these changes will not occur at the same pace in all enterprises nor will they have a uniform character. Therefore, there will be a problem of cooperation in supply chains of enterprises with various levels of advancement in the implementation of the industry 4.0 concept.

Methods: The aim of this article is to identify and present possible ways to solve this problem. In the considered conditions, the importance of coordinating the activities of individual partners in the supply chains is growing. The effectiveness of coordination will depend on communication between partners.

Results: The article presents two possible scenarios of improving communication in supply chains. The first of these is to leave the problem of improving communication at the level of individual enterprises. Observing the current operations of supply chains, it can be concluded that two scenarios are possible within this scenario: creating common data sets and using agent technologies. The second possible scenario is the attempt to create a central communication mechanism at the level of the chain and in the field of communication between the chain and the environment. The analysis will examine the advantages and disadvantages of individual scenarios and current results as part of their implementation.

Keywords: Supply Chain, Industry 4.0, Communication in the Supply Chain

INTRODUCTION

The formulating of the problem considered in this article, should be started by defining the terms used in its title. Definitions of supply chains appearing in the literature can be divided into two groups. A characteristic of the first of these is treating the supply chain as a process, i.e. a series of events in the movement of goods, which increase the value of the goods moved. The above-mentioned definition can be considered characteristic for such an approach [Fertsch 2016]. For the purposes of this article, the definition quoted above will be obligatory.

The second group of definitions focuses on the institutional aspects of the supply chain. It treats the supply chain as an organization. This approach will not be considered in this article.

A broad review and discussion of various definitions of the supply chain can be found in [Ciesielski and Długosz 2010] and [Witkowski 2010].

The concept of Industry 4.0 (fourth generation industry) is difficult to define According to the available sources, it can be assumed that Industry 4.0 is the name of a modern trend in automation, information exchange and manufacturing technology. It includes cybernetic - physical systems, the Internet of Things, information processing in the cloud and intelligent data processing (cognitive computing) Production in Industry 4.0 takes place in so-called "smart factories". In the modular structure of these factories, cybernetic and physical systems implement and monitor physical processes, create a virtual copy of them, and make decentralized decisions. These systems communicate via the Internet of Things and collaborate with each other and with people in real time.

The key concept in the above-cited definition is the cybernetic-physical system. It is defined as a mechanism (physical system) controlled or monitored by software communicating with it and between itself via the Internet. In cybernetic-physical systems, physical components and software are closely related. Each of these elements operate in different physical locations and at different times and interacts with each other in different ways that change with the context.

With regard to production systems in the conditions of industry 4.0, certain conditions (principles) of their functioning have been formulated.

They are:

- interoperability - the ability of machines, devices, sensors and people to connect and communicate via the Internet.

- information transparency - the ability of information systems to create a virtual copy of reality and enrich the virtual copy of the factory with data from sensors. This requires aggregation of raw data from sensors to the level of information, full-fledged contextual data.
- technical support - first of all, the ability of IT systems to support people in collecting and visualizing information relevant to making decisions as quickly as the situation requires. Secondly, the ability of the production system to support and replace people in some jobs.
- decentralization of decisions - the ability of systems to make decisions about their own actions and carry out their tasks as autonomously as possible.

Changes that take place in enterprises under the influence of the Industry 4.0 concept set new requirements not only for enterprises but also for supply chains. We can assume that over time, more and more enterprises will undergo changes consisting in adapting their activities to the requirements of this concept. However, these changes will not occur at the same pace in all enterprises, nor will they be uniform. Therefore, there will be a problem of cooperation in supply chains of enterprises with various levels of advancement in implementing the concept of industry 4.0.

The purpose of this article is to identify and present possible ways to solve this problem. In the conditions under consideration, the importance of coordinating the activities of individual partners in supply chains is growing. The effectiveness of coordination will depend on communication between partners.

STRUCTURE OF THE SUPPLY CHAIN IN THE CONDITIONS OF INDUSTRY 4.0

The supply chain process is not a simple or homogeneous process. We can distinguish in it a number of partial processes (streams) that form it:
- stream of physical movement of goods (products) or services,
- information flow process controlling the movement of goods or services,
- commercial information flow process. This information is the basis for making decisions by enterprises or natural persons performing activities of physical movement of goods or services. This information is used by chain participants to calculate the profitability of their activities.
- promotional information flow process. This information is the basis for making decisions by customers - recipients of goods or services offered by the chain. Based on them, customers decide to purchase a specific good or service.

- money flow process - making payments for delivered products or services.

Three out of five partial processes (streams) forming the supply chain are related to the flow of information. Nowadays, information systems are widely used to handle the flow of information. They are complex computer programs or sets of cooperating programs designed to perform specific functions. Two factors - the development of computing power of computers and emerging new management concepts have created different ways in which management support information systems perform their tasks. However, the operation of the two factors mentioned above did not lead to the formation of one standard of the IT system supporting management. The operation of IT systems used in practice is based on various concepts. The most advanced of them are ERP systems - Enterprise Resource Planning. When characterizing the current state of the concept (the ERP standard - the use of this name is not entirely correct, because the ERP system standard has never been officially adopted, but due to its dissemination, it actually plays the role of the current standard of the IT management support system) its following features should be emphasized [Ginters 2002]:

- its origins date back to the '70s of the last century,
- a well-known and described standard, verified many times,
- has a number of drawbacks (most often 15-20 defects of the ERP standard are mentioned in the literature),
- difficult to implement - requires adaptation of the company's operation to the principles of software operation,
- very effective, primarily in the sphere of accelerating capital rotation and reducing inventories.

The problem considered in this article is an attempt to create a architecture model of the supply chain information system in the conditions of Industry 4.0.

ELEMENTS OF THE SUPPLY CHAIN IN THE CONDITIONS OF INDUSTRY 4.0

The elements forming the supply chain in the conditions of industry 4.0 can be divided into four groups (layers):

- physical layer - it is made up of production and auxiliary machines and devices that implement and support physical processes - production processes. The term "support" used above should be understood in a narrow sense - as the implementation of physical processes ensuring continuity and proper course of the basic process, which is the change of work objects

(materials) in terms of shape, size, appearance, physical or chemical composition or properties. Other processes are so-called auxiliary and service processes - transport and storage in the production process, production quality control, replacement of tools and workshop aids, maintaining cleanliness in the production process.

- IT layer - devices (computers) and software controlling elements of the physical layer and creating a virtual copy of physical reality and supporting people in collecting and visualizing information relevant for making decisions. The task of this layer is also to make some decisions in accordance with the principle of decentralization.
- social layer - people working in the production system, cooperating with its various layers.
- communication layer - Internet ensuring information flow between individual layers and their elements.

After characterizing the individual layers of the supply chain under the conditions of Industry 4.0, let's deal with the general principles of their functioning.

The physical layer will consist of cybernetic and physical systems. Their operation, according to the views prevailing in the literature on the subject, will be based on embedded system technology [Noergaard 2005]. These are special purpose computer systems that are an integral part of the equipment they support. Each embedded system is based on a microprocessor (or microcontroller) programmed to perform a limited number of tasks or even only to one [Lee and all 2011].

The IT layer according to the literature will cover five levels [Lee and all 2014]

- the level of data collection devices - It consists of data collection devices - sensors (sensors) installed on machines and devices whose task is to capture signals from the surrounding environment, recognize and register them and the network amplifying the signals and sending them over long distances, to subject them to further processing using digital techniques and computers as well as remembering it.
- level transforming data into information - this level consists of a set of programs collecting and processing data collected by the layer of data collecting devices. These programs can be placed on one central computer, on several computers or in a "cloud". The tasks of this level are:
- diagnosing the condition of machines, devices and work environment,

- prediction of machinery and equipment failures and environmental hazards and their potential impact on system operation,
- analysis of collected data in terms of searching for their temporal, spatial and causal relationships for the needs of system and environmental diagnostics.

Some tasks at this level can also be implemented by embedded systems, which are elements of the physical layer. The division of tasks in the field of transforming data into information between the elements of the physical and IT layers is not clearly defined. It is difficult to indicate the criteria for this division. It seems that the main criterion should be to maximize the reliability of the entire system.

- information analyzing level - consists of a set of programs collecting and processing information collected by the layer transforming data into information. The tasks of this level are:
- modeling the behavior of machines, devices, changes in the availability of resources over time,
- analysis of distributions (statistics) of events, activities, system states over time to forecast their frequency and duration,
- grouping of collected information in terms of their similarity for the purposes of analysis using techniques for analyzing large sets of information.

- the level recognizing (diagnosing) the operation of the system - consists of a set of programs collecting and processing information collected by the information analyzing layer. It also organizes communication in the system by controlling the flow of data and information between individual layers. The tasks of this level are:
- preparation of information and data visualization for the needs of computer-human communication,
- simulation and integration of information to forecast resource demand,
- organization of cooperation in the scope of joint (human-human and computer-human arrangement) situation assessment and joint decision-making.

Analyzing the tasks of the level analyzing (diagnosing) the system's operation, we encounter a very interesting issue. It's a decision making problem. One may wonder whether the decisions will be permanently assigned to specific decision-makers (regardless of whether it is a human or a computer) or whether the obligation to make decisions will be dynamically allocated depending on the analysis of the situation.

- the level configuring (organizing, planning) the operation of the system - consists of a set of programs that process information collected by the level analyzing the operation of the system. He also works with people at the highest level of system management. The tasks of this level are:

- planning the system's operation under normal operating conditions as well as in conditions of system interference and changes in the system environment,
- proposing changes in the operation of the system adapting it to changes in the environment,
- anticipating changes in the structure and operation of the system that improve the flexibility of its operation.

RELATIONSHIPS BETWEEN ELEMENTS OF THE SUPPLY CHAIN IN THE CONDITIONS OF INDUSTRY 4.0

In the supply chain operating in the conditions of Industry 4.0, direct production machines and devices and production employees creating cybernetic-physical systems can be located in various manufacturing facilities (manufacturing facility) and be assigned to perform specific tasks on an ongoing basis. In this situation, the production plant, which in the traditional approach is a system of resources intentionally accumulated on a common area for the production of a specific assortment, becomes the sum of cybernetic and physical systems located in many locations that perform selected operations in physical processes in the basic process, which is the change of work objects (materials) in shape, size, appearance, physical or chemical composition or properties. It must be supplemented with a set of purposely selected auxiliary machines and devices (which are also cybernetic and physical systems), implementing auxiliary and service processes - transport and storage in the production process, production quality control, replacement of tools and workshop aids, maintaining cleanliness in the production process.

The issue of the criterion for selecting elements of this set becomes a crucial issue. They can have the nature of a technological criterion - in apparatus processes, where the basic requirement is to maintain the continuity of the process or a specific phase thereof, continuous processes and the machines and devices operating them as well as employees will be gathered in one production location. Since production processes are usually determined by production volume in continuous processes, these will be large production plants. In this case, the

cybernetic and physical systems making up the production system will not always be created on the basis of a single machine or device. An intermediate level may appear for installations implementing a certain phase of technology (e.g. fuel supply phase in a conventional power plant). In the conditions of continuous production processes, it may also be that the most economical solution will be creating a cybernetic-physical system at the level of the entire manufacturing facility (manufacturing facility). Other criteria for structuring the physical layer under continuous production processes may be the reliability or operational safety of the entire production facility.

Under discrete production processes (job shop production, batch production, cellular production), the main criterion for configuring the supply chain will certainly remain the minimization of production costs. The supply chain will be the sum of cybernetic and physical systems located in different locations that perform selected operations in physical processes in the basic process. It must be supplemented with a set of purposely selected auxiliary machines and devices (which are also cybernetic and physical systems) that implement auxiliary and service processes.

In the case of a supply chain built from cybernetic and physical systems, the effectiveness of its operation will depend on the degree of centralization of system organization.

- Under strictly centralized systems, where all decisions will be concentrated in one place of the system, transformation of the logistics system into a cybernetic-physical system will not introduce significant changes in its operation.

- Under mixed-system systems, in which the decision-making powers will be dispersed at various places in the supply chain and its subsystems, a difficult to diagnose situation will arise where the extent of the cybernetic-physical system's interference in the operation of the supply chain and impact on the effectiveness of its operation as a whole and its subsystems will be hard to predict at the design stage.

- In the conditions of fully decentralized chains, consisting of cooperating independent cybernetic-physical systems with their indefinite or unclear hierarchy, it seems likely to expand the structure of the supply chain information layer by an additional level - the level of optimization.

This level will consist of a set of programs that process information collected by the configuration layers (organizing, planning) the operation of individual independent elements.

Operation of this level, as has been shown earlier, cannot be based on the ERP model because this model does not provide optimal solutions.

The tasks of this level will be optimal planning of the entire supply chain:

- optimal planning of the operation of each independent element in terms of restrictions resulting from the optimal operation of the whole,
- proposing changes in the structure and operation of the supply chain in advance that will improve its flexibility
- programming changes in the operation of the supply chain as a whole.

OPTIMIZATION LEVEL OPERATION

The basic element of the level under consideration in accordance with [Dagli 1994] will be a world model containing the knowledge about the environment in which the supply chain operates. The concept of such a model is presented below:

parameters:

Rj - demand in j- period [value]

Co- initial price [value]

Mij - investment in marketing of i - supply chain in j - period [value]

R & Dij - R&D investment of i - supply chain in j - period [value]

Qij - investment in quality of i - supply chain in j – period [value]

Rij - value of resources of i - supply chain in j - period [value]

Cj - medium price in j - period,

IDCj - indicator of price dinamics in j - period,

Kj - indicator of economic situation in j - period,

RDj - indicator of technology development in j - period,

Sij - sales of i - supply chain in j – period [value]

Cij - price for unit of sales of i - supply chain in j - period [value]

RWij - "value" of i - supply chain in j - period [value]

Uij - share in market of i - supply chain in j - period [value].

equations:

$R11 = \sum Si1\ C0$ [1]

$R1j = \sum Sij\text{-}1\ Csj\text{-}1\ IDCj\text{-}1$ [2]

$$Csj = \sum Cij / n \quad j = 1, ..., n \qquad [3]$$

$$RWij = \sum Rij \qquad [4]$$

$$IDCj = Csj / Csj\text{-}1, \; IDC1 = Cs1 / C0 \qquad [5]$$

$$Rj = R1j \; Kj \; RDj \; [1+ f \; (Mj + R \; \& \; Dj + Qj)] \qquad [6]$$

$$Uij = Rj \times f \; (Mj + R \; \& \; Dj + Qj + RWij + Uij\text{-}1) \qquad [7]$$

$$Sij = Uij / Cij \qquad [8]$$

SUMMARY

The article presents the current progress of work on creating a model architecture of the supply chain information system in the conditions of Industry 4.0. The next steps will be software and testing of the world model as well as developing the concept of an IT system for communicating the optimization level with the remaining levels of the information layer. The final result will be the development of procedures for the optimization level in the supply chain information system architecture.

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LOGISTICS 4.0 IN SELECTED LOGISTICS COMPANIES IN POLAND-PRELIMINARY REVIEW

ABSTRACT

Background: Logistics 4.0 is a concept that strives for improvement of performance of logistics processes. It encompasses many solutions dedicated for both, isolated logistics functions (such as warehousing, transport etc.), and integrated physical and information flows. Their implementation usually requires some investments (purchasing technology and/or infrastructure), as well as organizational changes. Since there is always risk emerging from implementation of new solutions, companies, especially SMEs, due to their limited resources, are cautious when it comes to the decision on introduction of changes to their structure or processes. On the other hand however, SMEs are believed to be flexible and opportunity-oriented seeking for chances to improve and increase their competitive edge and implementation of state-of-the-art solutions are undoubtedly such a chance. Nevertheless, they need support to increase their will and strengthen their need to implement contemporary innovative solutions.

Methods: Authors designed survey consisting of 25 questions. An invitation to participate in a survey was sent to randomly selected transport and logistics companies in Września county. The study was conducted on a very small random sample, so the accuracy of the test results is limited. The study covered randomly selected enterprises due to the scope of the study. The survey has been conducted in August and September 2019.

Results: 19 enterprises located in Września county participated in the survey. Chapter presents preliminary research that has been done within logistics companies and based on conducted survey it was possible to assess what is actual knowledge and implementation of Logistics 4.0 tools. The preliminary results contributes that selected polish micro and medium transport enterprises are not yet fully ready for the revolution of transport through Logistics 4.0. They focus on traditional methods of contact and conducting business, claiming that they are developing their business properly and do not need to make changes. Only a few have knowledge about Industry and Logistics 4.0.

Conclusions:. The problem with the implementation of the 4.0 logistics concept appears in many enterprises and results from the lack of clear information about what "thinking in category 4.0" can actually mean for the company in terms of real benefits. Research proved that there is a huge cognitive gap in transport and logistics companies in the scope of Logistics 4.0. Lack of knowledge can be eliminated by developing appropriate guidelines, roadmap and Logistics 4.0 maturity levels.

Keywords: Logistics 4.0, Transport and Logistics Sector

INTRODUCTION

Interest in Logistics 4.0, which is a form of reaction of enterprises, to changes in industry at the level of the fourth industrial revolution has been growing for several years. Industry 4.0 are those enterprises that created production lines that are a combination of mobile automation and process control information systems. The development of new generation production companies and their cooperation with logistics companies have led to the creation of a new supply chain structure (Gajdzik, 2019; Pfohl, 2016)

Hereby chapter presents preliminary research results with respect to Logistics 4.0 in selected transport companies. Authors describe either theoretical background or practical part based on surveys.

Explaining what logistics is, is not easy. In the collective imagination, this term is commonly associated with freight transport. Conferring to the logistic term an exact definition is not at all simple, according to the field of application its meaning changes. Nowadays it is applied in different sectors, above all to the productive and commercial one.

What is Logistics 4.0? It can be said that it is a term referring to modern logistics, including mutual data exchange, digitization and cloud computing. Therefore, the tasks of logistics are no longer limited - as before - to the transport itself and its operation, but are based on managing functions and coordinating activities between logistics companies in the supply chain. Logistics 4.0 is a reflection of the Industry 4.0 concept in supply chain processes, which, according to the idea of revolution 4.0, are gradually connected into a network and subject to constant monitoring. The effect of these activities is to be a significant increase in the efficiency of these processes. Logistics 4.0 provide for modern communication and information technology. Intelligent and digitally connected systems are to enable communication between people, machines, equipment, logistics solutions and products. When logistics is integrated at an early stage in the supply chain, just-in-time optimization is achieved. On the other hand, carriers have an even better planning basis, better utilization of their fleets and shorter waiting times at charging points (Timocom, 2019)

Authors use the term “Logistics 4.0” to refer to the combination of using logistics with the innovations and applications added by CPS. Logistics 4.0 is related to the same conditions as Smart Services and Smart Products. We have then to consider that the technology driven approach used to define “Smart Products” and “Smart Services” is used to define “Smart Logistics” (Barreto et al., 2017).

“Smart Logistic” is a logistics system, which can enhance the flexibility, the adjustment to the market changes and will make the company be closer to the customer needs. This will make possible to improve the level of customer service, the optimization of the production and make lower the prices of storage and production. As the “Smart Logistics” will change accordingly to the actual technology driven, it has a time dependency and thus it is essential to define the state of the art of the technology (Uckelmann, 2008).

The Logistics 4.0 technological solutions are based on using drones, self-steering vehicles, sensors, Big Data, GPS, RFID, M2M. As part of the concept, the technologies dedicated to modern enterprises use i.e. virtual reality glasses, intelligent transporters, gates, forklifts and automatic vehicles (DHL, 2015).

Delineated the citations listed above, which constitute only a part of those in the literature, an attempt is made to give an explanation that is summarized and suitable for the study: *Logistics 4.0 means a process of digitalization of communication systems employing innovative*

technological solutions, to increase the connection and sharing of data along with all the links in the supply chain, with considerable benefits in saving time.

Relevant technologies of Logistics 4.0 are, e. g. identification, mobile communication, localization, electronic data interchange, data analysis methods, and data analytics processing. In short, the Smart Logistics frees humans from carrying out logistics activities that can be delegated to Smart Products or Smart Services (Uckelmann, 2008).

Logistics 4.0 enables process improvements through a variety of technological innovations, including smart robotics, driverless transport vehicles, automated systems for handling parts inside warehouses and factories, sensor systems, smart products, etc. Nowadays, the concept of smart products defines the products which have the ability to do computations, store data, communicate and interact with their environment (Schmidt, Möhring, Härting, Reichstein, Neumaier, & Jozinović, 2015).

The potential of Logistics 4.0 is far from being exhausted due to the deepening digitization and the growing amount of collected data that will need to be analyzed.

The problem with the implementation of the 4.0 logistics concept appears in many enterprises and results from the lack of clear information about what "thinking in category 4.0" can actually mean for the company in terms of real benefits. Along with the development of the concept, the questions inevitably arise: Is Logistics 4.0 a response to the trend associated with the growing requirements of customers to the increasingly tailored needs for a fast and flexible way of adjusting the flow of materials? Will implementation in Logistics 4.0 allow it to gain an advantage in a highly competitive logistics market? For many Logistics 4.0 is the opportunity to use new IT systems, for others an introduction to robot warehouses. These are certainly network systems and processes (Dataconsult, 2019)

TRENDS IN THE TSL INDUSTRY

As in the previous period, automation and digitization of supply chains, along with e-commerce, determine changes in logistics. Robotization of warehouse works, autonomous vehicles, electromobility, Internet of Things (IoT), Big Data, artificial intelligence (AI), sharing resources and blockchains are a growing challenge in the TSL industry. However, as can be seen, most companies in the TSL industry are at the stage of recognizing the suitability of new information, analytical and hardware solutions or are analyzing the pace and scale of their

introduction. However, all these breakthrough innovations are intensively tested by leading global logistics companies such as Amazon and DHL. In the field of e-commerce, Poland remains one of the fastest growing markets in Europe. Eurostat data shows that 45% of Poles over 16 years of age were shopping online in 2017. In the leading countries over 80% of citizens were shopping through this channel. Factors stimulating the growth of e-commerce were certainly the ban on Sunday trade coming into force in 2018 and the possibility of shopping and making payments from mobile devices. Customers of the e-commerce market are exerting increasing pressure on logistics companies for delivery on the day of placing the order (same day delivery). To meet this, logistics operators offer the delivery and collection of shipments (returns) via extensive networks of service points located: in parcel machines, shops, gas stations, etc. To meet the expectations of recipients, the courier industry has entered the world of non-cash payments. It is estimated that in 2017, approximately 400 million parcels were delivered to recipients in Poland, which represents only 2.6% of the European market (Fechner, Szyszka, 2018)

The polish transport, shopping and logistics sector is facing numerous problems posed by the authorities and other contries. Selected transport and logistics companies are trying to explore and implement the best possible solutions to overcome obstacles and foster the further development of the sector.

ANALYSIS OF CONDUCTED RESEARCH

The concept of Logistics 4.0 presented above should be present in most Polish enterprises which, in order to be competitive and stay on the market, must move with the times. However, in practice it varies and there are many more companies that do not follow this approach.

Therefore, there is a need to carry out research on Polish enterprises from the TSL sector in the field of knowledge about Logistics 4.0 and its solutions in its operations. To this end, surveys were carried out. The survey was conducted using CAWI qestionnaire in order to obtain a set of data suitable for further quantitative analysis. Research group was made up mainly for small and micro enterprises.

It is characterized by the fact that it allows to acquire knowledge of a large population by examining only its representation, i.e. sample representation. These studies are among the most

commonly used. Because they let you get to know a large community in a relatively short time. The data obtained are suitable for quantitative analysis.

The main goal of the survey was:

– learning the knowledge of owners and forwarders of enterprises on Logistics 4.0,

– applying IT support in enterprises,

– analyzing how data is identified and stored,

– determining the demand for the concept of Logistics 4.0.

According to the criterion of type and detail of marketing decision problems, the research is investigative. It was conducted as an auxiliary in identifying the problem, determining the direction of further research and formulating conclusions. However, from the point of view of the nature of the information obtained, they are qualitative research due to the small sample size. They explain and allow to understand the analyzed phenomena, which, nevertheless cannot be confirmed statistically. Research results cannot be generalized to the whole population due to the small and unrepresentative research sample. Undoubtedly, they are an assessment and characterize the examined population.

The research subjects are the owners and forwarders of transport companies. Defining the studied population:

- entity - preferably the owner or forwarder,
- sample unit - transport companies,
- spatial scope - Września[1] county,
- time - August and September 2019.

The study was conducted on a very small random sample, so the accuracy of the test results is limited. 19 enterprises located in Września county participated in the survey. The study covered randomly selected enterprises due to the scope of the study. The survey was conducted as indirect interview using questionnaires, which were answered by 19 companies 47.5% of 40 participating in the survey. The remaining 21 companies did not complete and did not return

[1] Września County (Polish: *powiat wrzesiński*) is a unit of territorial administration and local government (powiat) in Greater Poland Voivodeship, west-central Poland.

the survey. Questionnaire consisted of 25 questions divided on four main parts: management, material flow, information flow, additional questions.

The questionnaire was answered mainly by business owners 79%. The remaining respondents are forwarders 21%. In 100% they were service companies, exclusively with Polish capital and having one branch.

19 surveyed enterprises were divided in order to obtain information on knowledge of Logistics 4.0 and use of the latest IT methods in the process. The criteria of division were the size of the enterprise, its place in the supply chain and scope of activity (see Table 1).

Table 1. Criteria characterizing 19 surveying companies

Criterium	Share %
Company size:	
– 1-10 employees	84
– 11-49 employees	16
– 50-199 employees	0
– 200-499 employees	0
– 500 and more employees	0
Partipant in supply chain:	
– supplier of raw materials	5
– supplier of components	22
– Suppier of final goods	63
– flow integrator (partial)	10
– global integrator (supply chain integrator)	0
The scope of activity:	
– local/regional	5
– national	47
– european	48
– global	0

Source: own elaboration based on conducted syrveys

Research prove that there is no connections between the scope of activity, participant in the chain and size of the surveyed enterprises, and knowledge of the concept of logistics 4.0.

The competitive position of the surveyed enterprises is stable and the companies have only Polish capital. When asked whether the flow of documents is electronic and automatic identification of data only 11% answered in part and the remaining 89% answered in the negative.

Regarding data storage, all surveyed companies replied that internal documents are stored in chapter version in binders and on standard carriers. None of the respondents put information on the disk in the cloud or data warehouses. If the surveyed enterprises analyze the data, then only using spreadsheets. Respondents do not use automatic and autonomous solutions supporting the flow of materials in the form of forklifts, conveyors, storage devices or drones. They believe that they do not need such solutions as of today.

Currently, there are many IT systems on the market supporting management in enterprises, e.g. MRP, ERP, WMS, CRP, SCM, transport exchange. To the question: "What elements of IT support are used in the enterprise?" 74% of respondents indicated that the freight exchange and the remaining 26% do not use any IT support. This is due to the fact that 5 of the surveyed companies provide services for only one production company and therefore they do not need any support. However, some respondents in the future intend to introduce software into a smartphone (AR technology imposed by the transport company) that will be combined with freight forwarding in the company for which they provide services. This will help inform you about errors, delays or failures, and will speed up the unloading and loading process.

Due to the fact that the main goal was to learn the respondents' knowledge about logistics 4.0, there could be a question related to its knowledge. Well, only representatives of 21% of the surveyed enterprises read in publications and scientific articles about industry and Logistics 4.0. However, the remaining 79% have not heard of these concepts. It can be concluded that the lack of knowledge about Logistics 4.0 is associated with the lack of opportunities offered by this concept. In addition, according to respondents, the perception of the Logistics 4.0 paradigm is a goal that the company must reach, but will not affect logistics processes. Of course, the surveyed companies did not take any action regarding the company's position in comparison with the adoption of the Logistics 4.0 paradigm.

Respondents were also asked how they make decisions about the implementation of solutions supporting the service process. The surveyed enterprises could choose from one to three answers, which are as follows:

- in search of savings,
- in search of innovation,
- to increase competitive position,
- as a result of recommendations from related enterprises.

All respondents pointed to the search for savings, because this is the most desirable goal of every enterprise. As for the remaining answers, 79% of respondents also indicated the search for innovation and increased competition, and only 21% have to listen to the recommendations of related enterprises.

The preliminary results of research presented in hereby chapter contributes that Polish micro and medium transport enterprises are not yet fully ready for the revolution of transport through Logistics 4.0. They focus on traditional methods of contact and conducting business, claiming that they are developing their business properly and do not need to make changes. Only a few have knowledge about Industry and Logistics 4.0.

CONCLUSIVE REMARKS AND FURTHER DIRECTIONS OF THE RESEARCH

Logistics 4.0 changes the principles and solutions for logistics. Holistic cyber-physical systems (CPS) are important results of Logistics 4.0. They realize the networking and automation of transportation, allocation and if necessary, the use of storage systems based on digitalization of processes and decentral software control. With the help of the Internet of Things (IoT) the networked connection of physical objects to enable real-time data visualization and the automation of logistics flows.

The critical issues related to Logistics 4.0 are mainly related to investments (payback times), the complexity of communication between information systems and the lack of adequate skills. Companies are facing problems connected with the lack of courage to achieve a radical change and with the lack of necessary talents. Are required new skills, there will be many job losses in some work categories, whereas also some gains in others, such as IT. Moreover, one of the most important barriers, as said, is related to the lack of clear business cases that justify such investments. The money required for new technologies are significant, and so accurate and clear plans for their expenditures are needed, especially for those companies with concerns about their ability to cover the necessary investment.

These are some of the main components of the digital transformation applied to corporate logistics processes. The sample cannot be used for statistical evaluations as the number of companies involved is insufficient and the differences in size as well as in the sector to which they belong make it a heterogeneous sample. However, the replies to the assessment questionnaire were useful for making general observations. Such a far-reaching vision would bring many problems to companies that intend to keep pace with technological changes. Companies are uncertain about the financial effort required for the implementation of such new technologies and the consequent impact that they could cause to their business models. The massive problem for companies is to determine their status quo in relation to the issues they are

facing, the ability to know how to self-evaluate and determine a domain which they belong. For this reason, it is difficult for them to identify concrete fields of action, programs and projects.

Transport and logistics companies are going forward Logistics 4.0 solutions if they are big companies. Logistics companies, especially those large, dynamic and wishing to compete in the rapidly growing market, need to strive to be a market leader by all means if they want to maintain their status and position in the market.

Surveyed companies were rather small and micro sized therefore there is a lack of knowledge about potential modern tools and directions of evolution with respect to Logistics 4.0/ Industry 4.0.

There is no doubt that the transport and logistics sector is undergoing an important transformation as new technological solutions come into everyday use, driven by market trends. It can be expected that this trend will also affect Polish enterprises. Logistics 4.0 requires ease of access, quick information processing, security, and, most importantly, all of this in one place.

Furthermore authors will extend survey in order to gain data adequate for statistical analysis. Companies included in research will be evaluated based on L4MM (Logistics 4.0 maturity model) developed by Oleśków-Szłapka and Stachowiak (Oleśków-Szłapka, Stachowiak, 2019). The L4MM matrix allows an organization to gain insight into the current situation of its processes, and how it should pursue the desirable situation (i.e. a higher maturity level). Moreover authors will propose a maturity roadmap – steps to facilitate the implementation of a logistics 4.0 tools.

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THE PHYSICAL INTERNET AND DIGITAL SUPPLY CHAINS – SELECTED ISSUES

ABSTRACT

Background: The physical Internet is a global system of closely related logistics network, based on efficiency and reliability is the use of linked interoperable logistical assets interoperable based on unified protocols collaboration, standard transport unit modular and intelligent interfaces. Today's supply chains are long and complex. This is connected with the fundamental problems that the physical Internet can reduce or eliminate. In terms of transport, which is still the way, untapped potential and transport space and inefficiencies in processes.

Methods: The research included within the paper is based on the results of the query sources, literature and case studies of companies developing and using digital technologies.

Results: Regardless of supply chains in the B2C relationships in recent years has undergone a real revolution driven by technological innovations. As is evident for example the report prepared by the Advisory company Deloitte in cooperation with the Association of MHI, the digital revolution also affects supply chains in manufacturing industry and B2B relationships. The greatest influence on changes to trends related to robotics and automation, data analytics, and Internet of things (IoT). Confirmation of the above trends we find in the report the company PwC. Thanks to the construction of the foundations of digital capture, analyze, integrate, use and interpret high-quality data in real time. These data are fueling process automation, predictive analytics, artificial intelligence and robotics, or technology that soon will take over to supply chain management. Within the paper the objectives and pillars of the physical Internet as well as strategic challenges and barriers have been identified. The state of the art of rail

transport in Poland and Europe was highlighted, possible variants and solutions with regard to physical Internet have been discussed.

Keywords: The physical Internet, Digitization, Digital supply chain

INTRODUCTION

Information technology is penetrating every aspect of today's businesses; without a sound IT infrastructure companies cannot keep up with competitor firms who effectively use IT. Successful companies have already recognized this trend and have started to adapt – both to continually stay ahead of their competitors and to exploit the potential of digitalization to increase profit.

The environment, transport and logistics are relevant topics, within which the idea of the physical Internet and digitization of supply chains should be point of research. Goods flow processes in time and space (transport and logistics), their efficiency and reliability, affect the efficiency of business processes and determine the ability to timely, appropriate to meet the needs of individual clients and institutional players [Antonowicz & Jarzębowski 2018].

The physical Internet is a global system of closely related logistics network, based on efficiency and reliability is the use of linked interoperable logistical assets interoperable based on unified protocols collaboration, standard transport unit modular and intelligent interfaces [Bellot & Meller 2014]. The search for potential improvement of efficiency quickened with the realization that not only individual enterprises compete against each other but also entire supply chains [Christopher 1992]. Today's supply chains are long and complex. This is connected with the fundamental problems that the physical Internet can reduce or eliminate. From another point of view, to sustain long-term growth and profitability in a competitive environment, economic entities must continuously improve their efficiency [Sudit 1995]. In terms of transport, which is still the way, untapped potential and transport space and inefficiencies in processes.

Regardless of supply chains in the B2C relationships in recent years has undergone a real revolution driven by technological innovations. As is evident for example the report [MHI 2017] prepared by the Advisory company Deloitte in cooperation with the Association of MHI, the digital revolution also affects supply chains in manufacturing industry and B2B relationships. The greatest influence on changes to trends related to robotics and automation, data analytics, and Internet of things (IoT). Confirmation of the above trends we find in the report the company PwC [PwC 2019]. Thanks to the construction of the foundations of digital

capture, analyze, integrate, use and interpret high-quality data in real time. These data are fueling process automation, predictive analytics, artificial intelligence and robotics, or technology that soon will take over to supply chain management. Within the paper the objectives and pillars of the physical Internet as well as strategic challenges and barriers have been identified. The state of the art of rail transport in Poland and Europe was highlighted, possible variants and solutions with regard to physical Internet have been discussed.

RESEARCH METCHODS

One of the key drivers of this research is to deliver information and knowledge, essentially through two complementary approaches. Those are the systematization of information and data analyse on case studies of companies developing and using digital technologies.

These were identified through an extensive mapping on the basis of harmonized methodology and metrics on what qualifies something as a suitable case study in terms of results, as well as its replicability potential. Experiences that can be qualified as sustainable ware taken in to the consideration. The systematic literature review and work on case studies allowed to identify key issues (strategic challenges) around physical internet and digital technologies

POLAND ON THE WORLD TRANSPORT MAP

Poland lies at the crossroads of transit routes from east to west and from south to north. Its geographical location in the centre of Europe and its friendly, lowland terrain and temperate climate mean that many transit routes of great intra- and intercontinental importance pass through it [Jarzębowski & Bezat-Jarzębowska 2013].

Four Pan-European Transport Corridors (TINA) numbered I, II, III and VI run through Poland, as well as key EU freight corridors (Figure 1), Baltic Sea - Adriatic Sea (RFC 5) and North Sea - Baltic Sea (RFC 8) within the meaning of the *Regulation of the European Parliament and of the Council 13/2010 on the European rail network for competitive freight and freight corridors within the TEN-T core network* [Regulation …2010].

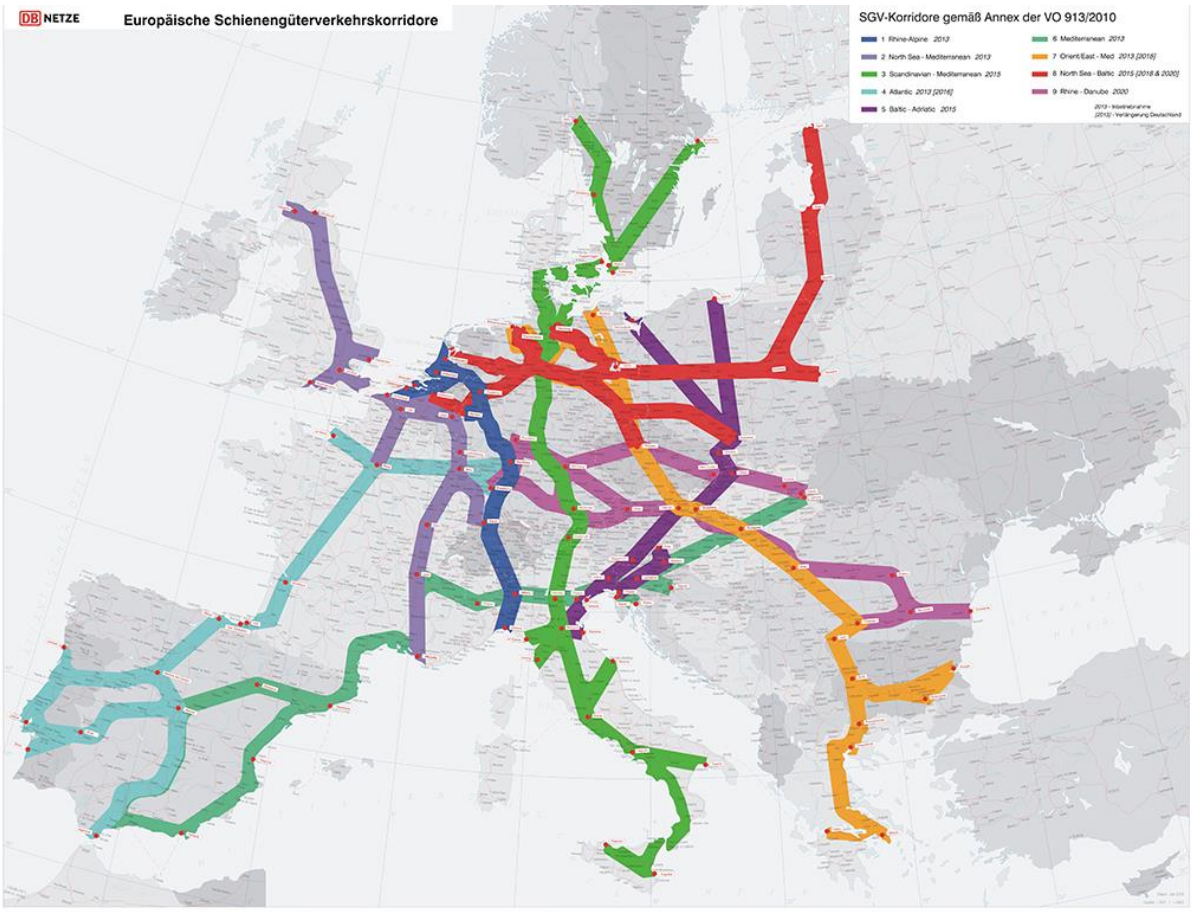

Fig. 1: Main freight corridors through Europe.
Source: [Three EU Rail Freight Corridors launched, 2015].

The RFC 8 corridor, which is a natural extension of the New Silk Road rail route within the territory of the European Union, is of particular importance for trade between China and the European Union. China remains a world leader in foreign trade, both in terms of exports and imports [WTO, 2018], Among the EU's trading partners, China was the largest partner for EU imports of goods, and the second largest partner for EU exports of goods in 2017, while the European Union remains the main trading partner of the China, accounting for 20% of its international economic exchange [Eurostat, 2018].

Given the particular importance of the Polish infrastructure for rail freight between China and the EU, the Polish authorities, with the support of the EU, carried out extensive measures to modernize the existing linear and nodal infrastructure between 2007 and 2015.

The financing of investment projects approved in the "Strategy for Responsible Development" is to be provided primarily by the EU budget from the Operational Programme Infrastructure

and Environment in the amount of EUR 12.172 billion dedicated to the modernization of, among others, railway lines. Between 2007 and 2015, the quality of rail transport infrastructure in Poland increased substantially. The proportion of lines in good technical condition rose from 25% to 55%, while the share of lines in an unsatisfactory technical condition fell from 28% to 16%. The large-scale of modernisation and revitalisation projects, implemented with support from EU funds, have increased the attractiveness of rail in Poland [Bień & Wójcik-Mazur 2014].

Poland has not only established better transport connections with neighbouring countries of the European Union, but has also prepared a plan of coordinated actions in form of National Railway Programme until 2023 (NRP), which was adopted via a resolution of the Council of Ministers from September 15, 2015 (updated in November 2016) to become a gateway to the European Union.

PKP S.A. conducts works aimed at developing its real estate for the development of railway nodal infrastructure facilities, including logistics centres and transshipment terminals. The company has selected a portfolio of properties all over Poland, which may be used for the development of logistics infrastructure, and in the near future it plans to develop these areas. This action is also part of the initiative to create in Poland a logistics platform serving the markets of Central and Eastern Europe, which would be able to handle the increasing flows of cargo transported (not only by rail) between China and Europe.

The Central Transport Port (CTP) is the concept of a high-capacity logistics centre with good road and rail access. A natural advantage of CTP, apart from its central location in Poland and good access to motorways, would be the possibility of combining on the first and last miles of cargo transported by different modes of transport between distant locations, taking into account the main transport corridors. In addition, PKP Group companies have taken a number of initiatives aimed at removing transport barriers, which have been highlighted by the Chinese side.

In order to eliminate the risk of lack of container transport platforms, PKP CARGO announced on 4 September 2018 a tender for the purchase of 936 intermodal platforms; at the end of the year the company also received EU funding for the purchase of another 220 container transport platforms dedicated to international transport. In total, in the years 2018-2023, PKP

CARGO S.A. planned to purchase over 1000 wagons-platforms, which will improve the transport process and ensure greater reliability of operation.

PKP CARGO has also taken important measures in terms of insufficient productivity of information exchange. Mechanisms are being developed for providing information on wagons and containers on trains travelling from China to Europe before their physical arrival at the border crossing points, as well as railway and customs documentation necessary to cross the external customs border of the European Union. This optimizes the use of resources and speeds up rail and customs formalities, which has a significant impact on the total time it takes for containers to be transported by rail from China to EU countries. Currently, efforts are being made to obtain the necessary data after the transshipment of trains at border crossings in China (1435 mm)/1520 mm railways (Kazakhstan, Mongolia, Russia), which would give at least a few days of reserve to prepare for the acceptance of the train to the network in Poland, customs and border clearance of shipments, transshipment of containers, and the formation of trains for their final transport to terminals of destination on the European rail network.

A system for the mutual exchange of information between railways on container streams to be carried and in the event of unexpected obstacles to transport has also been developed, thus largely preventing congestion at 1520 mm and 1435 mm border junctions as well as at border and destination transshipment terminals.

Moreover, in order to shorten customs procedures at the Polish-Belarusian border, which is the last of the operational barriers to the development of NSR transport indicated by Sinotras (Song, 2016), at the Terespol-Brest crossing point, a pilot TORY-24 programme was introduced by the Ministry of Finance. Its aim is to streamline the processes of handling foreign trade in rail traffic carried out by services, inspectorates, carriers and other institutions operating in Małaszewicze. This tool enables all participants in the freight traffic management process to participate in the exchange of information. The duration of custom clearance of goods imported from third countries carried out by the services and inspections should not exceed 24 hours from the time when the goods are placed under control to the competent authorities.

The implementation of the traffic management and control coordination mechanism (TORY-24, *English: TRACKS-24*) makes it possible to improve the handling of trade in goods through:

- Faster electronic exchange of information,

- Availability of information for users operating in different locations,
- Coordinating the place and time of the inspection of goods,
- Possibility of monitoring the process of handling the trade of goods.

The carrier/forwarder/customs agency/postal operator is given the opportunity to participate directly in the freight handling process from the moment of entry of the train, submission of the request for an inspection to the relevant service/inspectorate, transmission or acquisition of information on the time and place of inspection and its results. The services will receive advance information (advice) about the intention to submit an application for control by the dispatcher of the goods, which allows for effective work planning and enables the exchange of additional information between users at each stage of the control process.

Companies from the PKP Group work on the development of technologies and innovative solutions to support intermodal transport. One of the possible actions to improve the movement of loads across the Polish eastern border is also the implementation on a wider scale of a system for automatic gauge changing (the most promising seems to be the second generation of the SUW-2000 system), which would allow reloading-free movement of railway consignments through the 1435mm and 1520 mm gauge intersections. However, it would take several years from verification of a greater long-term interest in using such a solution to its possible commercial implementation to refine the configuration of the implemented variant of the system and then test it and start serial production of variable-track axle sets to be used in freight wagons and to construct track gauge setting points at the interface between tracks of different gauges, through which it will be possible to change the track width automatically without unloading or changing wagons or their bogies.

Table 1. Variants of cargo movement at the contact point of different track widths

Variant	**Name**	**Method of operation**	**Operating time (min.)**	**Calculation performance**		**Versatility**
				weight/hour	**tonnes/hour**	
I	Cistern-cistern pumping	Overflow station	40	1,5	90	Required technological stock of wagons

II	Transshipment of cargo units	Transshipment berth	6	10	215	Full
III	Replacement of trolleys with body lift	Resetting station	20	3	180	Required technological stock of trolleys
IV	Automatic Gauge Changing Systems	Continuous, with the use of a resetting station	0,5	120	7200	Carriage in single wagons, in groups or full-train

Source: own elaboration.

The application of the mechanism would allow for a significant acceleration of transport across Poland's eastern border and would also increase the reloading capacity of the largest transshipment terminals located at the junction of railway lines with different rail gauge.

STRATEGIC CHALLENGE FOR RAIL TRANSPORT IN THE AREA OF LOGISTICS[2]

A combination of a strategic concept and the technology of its implementation, which is a value chain that allows for the effective exploitation and renewal of resources and skills [Obłój 2002]. For the transport and logistics in the field of rail services in order to improve the effectiveness and efficiency of transport processes, consider the idea of physical Internet. Goods flow processes in time and space (transport and logistics), their efficiency and reliability affects the efficiency of business processes and determines the ability to timely and appropriately meet the needs of individual and institutional clients using those services via railway transport.

The physical Internet is a global system of closely related logistic networks, based on efficiency and reliability. It is based on the use of linked interoperable logistical assets which use an unified collaboration protocols, intelligent interfaces and standardized modular transport unit [Bellot & Meller 2014].

Modern transport chains are long and complex e.g. rail transport chains of the New Silk Road. Some of the fundamental problems that the idea of the physical Internet can reduce or eliminate

[2]Uses elements of: **STRATEGY OF PKP S.A. AS AN INSTRUMENT OF POLISH RAILWAY TRANSPORT DEVELOPMENT**

are unused space, transport inefficiencies in processes as a result of the lack of integration of systems and the lack of intelligent interfaces [Antonowicz 2018].

The idea and the basic objectives of the physical Internet shows the Fig. 2.

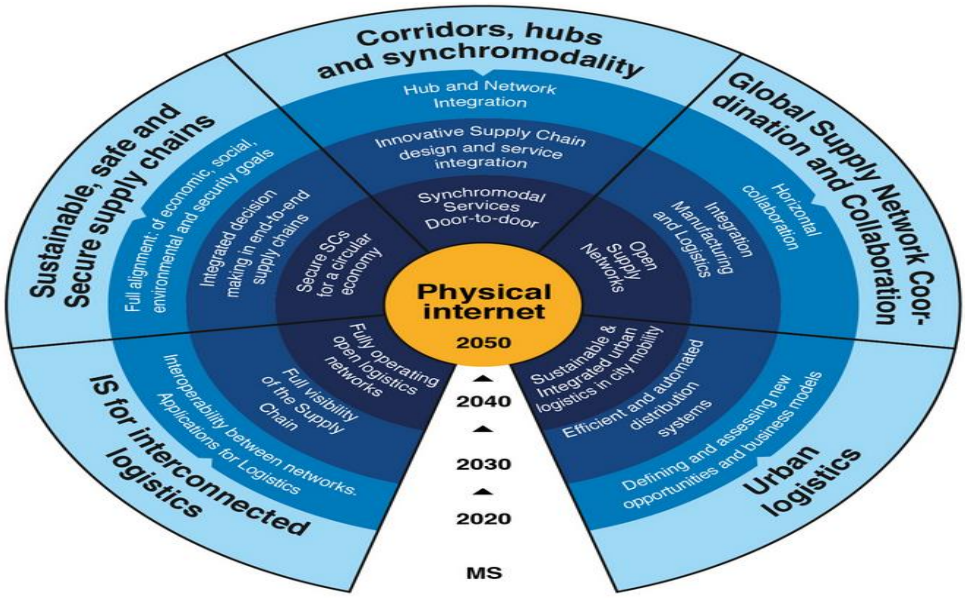

Fig. 2. Idea and basic objectives of the physical Internet.
Source: [Alice 2014].

The basic objectives are:

- More than twofold increase in the efficiency of logistics (taking into account the benefits of the redirection of already sent shipments),
- Improvement of the reliability of the flow of goods achieved through fast, automated supply chains based on complex information about the difficulties and dangers,
- Better use of human resources, hardware and infrastructure,
- Significant reduction of greenhouse gas emission in land transport,
- Increase in innovative logistics solutions.

As it appears from conducted in the U.S. research, physical Internet proposes a system in which the global logistics supply chains are connected by an open intermodal system (pie, railway, shipping-barges and ships) that uses standard, modular, reusable containers, identification and

coordination of routes in real time by shared logistics centres. Producers, shipments senders, transport operators operate independently, using shared logistic networks, which increase the load of vehicles, wagons, boats, and reduce empty mileage of vehicles [Antonowicz et al. 2018]. Pillars of physical Internet are shown in the Fig. 3.

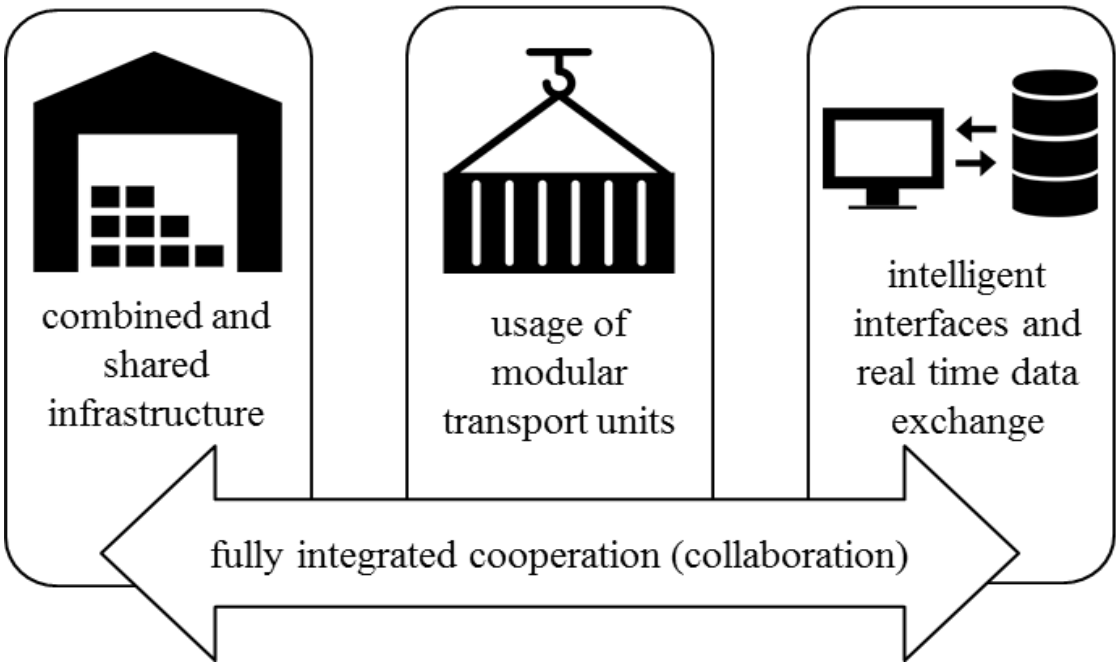

Fig. 3. The pillars of the physical Internet.

Source: own elaboration based on: [Zdziarska & Hachuła 2015].

Therefore, the aim of most of the logistics activities in PKP Group are potential sources of benefits of constructing of a global logistics system based on the concept of the physical Internet:

- A significant increase of intermodal transport magnitude obtained by standardization and usage of modular transport units (intermodal is the most perspective segment of rail services)
- Generating a huge pool of orders for railway transport as a result of suggesting shipments senders to plan the decision process via a computer system that takes into account a variety of multimodal options.

For the achievement of these benefits first and last mile rail road freight terminals, managed under the idea of the physical Internet, should have adjacent warehouses and grading plant and

increased length of the railway loading track which would enhance capabilities to simultaneously manage and handle the transhipment point of many trucks.

Sample layout of the Terminal for intermodal rail transport-road shows the Fig. 4.

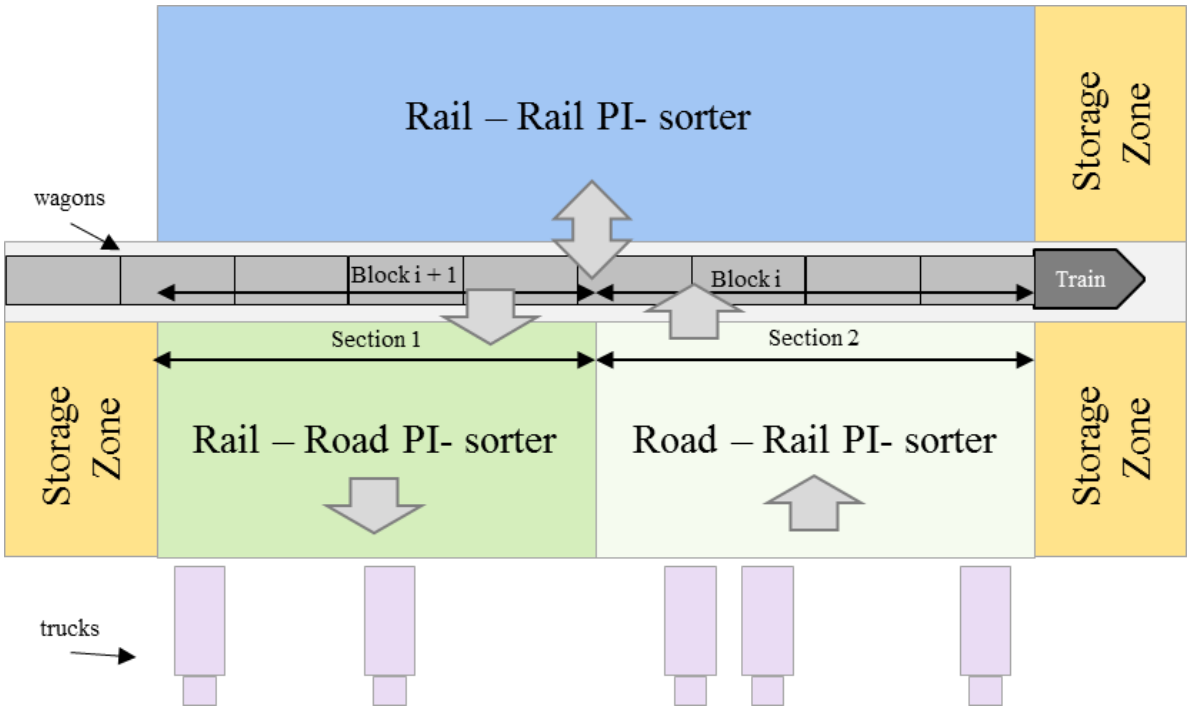

Fig. 4. Example of the layout of the Terminal in the concept of the physical Internet.

Source: own elaboration based on: [Antonowicz & Zaremba 2019] .

The implementation of this idea is conditioned on improvement of clarity of collaboration rules with various stakeholders in order to acquire goods for common supply chains, integration and implementation of investment processes and business, competence development and deployment the latest solutions and techniques to optimize logistics processes, promotion of multi-modal services and the organic forms of transport.

THE ROLE OF THE CONCEPT OF THE PHYSICAL INTERNET TRANSPORT

When considering the following options on the assumption that:

- new variant of zero indicates no grouping of cargo transport,
- option 1 means car transport aggregate loads,
- option 2 assumes the grouping of loads with optional use of railways,

- option 3 contains a grouping of loads with optional use of railways and cross-docking.

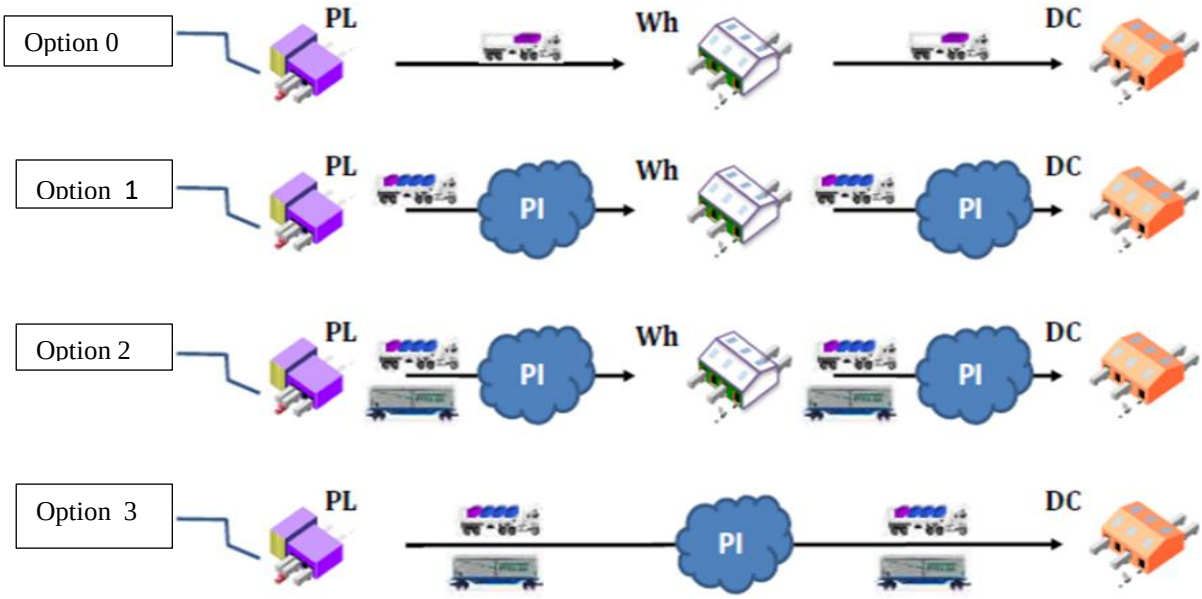

Fig. 5. The potential cost and environmental history of the concept of the physical Internet connection associated with the Assembly of consignments and choice of modes of transport.
Source: own elaboration based on: [Antonowicz & Zaremba 2019].

Cost and environmental potential of the concept of the physical Internet connection associated with the merger of consignments from different senders on the routes of carriage is significant (see Fig. 5). By making a relative comparison of logistics costs arising on stage between production facility and distribution center retailer it is estimated that the consignments of enumerable shipment in modular units of transport solutions bimodal and cross- dockingu logistics costs from the production plants to the city center the distribution network can take to reduce by up to 32% and CO2 emissions reduced by 60%. While the use of rail transport in the concept of the physical Internet reduces CO2 emissions by up to 80% compared to road transport by combined logistics on the basis of the physical Internet.

Given the above ramblings market challenges for the combined logistics based on the idea of the physical Internet are the following:

- price, delivery times and conditions acceptable for most target customers,
- transparent deals on full service packages from the original origin to destination target,

- instantly generate quotes for services using multiple means of transport (including multimodal) in response to a query,
- the ability to modify the customer routes or expected time of delivery or target destinations for all or a lot of loads already once shipments,
- the popularization of multi size modular packaging, that can be easily aggregated into larger standard transport units on the market.

This means that the development of the physical Internet connection will result in a fully integrated network that support movements of goods in the standard modular packaging.

CONCLUSIONS

As companies continue to grow and expand into new markets, the need for increased IT integration is a must. Enterprise technologies can be the backbone of an organization's global operation. In order to remain competitive, enterprises must continually develop and identify new solutions, implemented through constant investments and the introduction of new technologies. This underlines the ability to stimulate economic activity with the potential to create jobs for regions in need of economic development. One way is indeed to improve entrepreneurial competencies and skills through the innovative potential in IT architecture creation. The speed and scale at which business is conducted today requires intense coordination of business processes; enterprise technologies give companies the ability to operate at speed and scale demanded in today's business world.

The aim of the paper is an indication of the ability to apply the idea of the physical Internet and an indication of the role of modern technology in the management of modern supply chain. The research included in the paper is based on the results of the query sources, literature and case studies of companies developing and using digital technologies. Within the paper the objectives and pillars of the physical Internet as well as strategic challenges and barriers have been identified. The state of the art of rail transport in Poland and Europe was highlighted, possible variants and solutions with regard to physical Internet have been discussed.

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IMPLEMENTING IOT (INTERNET OF THINGS) SOLUTIONS ON THE BASIS OF PROCESS ANALYSIS AND DESIGN THINKING (ON THE EXAMPLE OF A PRODUCTION COMPANY)

ABSTRACT

The aim of this article is to outline the process of implementing changes within an organization, which are meant to achieve competitive advantage. The study was conducted in a company with a complex production structure. The article presents selected process aspects, the most important change determinants, as defined by the authors, and selected methods of creating dedicated new Internet of Things related solutions such as combined process analysis with the usage of BPMN 2.0 standard and Design Thinking methodology. The chapter outlines suggested implementations and the framework of further studies.

Keywords: Technological processes, process analysis, BPMN 2.0, IoT (Internet of Things), development, innovation, Industry 4.0, Design Thinking.

INTRODUCTION

Due to advancing market needs and technological development, companies are required to continuously grow and analyse their operations. Polish companies in the era of 4:0 economy face the challenge of achieving competitive advantage in a technologically advanced business environment. The fourth industrial revolution assumes mass customization, i.e. effective production of diversified and even personalized products. This type of complex activity requires very specialized agile manufacturing [Fertsch, Cyplik and Hadaś 2010], which is based not only on technical advancement, but above all on changes in thinking about how to plan processes,

organize resources, and in a broader context - management at a different level of own business strategy.

The concept of process analysis of a production company should include an audit of the existing process and proposals for changes that take into account technologically advanced solutions.

Scattered research and development strategies, new software, Internet of Things (IoT), new communication and logistics channels [Rifkin 2012] - these are the areas giving the potential for very individual concepts in terms of strategy building. Specialists assume that one of the most important determinants of strategic management of enterprises in the business network will be innovation and new technologies, as well as reduction of human resources for process optimization. Specialists agree that the upcoming revolution will result in the emergence of new comprehensive models of economic activity. These business models will require innovative managerial skills to take full advantage of the opportunities offered by the fourth revolution. A management team prepared in this way will be able to use new theories and management methods. "Perhaps we are moving towards new ways of doing business, where the boundaries between innovation and profit, fun and seriousness (...) will be erased". [New directions in organization and management 2012]. Moreover, this thinking is overlapping with the contemporary use of technology, to which the level of user confidence is increasing. Process remodeling must therefore take into account business changes taking place in the economy and propose changes that take into account the latest technologies.

In the following article, the authors focused on the analysis of selected internal processes and proposing solutions related to the IoT, which are aimed at achieving a competitive advantage by more precise responding to customer needs.

Despite the choice of one scope of analysis, it turned out that both the problems and the effects of possible implementations extend to other processes, improving the functioning of the company in a broader context.

RESEARCH OBJECTIVES

The authors of the article attempted to combine process analysis with the Design Thinking method in order to develop and implement simple solutions related to the Internet of Things in a selected company representing small and medium-sized enterprises. The research goal was to

verify the impact of using the above-mentioned methods in creating new innovative solutions within the organization.

The studied company is a producer with a specialized profile in construction field, which distributes their products throughout the country.

In terms of optimization the company X, the research objectives included:

- finding areas inside the X company in need of improvement,
- creating a list of recommendations related to Internet of Things that could be adapted to in the areas indicated in the process analysis in company,
- estimating the benefits of implementing solutions.

DESCRIPTION OF THE RESEARCH METHOD

In the first stage of the study, a group of people employed in various departments of the company X was gathered and a number of preliminary interviews were conducted in order to learn more about the company characteristics and current needs. For further research the "customer acquisition process for periodic inspections in the Service Department" was chosen. In the second stage the process analysis was conducted. BPMN 2.0 notation was used to correctly reflect the processes taking place in the investigated organization. Application of this notation allows for unambiguous representation of processes occurring in the organization in a way that is understandable both, for persons directly implementing processes as well as for managers and IT specialists who implement process changes. The processes, illustrated by maps, constitute the starting point for further analysis [Ragin-Skorecka, Nowak 2017].

In the third stage, in order to create target solutions that could contribute to increase of the effectiveness of the process, workshops were conducted in accordance with the Design Thinking methodology based on process maps developed during previous stage of the project. Design Thinking, as a supporting method, allows for quick and precise detection of areas of potential improvements and development of a target model of a new process together with its prototyping, without incurring high costs. An additional benefit of joint workshop work on solutions is the understanding by team members of the nature of the developed changes, and the possibility of direct impact on their formation allows to identify with the possible implementation. This creative method is used to constructively solve the diagnosed problems. In this particular case, the workshop was attended by the employees of the Service Department,

to whom the examined processes were presented. In the abstract of the workshop the aim of the project, the definition of the problem and the challenges they bring with them were emphasized. It also outlined the expected changes and the values we want to achieve thanks to the process changes.

The workshop consisted of several phases:

1. Project brief.

Brief defined the problem identified at an earlier stage thanks to process analysis and map preparation (AS IS). The abstract of the workshop indicated the purpose of the project, the definition of the problem and the challenges. Expected changes were outlined.

2. Individual generation of ideas.

Workshop participants were asked to generate as many ideas as possible about how to make the expected changes.

3. Group verification of ideas.

All individual ideas in groups were verified. They were evaluated and classified. Each group selected one of the best ideas, which was then subjected to the process of refining.

4. Prototyping selected ideas.

Selected ideas were prototyped and presented in the forum for evaluation. In the fourth stage the best concepts of changes developed during the Design Thinking workshop had an impact on the final shape of maps, presenting the target way of functioning of a given process (TO BE). This allowed to easily and transparently compare the course of both processes (Current and Target).

In order to provide a thorough analysis and more accurate effectiveness, the process taking place in the Service Department has been extended to include the diagnosis of neighboring processes. The extensive review resulted in comprehensive solutions, whose effectiveness can be evaluated in the context of the entire company, and not only in the context of one department.

DESCRIPTION OF THE RESEARCH RESULTS

The process of implementing the IoT-related solutions in the X manufacturing company took three months. In the first phase of the project, the authors of the article tried to discern which processes are the most important from the point of view of customer service. Although X is an economic entity whose activity oscillates around the manufacture of specialized products, it

was noticed at the beginning of the analysis that the improvement of processes related to the processing of internal information focused on customer service may be a determinant of development.

In the existing business model of the company, there are two separate departments which contact the customer and influence the number of orders received by the company and contracts signed. These are the Sales Department and the Service Department. Both of them work in cooperation with the Execution Department, which realizes the topics acquired by the trade and after the investment is completed, they transfer them to the Service Department. The task of the latter is to maintain relations with the end customer, acquire service orders and sign long-term inspection contracts.

The authors focused on the flow of intra-organisational information about realizations. The circulation of the offer or contract, which is transformed into a production order with an individual number and then the company's implementation, was analysed and finally it became the subject of preparation by the Service Department. In case of large investments, a contract is signed between X and the client, the details of which very often relate to the obligations of other departments, such as Construction, Production or Service Departments.

At the very beginning of order circulation, a *Contract File* is created, containing the most important information necessary for order processing. The above mentioned *File* circulates all sensitive departments of the company and is finally archived in the Service Department.

During discussions with individual departments and preliminary analysis, it was decided that two service processes will be subject to detailed mapping, the task of which is to obtain new contracts for service inspections and the course of inspections. There were several reasons for such decision. First of all, these processes have a large income potential, as the number of facilities supplied with the company's products throughout the country is growing every year, and each of them is a potential service client of X. The Service Department, in addition to acquiring customers for periodic inspection, also deals with complaints, defects and free inspection, which significantly reduces the sales effectiveness of the team. Therefore, it seemed to be a good idea to find a solution that would guarantee easier target customer service. Additionally, the implementation of new solutions in this department turned out to be faster and simpler during the preliminary analysis than in the case of other business paths of the company. The estimated cost is much lower than in case of implementation of solutions in other

departments, which has an additional impact on the positive approach of the Management Board to invest in changes that may bring long-term benefits.

Areas qualifying for improvement in the Service Department were identified in the course of research work. The mapped processes (Figure 1) revealed information gaps and activities which turned out to be duplication of data already entered by other X company departments. In order to make this process more complete and to be able to accurately illustrate the internal organisational problems accumulated in the studied area of the company, the authors also analysed the preceding stage of the process - the customer service process. It turned out to be necessary from the point of view of effectiveness of the proposed solutions. The problems of the Service Department did not start at the level of the team itself, but are the result of decisions and actions taken at an earlier stage of implementation. The effects of the analysed processes are accompanied by a high risk of failure due to failure to provide complete information necessary to undertake sales activities.

It was diagnosed that some of the activities in the process are possible to eliminate. These elements have been marked in blue on the AS IS charts and listed in Table 1. It applies to: analysis *of Execution File,* analysis of production order lists in xls file (by Service Department Manager), manual control of dates for offering service (by Service Department Specialist), *KT product plate* verification (by Service Crew and Service Department Specialist).

This applies to the preliminary analysis of production order lists, offer numbers in an xlx file and the review of the *Execution File* provided by the Execution Department. All these analyses are performed by the manager.

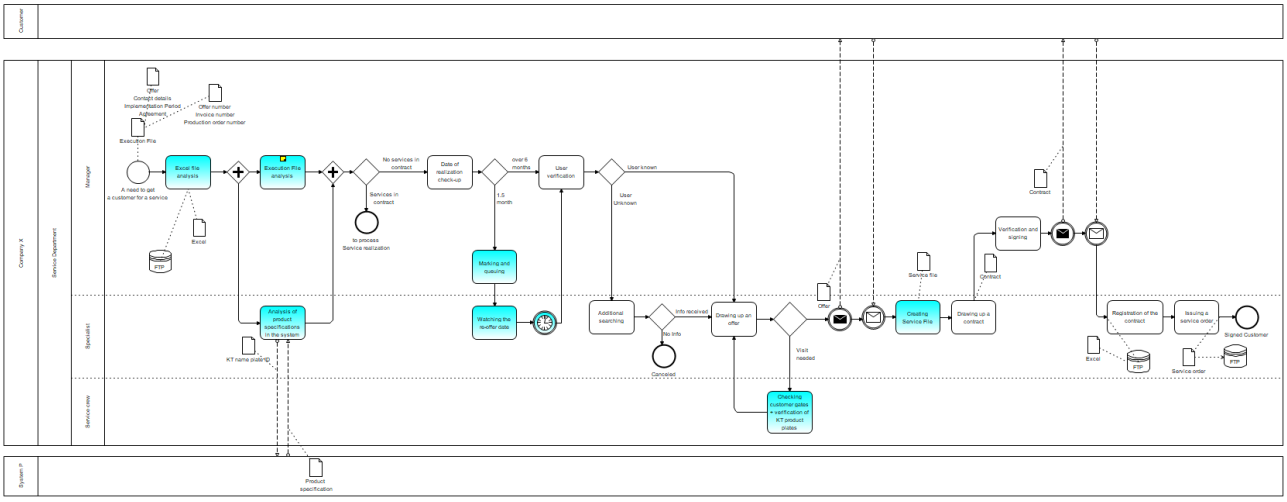

Fig. 1. Process of acquiring a customer for periodic service - current state (AS IS) Source: own elaboration.

Table 1. Areas selected for improvement in the process of acquiring customers for periodic service – current status of AS IS.

Areas identified for improvement	Characteristic	Current state
Analysis of Execution File	All documents that are included: - commercial offer, - agreement, - contact details and email arrangements, - production order, - invoice.	Approximately 7 Execution files per month
Analysis of production order lists (in xls file)Analysis of product specifications in the system	Contains all production orders for a given month. Helps identify products on site.	Approximately 50 production orders per month/
Manual control of possible service offer dates	A list containing all service offers provided to customers in a given month.	Approximately 25 Service Offers month
KT product plate verification	The KT product plate contains information collected inside the company: - product type and characteristics, - product components,	Approximately 140 products per month

Areas identified for improvement	Characteristic	Current state
	- production date.	
Creating Service File	Follow-up of previous service activities necessary to sell service services.	Approximately 25 Service Files per month

Source: own elaboration.

Due to the fact that all necessary data is collected to start the topic at earlier stages of implementation, placing the data in one interactive place would facilitate the issues of data collection and analysis. A *cloud storage* was proposed, which not only enables access to all interested parties, but also supports superior management. The mapping also resulted in the assumption that the preparation of service offers, their updating, as well as the creation of *Service File* could take place in the cloud.

The *cloud storage* allows the user to plan a series of reminders to make necessary updates and changes, which in the case of many topics run in parallel can be a great convenience. A necessary condition, however, is the updating of the indispensable data at earlier stages of implementation, developed jointly by all departments.

At this stage, an interactive *KT product plate* with a QR code was also generated as a solution guaranteeing more efficient product identification. The QR code allows linking up the information identifying it with a specific object. Therefore, there would be no need to visit service groups in order to verify incomplete data and to check whether they are duplicated by service specialists in the IT system within the organization (P System). In addition, it was noted that assigning *sales supervisors* to individual customers may result in greater loyalty of clients to the company. The proposed changes are shown on the TO BE map (Fig. 2).

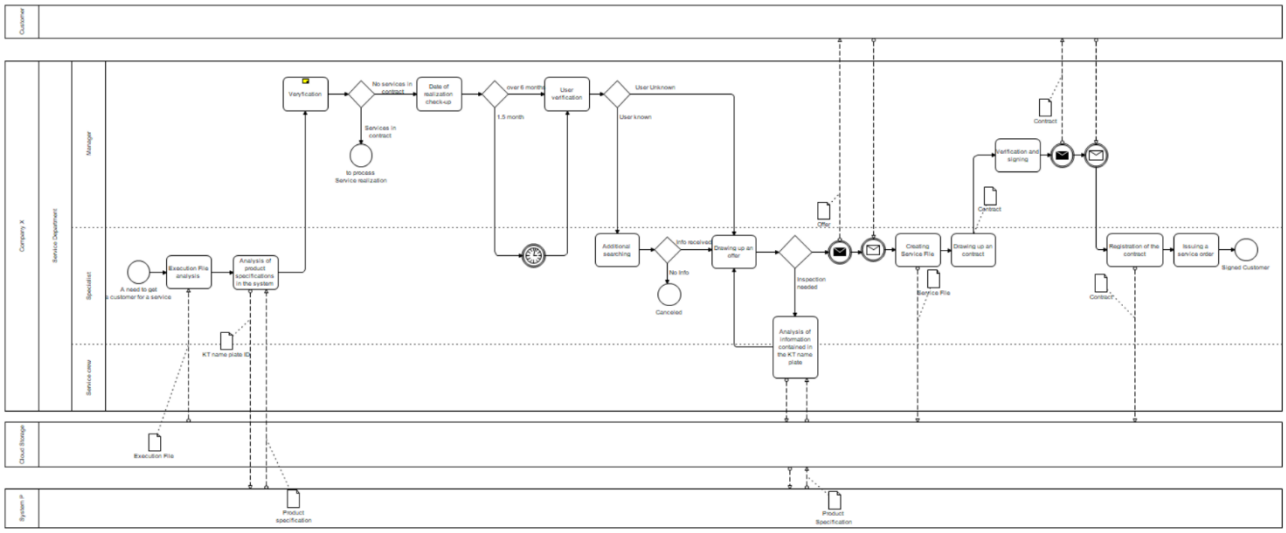

Fig. 2. The process of acquiring a customer for periodic service - TO BE.
Source: own elaboration.

The key changes in this process are:

- reduced managerial workload - any data needed for analysis is taken from a shared *cloud storage* and pre-processed by a specialist,
- no need to verify the date of re-offering in the Service Department, thanks to automatic system notifications - relieving the specialist from these duties while increasing the effectiveness
  and accuracy of this task,
- introduction of an interactive *KT product plate* of the product - all necessary production data is linked up into a plate attached to the product. Customers interaction with the plate sends the X company, a set of data necessary to prepare the service,
- creation of *Service File* in a *Storage Cloud* - this procedure will allow to improve the quality of other related processes,
- a *dedicated sales supervisor* for individual companies – according to the analysis there is no need for additional recruitment - the resources released during automation of other processes should be sufficient to handle new tasks.

Similar problems, as in the process of acquiring a customer for a periodic service, were noticed at the next stage of the department's employees' activities. There are areas that can be eliminated in the course of the periodic inspection process.

An additional implementation proposal are *RFID chips* or *beacons*, which, when properly placed on the shelves in the warehouse, could help the Logistics Department and the Service Department
to diagnose warehouse shortages. Delegated employees, equipped with appropriate mobile applications in their phones, would receive notifications of low inventory levels.
The key changes in the process are:

- introduction of an interactive *KT product plate* - instead of marking with service stickers the products that have been checked, the information will be uploaded to *Cloud Storage* with the help of QR code. The information stored will allow service technicians to check the exact product specification before a periodic inspection and to prepare spare parts with the statistically highest probability of failure. The result would be a significant increase in the chance of express repair, which will reduce the costs associated with business travel and service technicians' working hours, but can also directly contribute to increase the customer's satisfaction,
- elimination of the activities of drawing up a protocol for the execution of service activities - it is generated during the product status update,
- additional supervision over warehouse inventory through *chips* or *beacons* - this is to improve warehouse logistics management, which will have a direct impact on the improvement of the discussed processes.

RESEARCH RESULTS

The study combined two methods: process analysis and Design Thinking to optimize intra-organizational processes and develop new solutions to improve processes performance. At the analyzed stage of the study, the authors considered the combination of both methods to be more effective than when individual methods were used separately. The combination of: identifying customer needs, standardized process analysis, creativity and prototyping allowed to identify a number of solutions for the examined company that can be implemented.

In order to increase X's competitive advantage, it was proposed to use the latest technologies within the scope of optimisation activities. It was noted that the implementation of several solutions related to the Internet of Things may significantly improve the functioning of the whole process.

The concept of the Internet of Things was created in 1999 by Kevin Ashton who described it as „a network of interconnected objects" [Ashton, access: 2009]. The idea behind the IoT is to connect intelligently, through a network of Internet devices, machines, products or dedicated programs that collect data and share it with each other, creating added value through this relationship.

Manufacturing of personalized services or products in the industry requires dedicated business solutions. They are developed in close cooperation with the customer, after a thorough analysis of his needs - they are to be manufactured as customized products, while maintaining the costs and prices of mass production. The advanced concept of the IoT assumes combining industrial devices and systems into advanced cyber-physical systems, resulting from inter-organisational cooperation. These innovative ways of communication within the organization, with customers and subcontractors are, however, inaccessible to small and medium enterprises (SMEs). The costs of their implementation are too high and most entities cannot implement the desired advanced solutions within their own structures. The authors of the article encountered similar problems in X company, therefore, in order to obtain business value from the use of the IoT it was necessary to take an appropriate approach to data analysis and implementation of automation.

At the stage of proposing dedicated solutions, the following architecture of tools, which make up the IoT solutions, was assumed:

- products that can communicate, transmit information in real time (online) or collect it (offline),
- intra-organizational network mediating in relations of company's teams and contacts with clients,
- an IT system that supports the collection and processing of data, as well as their transfer to equipment and relevant products.

The guarantee of achieving the highest possible intra-organizational value from the implementation of dedicated solutions is their proper selection and proper approach to data analysis within the involved team, and on a wider scale - throughout the entire organization. Taking into account the financial capabilities of the company and the team's approach to change, after a process analysis supported by the Design Thinking method, the following solutions were proposed:

I. *Cloud Storage.*

One data set, established at the stage of creating an offer for the client and updated at subsequent levels of implementation. It should contain the documents necessary for inspection, which would save time for the team at the stage of taking over the implementation and would guarantee greater completeness of documentation. New Microsoft solutions, which are widely used within the organization, were proposed as an application base. The basis for the solution would be Microsoft Teams service based on cloud-based data, containing services and a range of tools for teamwork [Microsoft Teams: 7 things you need to know, access: 2016] .

II. *Interactive KT product plate* of the product.

Each product manufactured by the company X is marked with a rating plate (*KT plate*) specifying its basic data. The marking with a plate is done after assembly and product inspection by the manufacturer or an authorised assembly company. It is possible to place a QR code, which would be connected to the product database, on the plate. The QR code can be used by the customer to contact the Service Department in case of failure or the need to inspect the product. For the team, this solution would guarantee direct, detailed product identification.

III. *RFID chips or beacons* - support for warehouse management.

Additional help in more efficient customer service of the service department (but not only) can be the use of *RFID chips* (radio-frequency identification) hidden in the shelves, which with almost 100% accuracy will determine how many pieces of product remain on the shelf and signal the need to order goods. A similar proposed method are beacons - simple devices that use Bluetooth protocol to send information to nearby smartphones with appropriate application software to read this information.

IV. Dedicated *Customer Sales Supervisor*

It would be extremely helpful for the Service Department to support its customers by dedicating individual customers to them. Employees could be additionally trained in the IoT-related solutions, which would greatly facilitate the implementation of the proposed changes and improve communication between the customer and the company.

The authors of the article noted that the use of the Internet of Things in the company's development strategy creates many opportunities to gain a competitive advantage. The benefits

of the IoT solutions include: cost reduction, increased productivity, more efficient use of internal resources and improved customer relations. The conducted research allowed to generate ideas allowing to increase the effectiveness of the company in the areas investigated and to initially design their implementation as well as to identify the basic phases of the implementation of projects based on the IoT in the company. These stages should be expanded and described in subsequent articles on this subject.

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TECHNOLOGIES IN THE CHAINS OF SUPPLY OF INTERNATIONAL ENTERPRISES

ABSTRACT

Background: Dynamic technological progress as well as more and more difficult business conditions are key factors that stimulate the increase in the use of modern IT tools to manage integrated links within chains. One can point to such approaches as: Industry 4.0, and increasingly even Industry 5.0, emphasizes the importance of technologies such as IIoT (Industrial Internet of Things) and ICT (Information and Communication Technologies). Nowadays, modern technologies are gaining more and more importance in supply chain management, leading to the transformation of its three elements: network structure, business processes and management components. Both in the literature and in business practice, the role of SMAC digital technologies is emphasized, in other words: social media, mobile technologies, advanced analytics and cloud computing (cloud).

Methods: The purpose of the article is to analyze modern technological solutions in the field of supply chain by international enterprises. The research methods used were the analysis of the literature on the subject and diagnostic soda (the original questionnaire form was used). 20 international entities constituted a research sample.

Results: Currently, although it is possible to point to examples of the use of SMAC technology in supply chain management, it should be noted that they are developed primarily by business leaders and are at the stage of developing implementations in the light of such supply chain management concepts as: agile, lean, demand driven, resilient, sustainable.

Conclusions: The current scope and effects of approximate applications in the technology article point to an evolutionary change in supply chain management. High potential for their development in the 21st century, creates the perspective of transformation of supply chain management models in the future.

Keywords: supply chain, digital technologies, digital supply chain, and digitalization

INTRODUCTION

IT solutions have revolutionised the business models and processes of multinational companies, which are defined as entities with their headquarters in their home countries, for years, but generate a significant part of their revenues from other countries by extending their organisational structures (to other countries).

Skills of effective use of the potential of digital technologies and digital competences of organizations become a source of competitive advantage of entire industries and economies. In 2020, the saturation level of the world economy will reach 25%, while in 2005 it was only 15% [Concoran 2016]. The functioning of international organisations in the global economy has become synonymous with modern management. This becomes particularly important in the period of digital transformation, the essence of which comes down to building more effective supply chains based on new business models supported by advanced IT solutions.

There are many IT tools that can contribute to the digitalisation of the supply chain. These include social media, mobile devices, data analytics and cloud computing. This categorisation is referred to as the SMAC concept, also referred to as the third platform. It is a new generation of technological trends that individually have the potential to generate benefits in the supply chain, and together they can create a completely new quality of the process flow.

There is a wide range of information technology. However, in the case of four categories: social networks (Social), mobile devices (Mobile), data analytics (Analytics) and cloud computing (Cloud) they are described by the acronym SMAC. The SMAC effect is the creation of completely new models of supply chain management that significantly change the existing logistics processes.

It is pointed out that 76% of enterprises will now use social media, and 63% of entrepreneurs claim that analytical tools allow them to gain a competitive advantage. As many as 92% of entrepreneurs are satisfied with cloud services and plan to increase their use, and 54% of mobile phones are smartphones [Slowik 2015].

Such a significant business potential of SMAC technology may also translate into the functioning of supply chains, in particular those built by international companies, for which an efficient information flow, ongoing monitoring of flows, the ability to access data by all employees regardless of location, ongoing analysis of complex numerical data, are essential.

SMAC TECHNOLOGIES IN SUPPLY CHAINS

Ernst & Young's global reach study shows that Information and Communication Technology (ICT) managers currently spend more than 25% of their budget on SMAC innovation [Ernst & Young 2015], i.e. on technology development such as social media, mobile, advanced data analytics and cloud computing. These technologies create a specific ecosystem that enables enterprises to improve the quality of operations and get closer to the customer [Rutkowski 2016]. The individual SMAC categories (Social, Mobile, Analytics, Cloud) will be explained below.

Big Data Analytics (BDA) focuses on the use of advanced methods and models of data analysis mainly to identify interdependencies and predict future phenomena. The potential of Big Data Analytics is described in literature as a "management revolution" and assessed as a key element in value creation, gaining influence over all activities of enterprises [McAfee and Brynjolfsson 2012; Fosso Wamba et al. 2015]. Despite the huge potential for opportunities and benefits identified by the authors, Big Data Analytics is currently at an early stage of development in terms of its use in management, including supply chain management [Kache i Seuring 2017]. The gradual development of BDA applications is evolutionary and complementary to concepts such as business intelligence, business analytics and master data management. Understanding customer behavior and preferences is one of the greatest benefits of using analytical tools. From the collected data, analyzed by advanced algorithms, entrepreneurs are able to deduce how to take care of customer loyalty, improve marketing campaigns, improve product development processes and provide services that match the preferences and requirements of customers. By knowing the tastes of users, entrepreneurs are able to, among others present content in line with their expectations. The overriding goal of using analytical tools in running a business is therefore to make the right decisions based on current and aggregated information.

Cloud computing refers to the ability to use ICT resources shared and made available over the Internet. It covers the following main types of services: Infrastructure as a Service (IaaS), Software as a Service (SaaS) and Platform as a Service (PaaS). It has the most important features such as: stand-alone configuration tailored to the individual needs of the user, availability from a variety of devices connected to the network regardless of location, flexibility to change the required resources, and measurability of service and charging according to the

resources used. According to K. Nowicka [2016], cloud computing uses external resources through IT environment management in a service model based on virtualization and centralization of IT infrastructure. Cloud computing technology offers tools for efficient information gathering and effective business management. Using the tools available in the cloud allows entrepreneurs to reduce IT costs, overcome geographical barriers and have access to data at any time and place. The cloud is the factor that binds the other elements that make up SMAC.

Mobile technologies include mobile devices, mobile software and related professional IT and telecommunication services. In particular, attention is drawn to the huge potential of mobile technologies in the context of the Internet of Things. Their development is assessed as one of the greatest innovations in logistics, a powerful force capable of triggering significant changes in supply chain management [Frandsen 2014]. Integration of mobile technologies can lead to real-time business process management in an effort to reduce costs and improve flexibility, resulting in enhanced supply chain competitiveness [Eng 2006; Ferguson 2012]. Mobile devices have also increased the ability to reach companies who, using mobile devices, have become accustomed to shopping and using various types of services and applications at any time and in any place. The growing popularity of mobile shopping has forced entrepreneurs to develop their online marketing channels and provide mobile channels to customers. Under these conditions, presenting an offer on mobile devices is the basis for gaining or maintaining a high market position.

Social media refer to informational communication in the form of multimedia, multi-channel network communication for specific social or business purposes in various types of community portals. The data collected through social media and mobile technologies are of an individual nature, and their analysis allows companies to precisely identify customer segments. In this way, companies seek to hyperpersonalise the value delivered in relation to individual needs, expectations and experiences of consumers in supply chain management. Social networks break the barriers of information flow between people and become platforms thanks to which quick exchange of knowledge is more and more effective. Communication within social platforms strongly displaces telephone or email communication. This phenomenon also occurs in the business area, where rapid exchange of information is extremely important. The use of social networks allows for better interaction with customers, thanks to which it becomes

possible to respond faster to problems and build a knowledge base based on the preferences and behavior of users. Associated employees can exchange experiences, interesting content and speed up problem solving much easier and faster.

In addition, attention should be drawn to the clear need for technology integration to ensure the fullest possible access and transparent flow of information for decision-making at all levels of management: strategic, tactical and operational. Joint research by A.T. Kearney and WHU Otto Beisheim School of Management has shown the most important aspects: IT integration between all business functions in an enterprise and supply chain partners, use of Big Data Analytics to improve supply chain management, implementation of electronic circulation and archiving of transport documents and use of e-platforms as tools to support selection and transactions with carriers [Schmidt et al. 2015].

It is also worth noting the wider perspective of the possibility of integrating SMAC technology in the world of the Internet of Things, augmented reality or Industry 4.0.

Enterprises use the potential of digital technologies in different ways and to different degrees as value sources and transform supply chains. At the same time, it is pointed out that the implementation of digital technologies requires strategic changes in both the business model and the operational model of the enterprise [Bock, Iansiti and Lakhani 2017]. The main challenge for the development of applications of these technologies is the threats in global cyberspace, which significantly increase the negative risks for data security or transmitted information [Boyes 2015]. Barriers to digital deployment also include: lack of sufficient knowledge about the essence and importance of digitalisation, inadequate assessment of its potential, lack of capital for technology investment and lack of trust preventing information exchange [Sherman and Chauhan 2016].

An important aspect of advanced digitalisation is the deeper integration of technologies and business processes leading to the creation of intelligent digital supply chains (smart, digital supply chains). The Global Supply Chain Forum defines supply chain management as the integration of key business processes from initial suppliers to end users who provide products, services and information and add value to customers and other supply chain stakeholders [Lambert 2001, p. 100]. Integrated systems extend the scope of technology implementation from individual companies to supply chain implementation. They ensure data acquisition,

information exchange and communication between the links, supporting managerial decisions and actions that respond to customer needs.

ASSUMPTIONS OF OWN RESEARCH - METHODOLOGY

The study focused on the use of SMAC technologies in the functioning of the supply chain of multinational companies, taking into account the effect of their use. The research sample consisted of 20 multinational companies (about 250 invitations to participate in the study were sent by e-mail). The selection method was a simple random sample, and the criteria for participation: running an international business and agreeing to participate in the survey.

The survey was completed by employees at various levels of the organization, among others: mention managers, logistics managers, operational managers, development managers, CEOs, branch directors, business change management. The method of the diagnostic survey was used. The technique was a questionnaire, and the research tool was an original questionnaire. The survey was conducted in August and September of 2019.

The aim of the study is to analyze modern technological solutions (SMAC) and the effects and application on the scale of the supply chain by international companies.

The author posed the following research problems:

- Q1: What tools do international companies (participating in the survey) use when it comes to social media?
- Q2: What are the effects of using social media in the functioning of the supply chain by international companies (participating in the survey)?
- Q3: What tools do international companies (participating in the survey) use when it comes to mobile technologies?
- Q4: What are the effects of the use of mobile technologies in the supply chain by multinational companies (participating in the study)?
- Q5: What tools do international companies (participating in the survey) use when it comes to data analytics?
- Q6: What are the effects of using data analytics in the functioning of the supply chain by multinational companies (participating in the survey)?
- Q7: What tools do international companies (participating in the survey) use when it comes to cloud computing?

- Q8: What are the effects of the use of cloud computing in the functioning of the supply chain by multinational companies (participating in the study)?

The original questionnaire consisted of 9 questions in total and included also a metric, which concerned the industry in which it operates, the position of the person filling in the questionnaire, the logistics area in which the company operates, the range of activities and the number of employees.

The research methodology algorithm is presented in Figure 1.

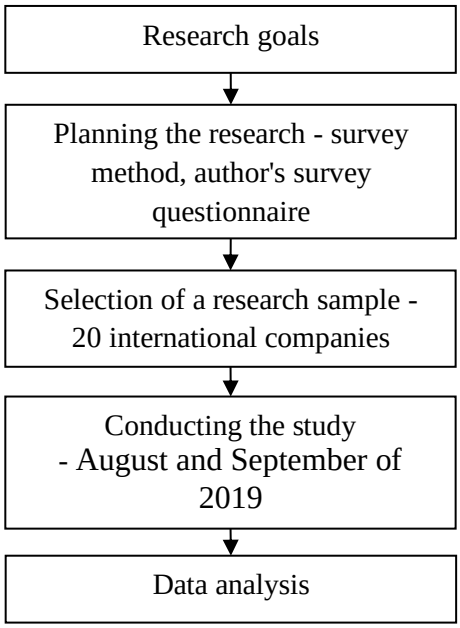

Fig. 1. Research methodology.
Source: own elaboration

Analysis of the survey questionnaire is included in the next section.

ANALYSIS OF SMAC SOLUTION IN INTERNATIONAL ENTERPRISES - OWN RESEARCH

The majority of entities participating in the survey were manufacturing companies (60%), also from the transport sector, forwarding logistics (35%) and the remaining 5% from the automotive sector.

Among the employees who filled in the questionnaires we should first of all mention managers (35%), logistics managers (25%), operational managers (15%), development

managers (10%), as well as CEOs, branch directors, business change management (all of them 5%).

Referring to the scope of activity (in geographical space), most entities (65%) operated on a European scale, on an intercontinental scale 20% and the remaining 15% globally.

The level of employment was considered in two ways: in Poland and globally. In the analysed entities, employment in Poland ranged from 80 to 15,000 (average 1688), while in the global perspective from 120 to 600,000 (average 4991) employees.

Each of the SMAC technologies (social media, mobile devices, data analytics, cloud computing) was analyzed in terms of the tools (functions) used and the effects achieved in the supply chains of multinational companies.

As the tools and functions used in the field of social media, social media (Lindedln, Facebook, Twitter) - 46.94%, marketing channel (16.33%) and algorithms of data analysis (14.29%) (Table 1) were indicated.

Table 1. The role and use of social media in supply chains (functions and tools used)

Used tools	[N]	[%]
The use of social networking sites, which Linkedln, Facebook, Twitter	23	46,94%
Marketing channel	8	16,33%
Integration of social platforms with CRM sytems	3	6,12%
Data analysis algorithms	7	14,29%
Cooperation with clients	6	12,24%
We don't use such tools	2	4,08%

Source: own elaboration.

The use of social media technologies in supply chains contributes primarily to improving flexibility in the implementation of orders (41.86%), increase in efficiency in managing production flows, including inventory management (20.93%) and improving the level of customer service (18.60%) (Table 2).

Table 2. The role and use of social media in supply chains (main effects in supply chain management)

Effects in supply chain management	[N]	[%]
Improving flexibility in the implementation of orders	18	41,86%
Improving the level of customer service	8	18,60%
Improving customer satisfaction	2	4,65%

Shortening the response time to customer needs	5	11,63%
Increase in efficiency in managing production flows, inclugind inventory management	9	20,93%
Other, building the company's image	1	2,33%

Source: own elaboration.

Among the functions and tools related to mobile technologies, the most frequently indicated were use of PDA mobile devices (36.67%), Applications for mobile devices with the ability (33.33%), and also reading data using a mobile application operating in a Wi-Fi wireless network on other mobile devices (30%) (Table 3).

Table 3. The role and use of mobile technologies in supply chains (functions and tools used)

Used tools	[N]	[%]
use of PDA mobile devices	11	36,67%
Applications for mobile devices with the ability	10	33,33%
Terminals enabling ongoing monitoring of product status and immediate updating	5	16,67%
Reading data using a mobile application opeating in a Wi-Fi wireless network on other mobile devices	9	30,00%
Mobile applications providing access to simulation of change in augemented reality	2	6,67%
We don't use such tools	1	3,33%

Source: own elaboration.

The use of mobile technologies in supply chains contributes to greater flexibility in order processing (30.19%), moreover, minimizing response time to customer needs (24.53%) and improving the level of customer service (16.98%) (Table 4).

Table 4. The role and use of mobile technologies in supply chains (main effects in supply chain management)

Effects in supply chain management	[N]	[%]
Increasing the efficency of product flow management and inventory management	7	13,21%
Greater flexibility in order processing	16	30,19%
Minimizing response time to customer needs	13	24,53%
Improving the level of customer service	9	16,98%
Increasing the degree of product customization and delivery method in response to customer needs	5	9,43%
Shortening order cycles	1	1,89%
Reduction of stocks of finished products	2	3,77%

Source: own elaboration.

The functions and tools related to data analysis include mainly application in the design of transport routes (36,36%), the use of Big Data Analytics, mobile applications using augmented

reality and wireless communication in the world of the Internet (18,15%) and use in product design processes (11,36%) (Table 5).

Table 5. The role and use of advanced data analytics in supply chains (functions and tools used)

Used tools	[N]	[%]
The use of Big Data Analytics, mobile applications using augemented reality and wireless communication in the world of the Internet	8	18,18%
Use in product design processes	7	15,91%
Application in production management and order processing	5	11,36%
Application in the design of transport routes	16	36,36%
Mobile applications providing access to simulation of change in augemented reality	3	6,82%
We don't use such tools	5	11,36%

Source: own elaboration.

The use of data analysis technologies in supply chains contributes to cost reduction and reduction of product development time (25%), reduction of transport costs (18,18%) and waste elimination on prototyping and production resources (13,64%) (Table 6).

Table 6. The role and use of application of advanced in supply chains (main effects in supply chain management)

Effects in supply chain management	[N]	[%]
Improving the accuracy of demand forecasts and the diagnosis of customer needs	4	9,09%
Cost reduction and reduction of product development time	11	25,00%
Eliminate waste on prototyping and production resources	6	13,64%
Increasing the efficiency of production flow management	5	11,36%
Optimization of transport routes	2	4,55%
Shortening of routes and delivery time in transport processes	1	2,27%
Reduction of transport costs	8	18,18%
Reduction of CO2 emissions	4	9,09%
Improving the transparency of information flow between the supply chain	3	6,82%

Source: own elaboration.

Among the functions and tools related to data analysis, the following have been identified in particular shared use of resources made available via the Internet (use of infrastructure, software, platforms) (36,67%), availability through a variety of network connected devices, regardless of location (30%) and independent configuration tailored to the individual needs of the user data analysis for threats, updating information on planned delivery dates (20%) (Table 7).

Table 7. The role and use of cloud computing in supply chains (functions and tools used)

Used tools	[N]	[%]
Shared use of resources made available via the Internet (use of infrastructure, software, platforms)	11	36,67%
Availability through a variety of network connected devices, regardless of location	9	30,00%
Independent configuration tailored to the individual needs of the user data analysis for threats, updating information on planned delivery dates	6	20,00%
We don't use such tools	4	13,33%

Source: own elaboration

The use of data analysis technology in supply chains contributes to reduction of administrative costs in the supply chain (38,46%), reduction of customs service time (20,51%) and increasing the ability to avoid negative events (15,38%) (Table 8).

Table 8. The role and use of cloud computing in supply chains (main effects in supply chain management)

Effects in supply chain management	[N]	[%]
Reducing fluctuations in the delivery cycle	5	12,82%
Increasing security of supply	3	7,69%
Shortening the response time to phenomena that have a nagtive impact on business process continuity	1	2,56%
Increasing the ability to avoid negative events	6	15,38%
Reducing the cost of maintaining inventory in transport	1	2,56%
Reduction of customs service time	8	20,51%
Reduction of administrative costs in the supply chain	15	38,46%

Source: own elaboration.

CONCLUSION

The functioning of modern international organizations within the global economy requires the use of management methods and supply chain development strategies adequate to the new management conditions at the digital transformation stage.

The developmental direction of the digital supply chain maturation period in the field is now the use of SMAC information technologies, which apart from flexible and effective data collection, analysis and knowledge generation through automatic conclusions based on the results of this analysis, can also "understand" the importance of phenomena occurring in the environment of the organization.

The economic changes in the digital transformation process and the evolution of business relations mean that international entities, in order to compete effectively in global markets, must give decisive importance to their flexibility and ability to implement innovative business

models and process reorganisation through the organisation of supply chains. This will allow to achieve higher levels of digital maturity, which will translate into greater efficiency of supply chain operation during the digital transformation period - significant changes in the reconfiguration of logistics processes and business communication are already visible.

Research has shown that SMAC-class digital technologies generate positive changes in the functioning of supply chains of multinational companies. It is worth noting that digitalisation is a phenomenon that will continue in the future. The main benefits are as follows: improving flexibility in the implementation of orders, increase in efficiency in managing production flows, including inventory management, greater flexibility in order processing, minimizing response time to customer needs, cost reduction and reduction of product development time, reduction of transport costs, reduction of administrative costs in the supply chain as well as reduction of customs service time.

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II. PROCESS DESIGN IN DIGITAL CONDITIONS

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PROCESS AWARENESS OF AN ORGANISATION – RESULTS OF PILOT STUDIES

ABSTRACT

Background: The article presents the results of studying process awareness in organisations. The target group comprised operational staff working in commercial companies. Survey questionnaire, which included standardised questions asked directly to employees carrying out basic processes during anonymous interviews, was used as a research tool. Obtained answers were analysed in quantitative terms, taking into account the specific industry and the size of a specific organisation. Companies representing industrial processing industry and the TSL sector, declaring high process awareness, constituted over a half of the studied group. The analysis of answers proves the lack of process awareness among employees performing operational actions.

Methods: The purpose of the study was to gain knowledge on the awareness of functioning processes among people who carry out basic activities. The study uses a survey questionnaire which, to make sure that employees understand the questions better, purposefully includes references to specific professional experiences, not to the knowledge on process management.

Results: The result of the study was a quantitative analysis of answers, providing for the size of the organisation being the object of the study (micro-, small and medium). The results have borne out the hypothesis that, despite the fact organisations have defined processes, persons responsible for their effective execution (process owners) and persons who design process changes (business analysts), process awareness of operating staff boils down to the knowledge of notions and rules (it is semantic, not practical). The persons performing process activities lack a sense that they are the ones expected to initiate changes in processes.

Conclusions: The awareness of processes taking place in an organisation is a starting point for studying process maturity. The authors believe that employees who perform activities on the operational level are the source of knowledge on the processes carried out in the organisation. They are the source of information for analysts who identify and optimise processes. Furthermore, these employees will be first to deal with the effects of implemented changes. The authors have therefore focused on studying process awareness on the operational level. It is wrong to identify subsequent levels of process awareness without being sure that the awareness of existing processes is common among operational employees.

Keywords: organisation, process management, process awareness and process maturity of an organization

INTRODUCTION

Variable and competitive environment forces organisations to seek better ways to adapt to operating conditions and to introduce changes to management methods. Companies are more and more frequently starting to notice the need to get to know its own processes, describe them and, as a consequence of actions taken, manage the identified processes. The analysis and improvement of processes in an organisation allows focusing on the value generated to the customer's benefit. Finally, it makes it possible to improve both working efficiency and the degree of customer satisfaction.

The use of process-based approach in management of an organisation is a difficult task, requiring changes in many areas, such as organisational culture. The implementation of process management relies on the following rules [Brocke et al., 2014; Brocke, Zelt, Schmiedel, 2016; Skrzypek, Hofman, 2010]:

- trust – using and sharing necessary information concerning the market, the customer and the processes in an atmosphere of mutual trust and partnership,
- communication – promoting horizontal communication between company employees by referring to team work and applying available IT systems,
- motivation – developing a motivation scheme which would reward persons who carry out specific processes and process owners for process results and for meeting customers' requirements and expectations,

- authorisations – providing process owners with permanent authorisations related to making decisions on matters of key significance to the processes,
- leadership – orientating process owners and medium-level managers to performing supporting, coordinating and training functions,
- knowledge – implementing mechanisms that favour team work, experience and the use of knowledge.

Organisations which implement process management may come across a number of obstacles on their way to achieve process maturity. It may cause the company to remain on a certain level of changes, failing to achieve the assumed process maturity level. Willing to meet the process maturity level, one should refer to the assessment of formal matters such as identification of processes, development of maps, and factors such as strategy, organisational culture, actual role of process owners, applied process improvement techniques or IT systems [Giacosa, Mazzoleni, Usai, 2018; Kucińska-Landwójtowicz, Kołosowski, 2012; Raczyńska, 2017; Bitkowska et al., 2011].

PROCESS MANAGEMENT

Publications on the subject include a number of definitions describing the essence of a process. Davenport refers to a process as a "set of structured and measurable actions designed to provide a specific result for a specific customer or a specific market; a process is a structured and measured (finite) sequence of actions designed to achieve a specific result for a specific customer or market" [Davenport 1993]. Hammer believes that "the difference between a process and a task is such as between a whole and a part; a task is a fragment of work normally done by one person, while a process is a linked group of tasks the result of which represents a value for a customer" [Hammer 1995]. Stabryła defines a process as a "sequence of actions representing defined functions, set in a specific order which expresses a causal link of phenomena having influence on a certain object" [Stabryła 1991]. According to Grajewski, a process is a "set of sequenced actions interlinked by cause-and-effect dependencies so that the results of previous actions are the starting points for subsequent actions" [Grajewski, 2007]. All actions taken in an organisation may be assigned to specific processes. It is also possible to indicate, whether the processes are fundamental or auxiliary. It allows generating a dynamic picture of an organisation which finds it easier to adapt to a changing environment [Adamczak et al. 2013; Grajewski 2007].

The analysis of different process description standards makes it possible to ascertain that every process is a whole composed of the following elements [Brocke, Zelt, Schmiedel 2016; Ragin-Skorecka, Nowak 2016; Nowiński, Szymańska 2013]:

- input – the beginning of a process, where cooperation with suppliers who provide an organisation with input outlays usually starts,
- suppliers – usually external entities responsible for providing an organisation with input outlays necessary to complete the process in exchange for economic benefits,
- input outlays – resources and tangible/intangible assets provided by suppliers, necessary to complete the process. Depending on the process, input outlays may include raw materials, semi-finished products, products, services, or documents and information,
- activities and events occurring in a specific process – a set of ordered tasks mutually linked on the cause-and-effect basis carried out by a single person or organisational unit,
- process owner – usually a person supervising and responsible for process execution,
- process result – an effect of processing input outlays as a result of a process,
- process client – a person or an organisational unit obtaining the result of a process achieved as a consequence of its execution. There are internal or external process clients,
- output – the end of the process, i.e. the stage at which the object of cooperation between an organisation performing the process and a process client may be considered complete.

Modelling process in an organisation requires selecting a certain standard. Reference books most often suggest [Śliwczyński 2005; Gajewski 2007; Trzcieliński, Adamczyk, Pawłowski 2013]:

- SIPOC (Suppliers, Inputs, Process, Outputs, Customers) – modelling a client-oriented process according to the value chain concept,
- ARIS (Architektur Integrierter Informationsysteme – architecture of integrated IT systems) – oriented towards building an integrated system of designing and processing information on the course of processes,
- BPMN (Business Process Model and Notation) – describing business and production processes, most commonly used in Poland and in the world [Rosing et al. 2015].

Applied notation allows representing processes occurring in an organisation in a way that will be clear to the persons directly executing the processes, managing the processes and implementing process changes. Processes, illustrated with maps, are a starting point to further

analyses. This is how process models, the simulation of which allows identifying areas qualified for change or indicating the quality of suggested changes, are developed [Kasprzak 2005].

Contemporary process management developed at the beginning of the 1990s. There are two different research directions: Davenport's direction, representing an evolutionary approach, and Hammer's direction, radically reorganising an organisation [Kucińska-Landwójtowicz, Kołosowski 2012]. Later experiences related to reengineering proved that the evolutionary approach, supported by the participation of employees, is correct [Grajewski 2007]. The purpose of process management is to allow the achievement of maximum added value generated by basic processes and the minimisation of the share of ineffective operations.

PROCESS MATURITY OF AN ORGANISATION

The implementation of process management in organisations comes across a number of problems, even though the approach has many advantages. The implementation seems easy – it requires getting input parameters of processes to optimise process outputs, focusing on costs, time, quality and appropriate service. First problems start at the stage of process imaging and process optimisation, and they remain there at the stage of pre-design, measurement and improvement. Implementing process-based approach requires changing organisational culture, motivation scheme, organisational structure or introducing process owners.

Its course is evolutionary and has gradual structure. According to Grajewski [2007] and Souza, Guerreiro, Oliveira [2015], process maturity of an organisation is expressed by the scope in which processes are formally defined, managed, made flexible, measured and made effective. These features are naturally graded and placed on a continuum ranging from an organisation which is immature to the one which is mature in terms of implementing solutions related to processes.

Reference books describe a number of process maturity models applied to organisations. They most frequently list features that prove an organisation's process maturity or immaturity. The characteristics of process maturity and immaturity of organisations have been presented in Table 1.

Table 1. Characteristics of process maturity and immaturity of an organisation

Characteristics of process maturity of an organisation	Characteristics of process immaturity of an organisation
The ability to build and improve a product or a service is a feature of an organisation, not individual employees.	High dependence on the abilities of individual employees.

The processes are fully identified, and knowledge concerning them is effectively transferred to employees. The works related to process designing are planned. The processes are observed and improved also by means of controlled experiments and analyses of relation between cost and achieved effect. The distribution of roles and responsibilities is clearly defined within the organisation of individual projects. The quality of products or services, and the degree of customer satisfaction, are monitored. There is an objective, quantitative base serving the assessment of products, services and actions.	Process efficiency may be predicted up to the stage of an individual project, and not within the whole organisation. Processes improvised by employees and managers. Specified processes are not observed. Reactive management. The schedule and the budget are usually exceeded, as a result of not having been based on a stable course of processes. Assuming invariable limitations on the schedule and the budget, attempting at meeting both of them is done at the expense of quality and functionality of a product or a service. There are no formal or objective criteria for product, quality and process assessment or early identification of problems.

Source: [Grajewski 2007; Looy, Bergh 2018; Neumann, Düring 2008].

Another way of presenting levels of process maturity of an organisation has been shown in Fig. 1. In this model, level 0 means lack of process awareness in a specific company. On level 1, activities are still performed in a chaotic manner, however, the organisation is aware of the need to implement process-based approach. Level 2 is characterised by the standardisation of processes taking place in a company. Processes are identified and duly documented. On level 3, it is essential to measure and record results, to be able to monitor the course of processes and take possible corrective actions on level 4. Level 5 is related to systematic and continuous improvement of processes. Level 6 results from actions taken on the previous level and it marks the maximum status of process management development.

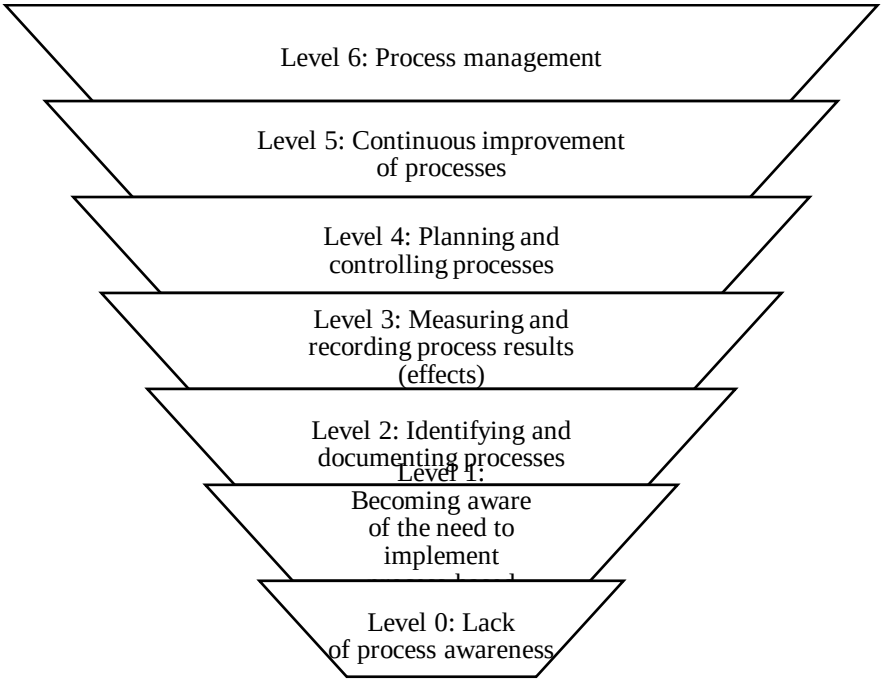

Fig. 1. Process maturity levels of an organisation.

Source: [Nowosielski 2008].

Grajewski defines levels of process maturity as follows [Grajewski, 2007]:

- Level 1 – initial chaos – unpredictability, processes carried out spontaneously,
- Level 2 – applied repeatability – practice and experimenting in search of the ability to repeat actions within processes,
- Level 3 – standardisation – project works as part of processes are standardised, stable and repeatable,
- Level 4 – process management – the application of measurements of process efficiency allows identifying threats and taking effective corrective actions which adapt the organisation in terms of structure,
- Level 5 – continued improvement – continued improvement and optimisation of processes achieved by streamlining current process configurations and introducing new methods and techniques of execution.

The awareness of processes taking place in an organisation is a starting point for studying process maturity. The authors believe that the persons who perform operational activities are the source of knowledge on the processes carried out in the organisation. They will be first to deal with the effects of improved efficiency. The authors have therefore focused on studying process

awareness on the operational level. It is wrong to identify subsequent levels of process awareness without being sure that the awareness of existing processes is common among operational employees.

SCHEME OF STUDY

The study was conducted using a survey method using the online survey technique. The study focused on process awareness in an organisation. The problem results from the fact that it is not possible to talk about process maturity if operational staff actually carrying out the processes is not aware of them.

The first stage in performing the study of process awareness in an organisation consisted in developing a study questionnaire. It was formulated on the basis of reference books, existing methods of researching processes in an organisation and experience related to the analysis of processes in different organisations. Existing questionnaires serving the study of process awareness of an organisation were adapted to make sure that the questions are clear to operational employees. At the second stage, the questionnaire was subject to an assessment by experts, i.e. 6 academics and business practitioners. It allowed assessing the measurement tool. Following the introduction of changes and re-assessment, the questionnaire was made available as an online form.

A pilot study of process awareness in an organisation was carried out in the first quarter of 2019. Its purpose was:

- for respondents to evaluate the study questionnaire (i.e. if the questions were simple and how easy it was to provide answers).
- to select the type of business run by a respondent (indicated by specific numbers of the Polish Business Classification) to the study.
- to select respondents to further studies on the basis of company size (initial analysis of the occurrence of relation between the size of the organisation and its process awareness).
- to initially analyse the results of the pilot study in order to make research hypotheses (apart from hypotheses formulated on the basis of reference books).

The subject of the study included employees of different departments who carry out processes on an operational level and who had agreed to take part in the study. Answers from 20 people were collected as part of the pilot study. The questionnaire was completed with missing

information at the respondent's premises, during an interview made on the occasion of analysing a selected process. It allowed meeting the first goal.

Figures 2 and 3 show the structure of the studied population according to the type of business and company size.

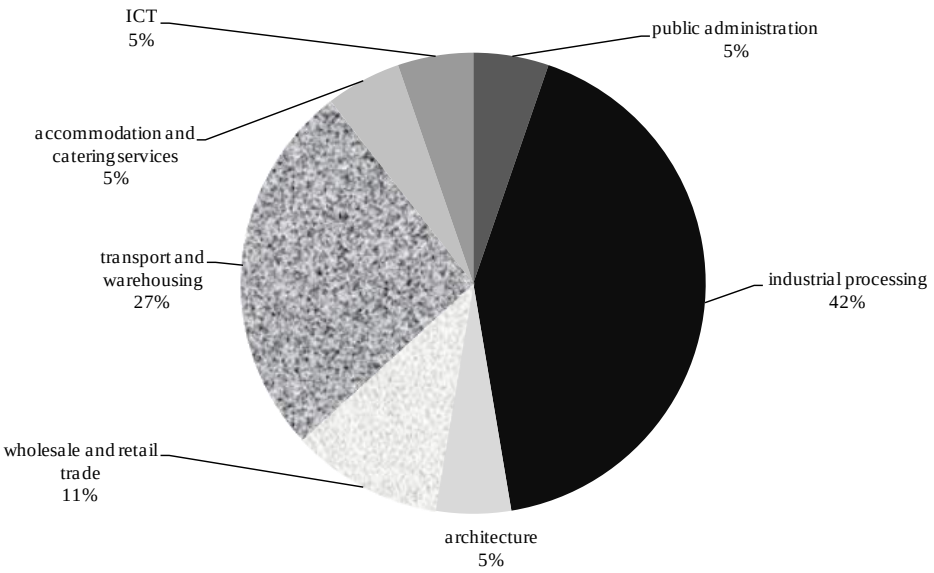

Fig. 2. Type of business run by respondents.

Source: own study on the basis of research results (n=20).

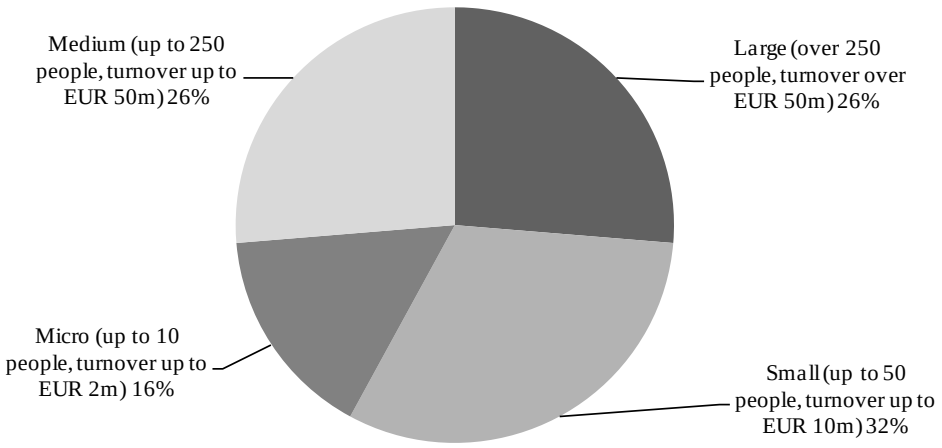

Fig. 3. Company size.

Source: own study on the basis of research results (n=20).

The pilot study was participated mostly by respondents representing the industrial processing industry (42%) and transport and warehouse management (27%). Taking the size of a company into account, it is possible to observe that they are represented approximately in the same way.

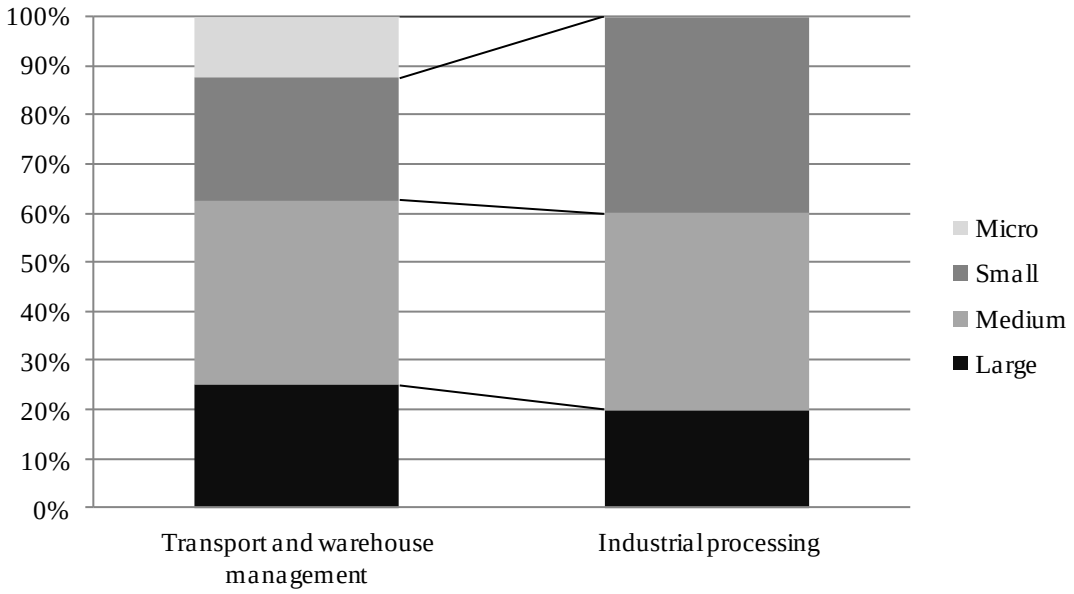

Fig. 4. Share of companies of specific size, depending on industry (the most numerous ones).
Source: own study on the basis of research results (n=20).

The analysis of industries with the largest number of respondents, providing for the size of companies, led to the conclusion that the companies were of different sizes (Fig. 4). There were not any micro-enterprises in the transport and warehouse management industry.

RESULTS OF PILOT STUDIES

Study results were subject to a quantitative analysis and an analysis of obtained results in the context of a specific industry and size of an organisation represented by a specific respondent.

The first question concerned defining a prevalent form of organisational structure. Respondents were to indicate if there were functions, departments or functional units in their organisations (Fig. 5). The majority of surveyed companies (78.9%) acknowledged that such division existed. Only micro- and small-sized enterprises stated there was no division (which results from the absence of such need in such small entities). Making a conclusion on the basis of

these answers, the author claims that this question does not need to be included in the questionnaire.

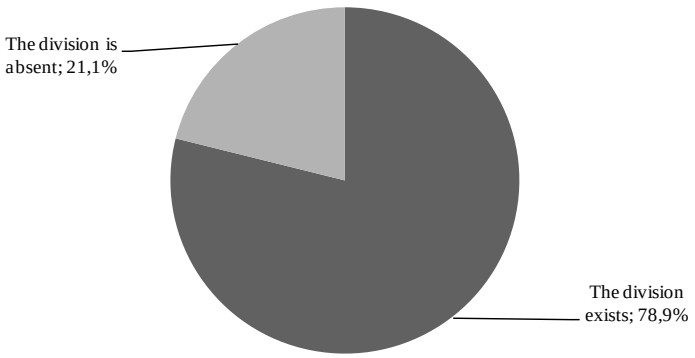

Fig. 5. Division to functions, departments or functional units in an organisation.
Source: own study on the basis of research results (n=20).

The second question required the respondents to indicate which actions concerning process management were carried out (a multiple choice question). The question was to allow the identification of declared actions in the area of process management in organisations. The answers have been presented in Fig. 6.

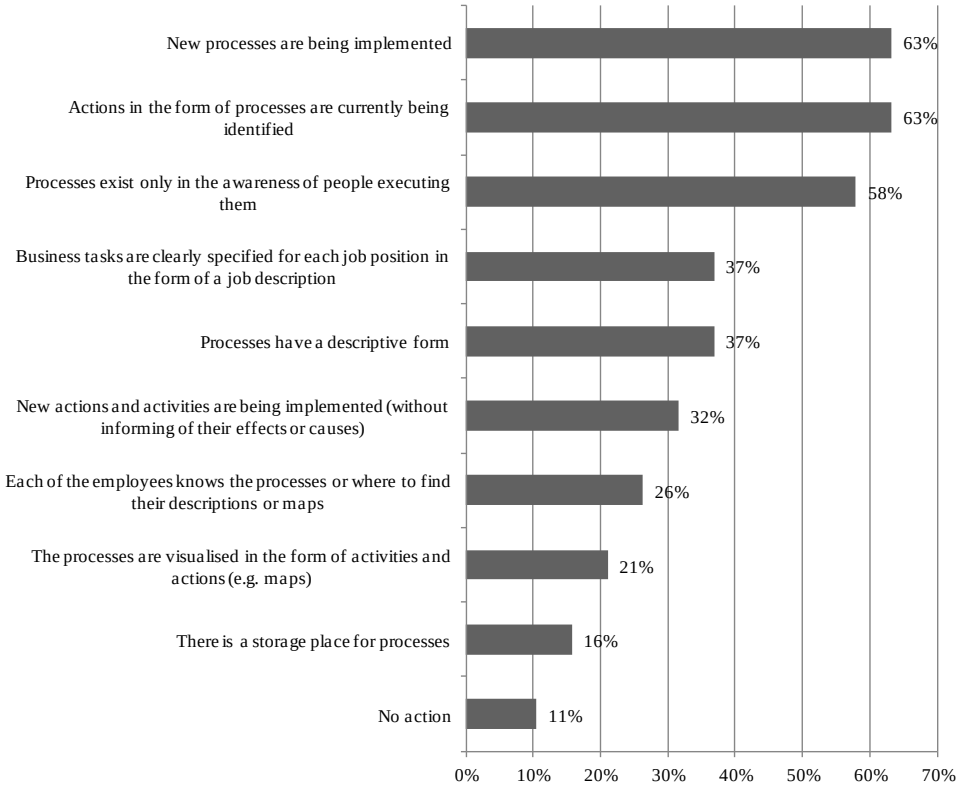

Fig. 6. Declared actions in an organisation.

Source: own study on the basis of research results (n=20).

Answers provided by respondents most frequently (in about 60% of cases) concerned such actions as: identification of present actions in the form of processes, implementation of new processes and existence of processes only in the minds of people executing them. Only 21% of respondents replied that processes were visualised and 16% of them acknowledged that there was a process repository. These respondents represent industrial processing industry and transport and warehouse management industry (the group was narrowed to these sections). Other possibilities indicated by respondents include: processes are in a descriptive form (37%), business tasks are clearly specified for each job position in the form of job descriptions (37%), new actions and activities are implemented without informing of their effects and causes (32%), each of the employees knows the processes or where to find their descriptions or maps (26%). Respondents from two companies did not provide any answer (micro-enterprises with business profile suggesting that actions from the list will rather not occur).

The analysis of the responses taking into account the size of the enterprise allows to indicate the following theses that should be resolved during the proper research:

– actions in the form of processes are currently being identified in each size enterprises,

- in small enterprises rarely new processes are being implemented,
- processes exist only in the awareness of people executing them in small and medium enterprises,
- business tasks are clearly specified for each job position in the form of a job description in medium and small enterprises,
- only in large enterprises the processes are visualised in the form of activities and actions (e.g. maps) and processes have a descriptive form,
- only in large enterprises there is a storage place for processes and each of the employees knows the processes or where to find their descriptions or maps,
- only in large enterprises new actions and activities are being implemented (without informing of their effects or causes).

Another analysed issue is the presence of a process owner in an organisation. The analysis of results shows that about a half of all organisations covered by the study have persons responsible for processes. A more profound analysis has shown that an answer to this question does not depend on the industry or on company size. On the other hand, 16% of respondents have acknowledged that their organisations includes a group which handles processes (and which also includes process owners).

Two of the effects that occur in process management are a single employee's influence on added value provided to customers, and the knowledge on how the effects of work of a specific employee influence the value. 85% of respondents answered "yes" to the question if employees know what happens to the effects of their work. The result did not depend on the size of the organisation or the industry. The distribution of answers to the question concerning employees' knowledge on their role in the process was similar.

In search of abilities to achieve improvement in terms of processes taking place in an organisation, one should verify the level of knowledge and application of specific terms. Fig. 7 shows respondents' answers (to multiple choice questions).

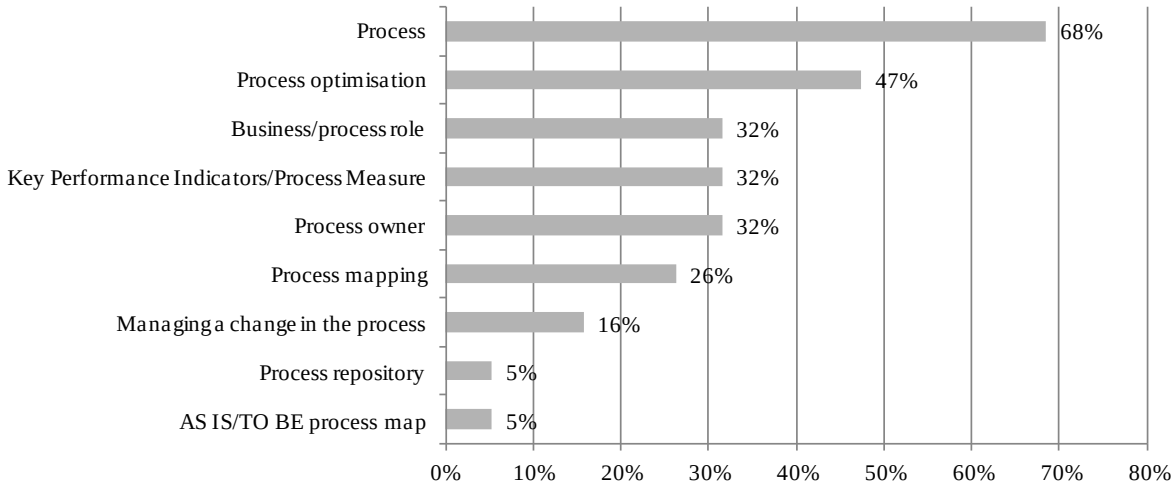

Fig. 7. The degree to which an organisation uses specific terms.

Source: own study on the basis of research results (n=20).

"Process" is the term most commonly used among respondents – 68% of indications. Another term is "process optimisation" (47% of indications), which, as observations and conversations show, is interpreted rather as improvement. 32% of respondents answered that their organisations used the terms "process owner" (presence of such a person was indicated in approx. 50% of organisations), "key performance indicator" (process measure) and "business (process-related) role". 26% of respondents know and use process mapping. Other terms (process change management, AS IS / TO BE process map and repository) are known in individual cases, which results from the nomenclature assumed in the area of process analysis (e.g. the BMPN 2.0 standard).

The analysis of responses taking into account the size of the enterprise allows to indicate the following theses:

- most small and micro enterprises do not use process-related concepts,
- large and medium enterprises use specific terms as: process and process optimisation,
- large enterprise use specific terms more often then another size enterprises.

CONCLUSION

The research carried out indicates that there is a big difference in the process opinions of enterprises depending on their size. Preliminary results of the research, which process awareness is much higher in large and medium-sized enterprises. However, each of the respondents

indicated that they identify the activities used in the forms of processes. Therefore, it is worth conducting in-depth research on a group of statistically representative respondents.

Further research will be carried out in the group of small, medium and large enterprises involved in industrial processing as well as transport and warehouse management. The scope of research will concern the settlement of theses set out in the article.

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CONCEPT OF COMMUNICATION INTEGRATION FOR AUTOMATED PRODUCTION PROCESSES REGARDING LOGISTICS 4.0

ABSTRACT

Background: Constantly changing market needs and concentration of the entire supply chain on the customer service level, forces both in the business and scientific world to search for modern solutions which improve logistic processes. This trend is leading to the transformation of current solutions towards intelligent supply chains. The use of modern technologies is aimed at improving logistics processes at the operational level by shortening the time of execution of activities, minimizing bottlenecks and errors which result from faulty information flow. Nowadays, there are numerous innovative solutions that lead the supply chains along the digitisation way.

Material and methods: Since 2016, the Institute of Logistics and Warehousing and the Poznan School of Logistics have been conducting intensive research work both in the scientific area and in the possibilities of applying individual solutions in business practice. Jointly developed long-term research methodology aims at applying the synergy effect of research work in the field of identification of innovative solutions for supply chain digitisation, with an analysis of their possible application in economic practice.

Results: The aim of this chapter is to present the concept developed to evaluate the communication integration efficiency of automated production processes as one of the key elements of the intelligent supply chain. The result of this work is participation in a research

project L4MS, and at the end of the project work the possibility of verifying the efficiency of intelligent solutions implementation in economic practice.

Conclusions: Information technologies, wireless sensors and advanced control systems are becoming the key of the new industry. However, it should be emphasized that such high value-added products can be realized with advanced computer-controlled machines. For this reason Industry 4.0 requires equipment and has the potential to expand through. It also creates a secondary market in areas such as automation equipment, robots and special machinery in logistics.

Keywords: Logistics 4.0, automated production processes, autonomous devices, communication integration, information flow efficiency

INTRODUCTION

In the current world, as a result of progressive digitisation, we are at the beginning of the fourth industrial revolution associated with the transition to cyber-physical systems connecting machines, processes and products into intelligent business solutions and self-controllable 'Smart supply chains'. As part of the latter, cooperating Smart Factories exchange information with partners, suppliers and distribution and service networks in intelligent supply chains in an automated way. These processes have an end-to-end dimension and cover the entire life cycle of the product. Such components create the concept of Industry 4.0 as a paradigm partially defined by the use of machine to machine (internet of things - IoT) communication devices to create factories that act as intelligent production systems: a number of devices and machines are adapted to continuous communication in order to create a coherent, clearly visible system. The ultimate result is the discovery of areas of inefficiency, more accurate optimisation of some decisions and automation of some simple (or not so simple) processes. Logistics 4.0 works according to the same principles, but with a different set of components. In particular, it uses "intelligent" containers, vehicles, pallets and transport systems to create a fully networked delivery stream that offers supply chain managers, freight forwarders and other partners the necessary visibility for optimal transport management and other logistical tasks.

RESEARCH METHODOLOGY

Research concerning the logistics processes efficiency in intelligent supply chains has been conducted since 2018 within the research and development projects of the Institute of Logistics and Warehousing and the Poznan School of Logistics. Figure 1 shows the general research methodology.

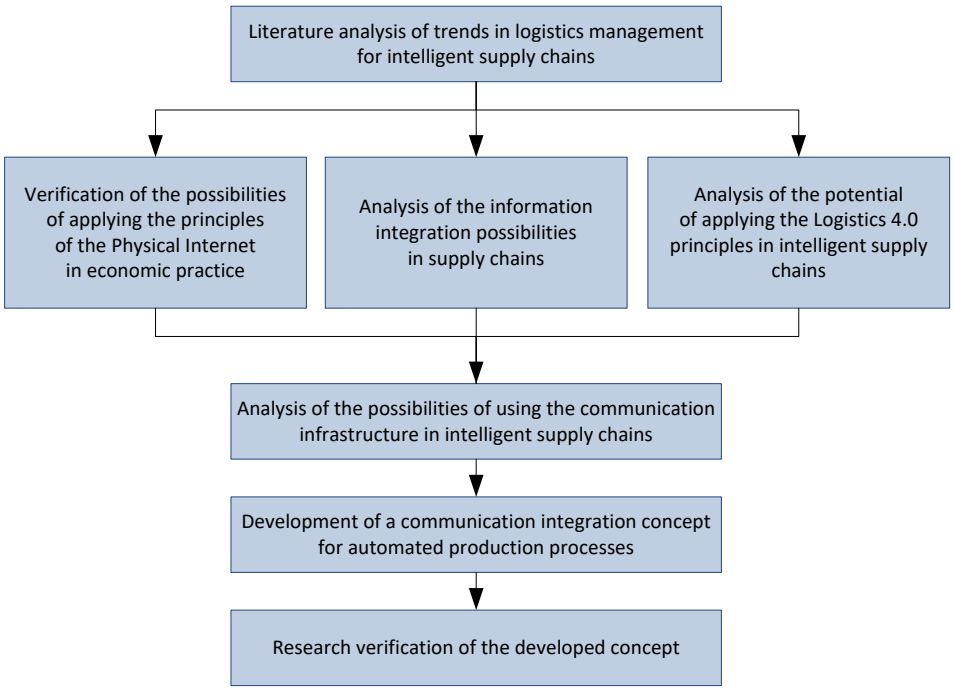

Fig. 1. Research methodology.
Source: own elaboration.

As it is a trending topic in Poland, researches in Turkey are also studying on Industry 4.0 in recent years. Moreover, there is a Ministry of Industry and Technology in Turkey. The ministry is responsible for improving the competitiveness of informatics sector, to authorize the firms that will supply public IT projects in accordance with the competencies or standards they need to carry, to cancel or to suspend authorization in accordance with technical criteria, to comply with the procedures and principles of public institutions and contractors to execute contracts related to public IT projects. To exemplify, there is a program called “University - Industry Cooperation” in Turkey and universities can be granted from the ministry up to 1 million Turkish Liras -around 152.500 Euro- (Ministry of Industry and Technology).

The research logic includes a broad literature analysis of trends for logistics management in intelligent supply chains, as well as their application in business practice. Theoretical foundations were based on a critical review of the literature on: application of communication standards [Pedersen,2012; Sliwczynski, Hajdul, Golinska 2012], and modern integration trends in the supply chain [Speier, Mollenkopf, Stank 2008; Stajniak & Guszczak 2011; Prajogo, Olhager 2012; Kawa 2012; Leuschner, Rogers, Charvet 2013; Cyplik et al. 2014; Hadas, et al. 2015; Kawa, Zdrenka 2016; Trojanowska, Varela, Machado 2017; Domanski, Adamczak, Cyplik 2018; Dujak, Sajter 2019]. As part of the above mentioned research works, analysis of the possibilities of using the physical Internet in economic practice [Osmólski, Voronina, Kolinski 2019] and analysis of the possibilities of integrating the flow of information in supply chains [Osmolski, Kolinski, Dujak 2018; Horzela et. al, 2018; Debicki, Kolinski 2018], were carried out. This chapter focuses on the application potential of Logistics 4.0 in intelligent supply chains and the concept of communication integration for automated production processes, taking into account the logistics 4.0 principles.

THE POTENTIAL TO IMPLEMENT PRINCIPLES OF LOGISTICS 4.0 IN INTELLIGENT SUPPLY CHAINS

The advantages of information sharing and integration in supply chain management has been frequently studied in the literature. In one study done by [Zhao et al. 2002], for example, information-sharing influences supply chain performance in terms of total cost and service level. In the same manner, [Lin et al. 2002] demonstrate higher level of information sharing is related to lower total cost and make a shorter order cycle as time. However, it should be considered that while sharing of information is vital, its impact on the performance of a supply chain depends on what kind of information is shared, how it is shared, and with whom [Byrne and Heavey 2006; Holmberg 2000; Li and Lin 2006]. In terms of business, it is important not to underestimate the requirements placed on companies that hope for smarter organisation of work in logistics, but its scope is disproportionately limited compared to the countless ways in which logistics 4.0 can bring added value. In the short term, increased end-to-end visibility (E2E) and the more comprehensive view of the supply chain will almost certainly be significant added value propositions for companies that are able to achieve them. Looking to the future, Logistics 4.0 has the potential to pioneer a new, more advanced value stream concept that

includes autonomous vehicles (i.e. vehicles without a driver), automated warehouse operations, and perhaps even completely eliminate warehouses for predicted deliveries with full, zero time integration in the intelligent production processes.

The above example shows how new paradigms can lead the way to the growth of 'anticipatory logistics', i.e. supply chain management, where intelligent technology is able to anticipate future operations, thus preventing process bottlenecks, allowing planners (and even autonomous machine processes) to adapt production schedules to future changes in demand. As anticipatory logistics will become a reality, the global value chain will become more complex, relying on advanced predictive algorithms and the integration of an increasing number of interlinked components, while being much leaner, offering a more adaptive, agile environment where lead times are significantly reduced and shortages, oversupply and disruption are becoming increasingly limited. The basic principles of Logistics 4.0 are presented in Figure 2.

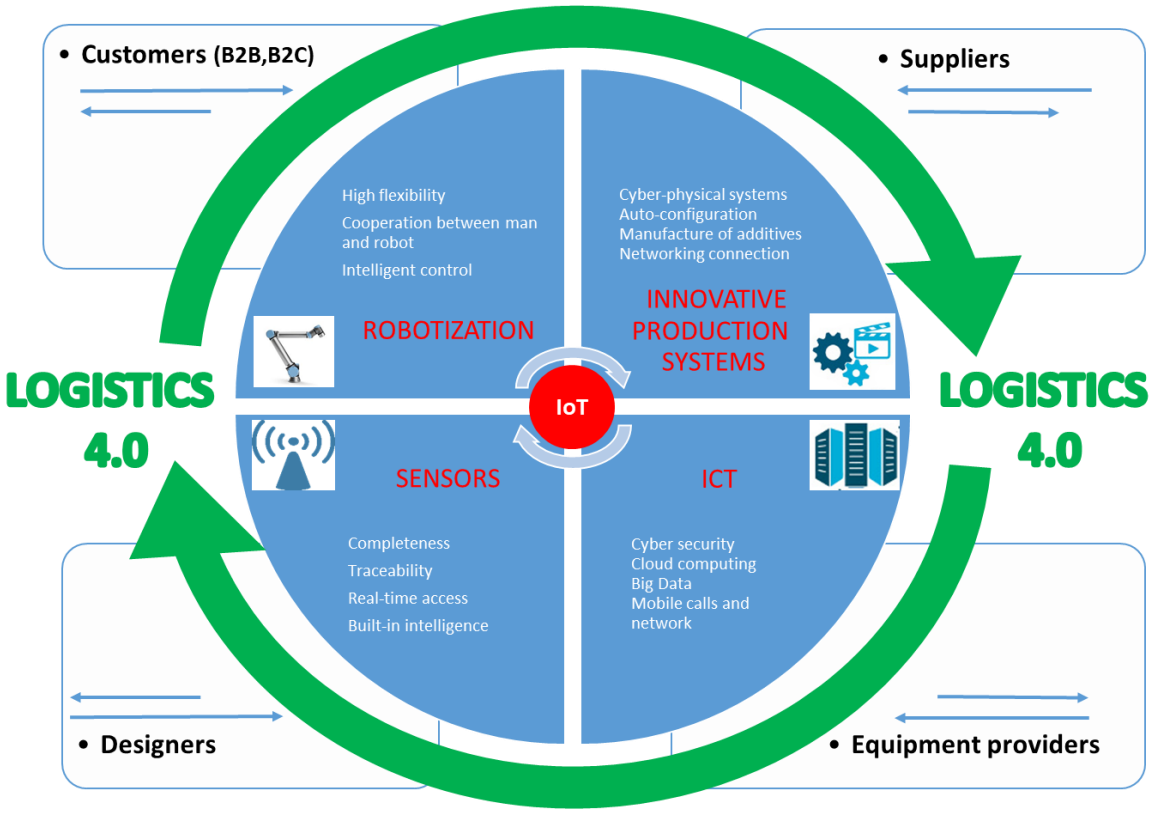

Fig.2 Principles of Logistics 4.0.

Source: own elaboration.

Due to the nature of these links, the main challenge is the integration of cyberspace with physical objects equipped with sensory systems. The implementation of such a challenge requires the integration of business and technological competencies in order to effectively support domestic economic initiatives, and in particular the use of solutions enabling structural use of simulation platforms integrating IT solutions of many manufacturing enterprises.

Industry 4.0's Smart Companies include intelligent machines and systems that detect business needs with sensors, communicate with other devices in production via the Internet, and get the production information they need from Big Data in cloud systems. The communication and interaction between the machines in production is provided via the internet. Structures that allow the communication of objects to each other are called Internet of Things (IoT). The structure of communication and coordination between the physical world and the cyber world is called the CPS - Cyber-Physical Systems. [Alcin 2006: 20]. In order for a company to be able to use the latest technologies in the field of Industry 4.0 or Logistics 4.0, it must be characterized by a high degree of technological advancement. The seven pillars of technological advancement apply (Fig. 3):

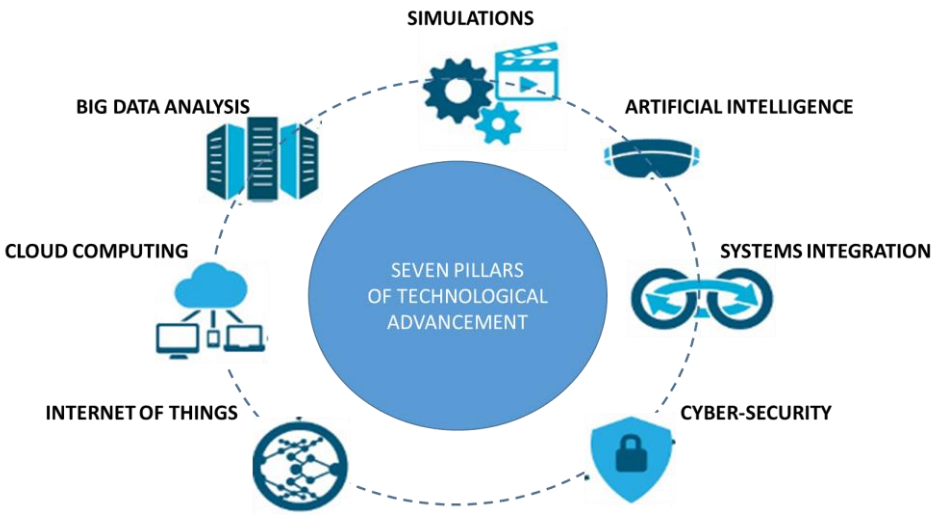

Fig. 3. Seven pillars of technological advancement.

Souce: ILiM research.

- **Simulations** - the use of simulation tools both in the design processes of structural, sales or process solutions,

- **Artificial intelligence** - to fully automate and support decision-making processes,
- **System Integration** - integration of services available in the network, offered by different suppliers, which can be used in a dynamic way ensuring different components of the value chain and implementation of new business models - includes services such as Smart Mobility and Smart Logistics,
- **Cyber-security** - application at every stage of IT systems construction (from design to operation) of methods of assessing and ensuring security of cyberspace and information and hardware infrastructure of enterprises and their cooperators, which is of key importance in the transformation to Logistics 4.0,
- **Internet of Things (IoT)** - building wireless sensory networks and controllable management models,
- **Cloud computing** - using cloud computing and digital services,
- **Big Data** - acquisition and processing of large amounts of data for analysis - modelling - simulation - forecasting - prototyping - implementation.

RELATED COMMUNICATION INFRASTRUCTURE - INITIAL OBJECTIVES

The related communication infrastructure concerns one of the most important aspects of logistics, i.e. obtaining precise information within a precise time frame necessary to be able to make the right decision. This becomes very important at a time when huge amounts of information are exchanged between companies, based on different data transfer channels. Very often important data is either lost, in the information exchange chain, or misrepresented or received with a long delay. In order to overcome these problems and create effective information exchange chains, it is necessary to focus in particular on the following elements:

- create common platforms for data exchange based on communication standards,
- their architectural structures should be based on a well-defined, clear model,
- use standard links to integrate systems in the form of access points,
- use simulation platforms to monitoring and control logistics processes.

These issues have been subjects to a full and in-depth functional analysis in the L4MS project ('Logistics For Manufacturing SMEs', Grant agreement ID: 767642, Funded under: H2020-EU.2.1.1.1), which created a platform integrating the information flow between IT

systems used in production logistics, enabling full coordination of autonomous devices control. This approach is an architecture for business applications created as a set of stand-alone components organized to provide services operating according to specific criteria, supporting the implementation of business processes. An important premise of this solution is the use of existing applications and systems, which are used by economic entities, reducing them to a standard functioning ecosystem. On the technical side, it is necessary to create universal links between existing and new systems, including through the use of integration platforms based on specific standards of information exchange. Such an approach also requires the development of the so-called information architecture, which will combine elements operating in the areas of individual computer systems, using available standards based on unified communication units. This type of activity leads to a full optimisation of logistics as shown in Figure 4

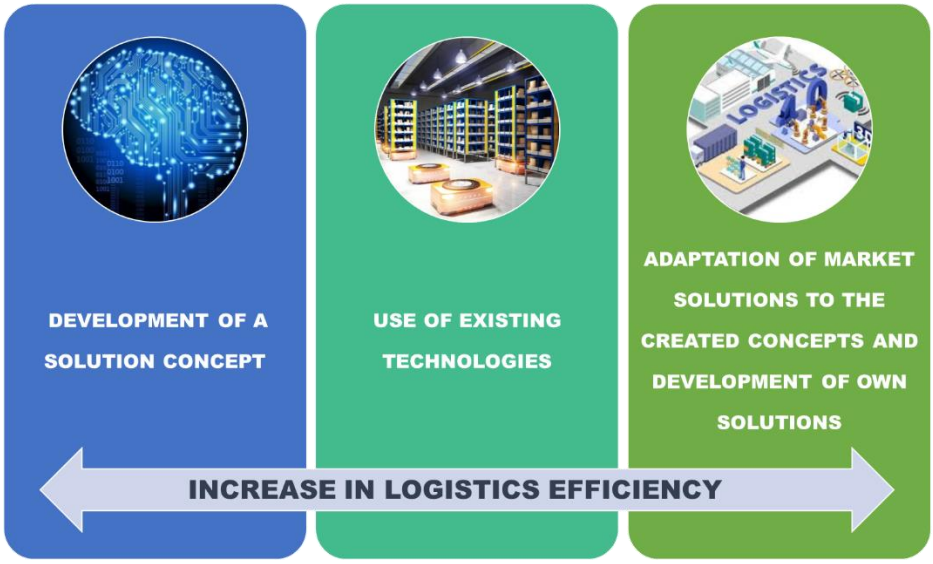

Fig.4. Increased logistics efficiency.
Source: own elaboration.

The benefits of such solutions are as follows:

- reducing the amount of work involved in modifying and merging systems,
- elimination of errors in the messaging phase,
- easy, fast and trouble-free access to data,
- acceleration of processes,
- low cost of implementing the changes,
- time saving,

- less cost production,
- using less resources,
- high speed reliability,
- increase in income and profit level.

THE CONCEPT OF COMMUNICATION INTEGRATION FOR AUTOMATED PRODUCTION PROCESSES

The purpose of the research is both to analyze the possibilities of integration of the communication information platform with autonomous devices used in the production process, as well as to identify the benefits of using automation of logistic and production processes in small and medium-sized enterprises. We can talk about 3 types of integrations during production process (http://www.akillifabrika.org):

- Vertical Integration: It increases the capacity of the system, computer, machine, work terminal, devices and tools in the company system.
- Horizontal Integration: The subsidiary companies outside the enterprise, suppliers, logistics companies, financial institutions, insurance companies, distributors, manufacturers, etc. integration that provides similar interaction over internet.
- End to End Integration: It is the end-to-end integration of engineering systems across the entire supply chain to support the enterprise to offer customized, more qualified products and services to people.

The analysis will cover the process of folding, internal transport of materials to production stands and finished products to the stands of packing and packaging gluing, which consists in dynamic buffering of materials based on the production plan, taking into account the use of AGV. Application of the solution will allow the company to achieve tangible benefits in the form of shortening the time of process completion, generation of cost savings, increase in the productivity of the implemented process. A measurable achievement, which is difficult to be clearly defined at the conceptual stage, is the improvement of operational efficiency through the optimization of process execution thanks to the use of 3D simulation visualization.

Currently, the analyzed process of packaging folding and gluing is partly automatic, based on the hybrid method assuming segmented automation of the production process and the use of human labor. Although the configuration of AVGs allows for partial automation of deliveries of finished products to the packing stand it is limited by the lack of communication between

them, which generates a limitation in the form of the capacity of the process of material buffering. This limitation has a direct impact on the productivity of the entire production process - the introduction of communication integration using the communication platform will increase the information flow efficiency, which will minimize errors in material collections, the number of empty trolley runs and their unnecessary storage movements. The expected outcomes of implementation of this solution are as follows: greater availability of materials in the buffer, shorter time of the buffer process, elimination of waiting time of the production machine for the material to be processed, increased efficiency of the production process and reduction of production costs.

The automation of the production process will be based on the use of AGVs, which can be integrated into the functionality of the communication platform. The technological solution of the buffer area itself is based on the installation consisting of 350 chain conveyors, operated by two horizontal elevators. Next stages of the production process are linked to the automatic buffer area through two autonomous AGVs. This way of buffer automation is aimed mainly at compensation of differences resulting from the production plans of individual processes (production plans are adjusted to the tool or product, compensation of differences has a significant impact on the efficiency of individual production stages). In the subsequent stages of the production process there is a conflict between the opposite strategies of material and stock management - push and pull. Another important aspect of using such a buffer system is the fact that the sensitive production process is secured and made independent by dynamic and flexible buffering of 350 pallets with materials according to an approved production plan. This solution allows us to combine different material delivery strategies in one buffer area. The buffer is able to collect the material according to the push strategy from the previous production operation and to forward it to the next stage according to the pull strategy. The ERP system is responsible for the management of the buffer area and the sequence of executed tasks, as AGVs and Automatic Buffer Area do not have their own visualization and simulation system for processes or individual operations. Integration with the ERP class system can be exchange of text files in standardized format (XML) or by means of direct access to the database and database views available. Selection of the method of integration depends on the capabilities of the ERP system provider. The application managing the buffer operation has its own database

based on which all transactions are performed, and their result is transferred to the ERP system with the use of an integrating application.

An important aspect of buffer automation and intralogistics between processes is also the fact that there is no need to produce long series of individual products. Products can enter the buffer area in any configuration, regardless of shape, color, size and value. The buffer will automatically adjust and optimize the allocation of goods in individual areas according to the data provided by the ERP system, so that the release to the next stage of the process (order) is performed as fast as possible. The buffer has the functionality of shuffling and rotating the material inside its 350 areas without the intervention of employees. In this way, the burden of intralogistics has been significantly reduced thanks to elimination of unnecessary forklift truck runs, searching for material with the right index, much shorter time of preparation for the next order. An additional advantage of implementing this solution is the clear and precise organization of the storage area - the buffer area is planned in detail and the goods are arranged there, which increases safety in the warehouse, compared to the situation when the same number of pallets is left on the floor on the intermediate storage area.

THE STAGES OF COMMUNICATION INTEGRATION

The stages of research work in the field of communication integration include as a first step, an analysis of the current state of the automatic solution used in the process of folding and gluing the packages, with particular reference to the identification of limitations. This analysis will identify the precise indications and functional conditions of the possibilities for implementation of the integration of AGV devices with the OPIL platform. Data showing the actual state will be collected, moreover, the expected outcomes of this implementation will be determined, which in the last stage will serve as a norm (target/desired value) of the obtained results of the implementation. After implementation of the analytical part and identification of integration possibilities (in organizational and technological terms), the OPIL platform will be implemented in the analyzed process. The prepared preliminary business model will provide for verification of the possibilities of application of integration in the studied area together with the possibility of its implementation in other areas of the studied process. Then, the implementation and technological validation of the platform integration with autonomous devices and IT system used to monitor processes in the company will be carried out. The next

task will be to conduct a process analysis after the implementation of the integration platform, compare the results obtained with the status before the implementation and the planned outcomes, as well as to set out further possibilities of implementation and process improvements.

The conceptual assumptions presented above can be defined as the basic research stages, which are shown in Figure 5.

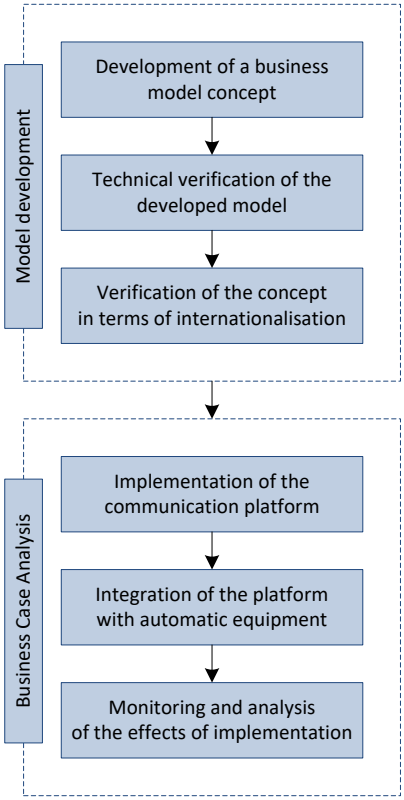

Fig. 5. Basic research stages of communication integration.

Source: own elaboration.

The main objective of the first stage is to develop a detailed business model, including an analysis of the effectiveness of implementation of communication platform integration with autonomous devices. The development of this model requires cooperation both in technological terms of the implementation and from the perspective of internationalization of the results obtained. This kind of cooperation at this stage will guarantee that the developed business model meets both technological requirements and is universal enough to be used not only in the realities of Polish business, but also the international business.

The main objective of the second stage is to implement the communication platform in the business case as well as monitoring and evaluation of the results obtained. The main result of this stage will be integration the communication platform with automatic devices that have been previously implemented in the analyzed process. The next element of this research will the monitoring of implementation effects, both in technical terms (outcomes of system integration) and business terms (outcomes of improvement in the logistics processes implementation).

The proposed KPIs concern both the analysis of the effectiveness of integration of the platform with automatic devices, and the impact of the implementation on logistics processes in the analyzed business case:

a) Analysis of integration efficiency:

- operational efficiency (influence of information management on productivity growth),
- efficiency of monitoring process (influence of visualization of the arrangement of pallets with goods on the efficiency of organization of autonomous transport operation).

b) Analysis of the impact of the implementation on logistics processes:

- cost and operational efficiency of autonomous transport (costs generated in the process and time of implementation of processes with the use of automatic equipment),
- efficiency of warehouse space development,
- efficiency of logistics processes implementation (number of errors).

CONCLUSION AND FURTHER RESEARCH

Information technologies, wireless sensors and advanced control systems are becoming the key of the new industry. However, it should be emphasized that such high value-added products can be realized with advanced computer-controlled machines. For this reason Industry 4.0 requires equipment and has the potential to expand through. It also creates a secondary market in areas such as automation equipment, robots and special machinery in logistics. Automation of logistic and production processes is a poorly implemented area among SME sector enterprises due to the financial barrier concerning high costs of implementation of these solutions. The use of autonomous internal transport equipment and the OPIL platform will make it possible to improve production and logistics processes on a large scale, which should be considered a breakthrough given the current state of technical preparation of small and medium-sized production enterprises in Poland. An innovative product of this project will be the

development of a simulation model based on the automation of the processes of delivery of semi-finished products to the intermediate storage area, their delivery to work cells and collection of finished products by autonomous AGVs and delivery to a fully automated packaging cell. Such simulations will be carried out based on the use of the OPIL platform together with existing production management systems. A new business model will also be developed, which concerns not only the efficiency of the solution application in the automated production process in terms of process optimization but will also include an analysis of the technical possibilities of implementation of this solution, taking into account the specificity of the SME sector and the possibilities of project financing.

This chapter presents a conceptual framework of research in the field of communication integration for automated production processes, on the basis on which scientific and development research is carried out at the Institute of Logistics and Warehousing and the Poznan School of Logistics. This concept made it possible to start research work in this area. The next stage of research will be the development of a business model and its business verification.

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AUTOMATION OF THE PROCESS OF REPORTING THE COMPLIANCE OF THE PRODUCTION PLAN WITH ITS EXECUTION BASED ON INTEGRATION OF SAP ERP SYSTEM IN CONNECTION WITH EXCEL SPREADSHEET AND VBA APPLICATION

ABSTRACT

Background: The ERP systems in spite of its huge functionalities cannot realize all user needs and requirements especially concerning intelligent business analysis and reporting (BI). Therefore it is necessary to find out new, simple and flexible methods and techniques to expand their functionality and report facilities. In this chapter we propose the new method of production process analysis, its automation and visualization, based on integration of the SAP ERP/PP module with Excel spreadsheet and VBA application. This approach is very useful for managerial decision making process in production planning and control.

Methods: Basing on the previous developed configuration methods we have proposed an integration approach, connecting data base resources from SAP ERP system with Excel spreadsheet and VBA application.

Results: The new application called FTP Report allows to prepare The compliance report of the production plan with its implementation within the prescribed period. It automatizes the process of data migration from SAP ERP Production Planning module and then supports intelligent data analysis and finally data reporting.

Conclusions: The new redesigned and implemented process of data migration and analyzing is faster and more flexible and allows to speed up the whole process of complex analytical report edition from 2 hours to 5 min.

Keywords: SAP ERP/PP enhancements, Production Planning and Execution, Data Reporting, Business Process Analysis, Production Processes Integration, Production Process Reengineering (PPR), VBA application.

INTRODUCTION

The essence of the article is to propose a method and a tool for automating the process of reporting and compliance analysis of the production plan with its executing. The tool should be easy to operation without any knowledge of programming in a complex production environment of SAP ERP 6.0 system [Auksztol, Balwierz and Chomuszko 2011, Schulz 2017]. The Program should significantly reduce the time needed to prepare the Report and prevent it from generating a human errors in the data retrieval and process analysis. Therefore we can treat this activities as a production process strategy PPIS and a part of BPR (Business Process Reengineering), [Akhatar 2015, Erwan 2017, Dickersbach and Keller 2011].

The program called FTP Report (Follow The Plan Report) that was created for this work is based on Microsoft Excel macro-enabled application and code written in Visual Basic for Application [Alexander and Kusleika 2016]. This tool automates the process of retrieving and analyzing data from the system SAP ERP PP (Production Planning module), needed to create a compliance report within the specified period, using SAP transactions – COOISPI and MB51. These system transactions are crucial for retrieving data into the Report.

SAP ERP PRODUCTION PLANNING MODULE

Production Planning And Execution With SAP ERP PP

The production execution process in SAP ERP begins when the planned production order (Planned Order) is transformed into a Process Order. The first one listed is in most cases generated automatically by a demand based PIR system (Planned Independent Requirement). When needed, the production planner can also create a planned order manually (using the SAP MD11 transaction). At the time of conversion to Process Order, the system ultimately checks finally, based on the product structure BOM (Bill of Material), whether all materials needed to complete the product are in stock. The user can additionally choose which batches of each component should be allocate to the order. When everything is ready, the status of the Process

Order is changed on REL (Released) and a new batch is assigned to a finished product. At this point, the materials assigned into the order can be delivered to the indicated Work Center and start production, which is done according to the data in the Routings [Akhtar 2015, Chapman 2006, Dickersbach and Keller 2011, Schulz 2017].

When the production process is completed, the order is confirmed, and any movements and material consumption are already posted during its lifetime. The order receives the status DLV (delivered), and the finished product is received and delivered to the designated place. Most often at the end of the month prior to the settlement of orders, to each of them is given the status of TECO (technically completed), in order to calculate the production deviations by the relevant department. The production planning schema in SAP ERP is presented in Figure 1.

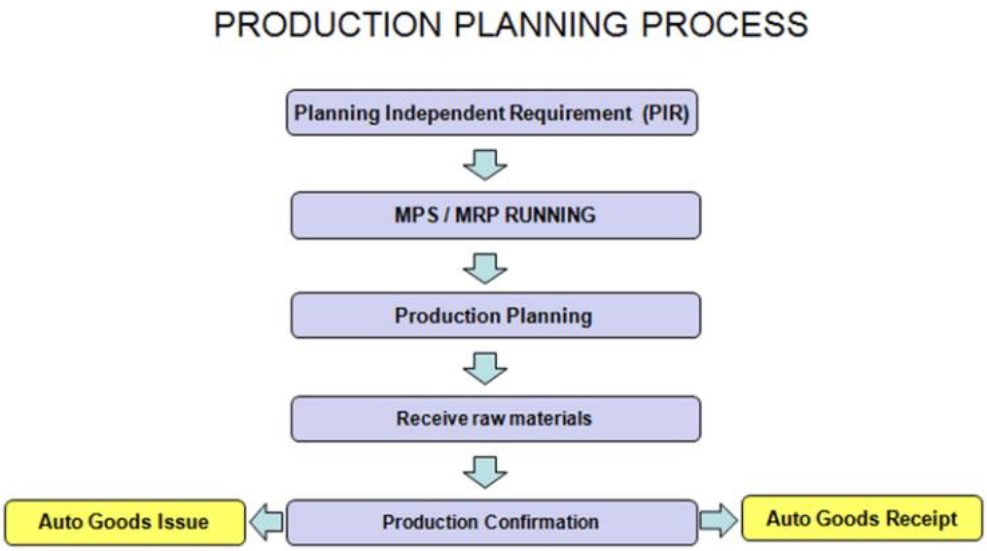

Fig. 1. Production planning scheme in SAP ERP.
Source: [Introduction-SAP PP n,d.].

Transactions In Sap Erp For Data Retrieving From Production Schedule (Cooispi) And Tracking Material Movements (Mb51)

The COOISPI transaction is described in SAP as Production Order Information System. Using it, you can get all the information about planned and process production orders, which is a large database for users planning production. To invoke COOISPI, you must use the SAP GUI to type the transaction name in the Menu.

The selection of columns and their order in the COOISPI transaction is fully selectable by the user. You can also easily send this data to a Microsoft Excel spreadsheet. The file generated by this method is shown in Figure 2.

Transaction MB51 is a useful tool in SAP ERP, mainly used to track the movement of materials in the system. In the software developed by SAP, all material movements are saved in the relevant documents. This makes it possible to track the history of material movements [MB51 n.d.].

	A	B	C	D	E	F	G	H
1	Order	Material	Item component list	Requirement date	Requirement quantity (EINHEIT)	Quantity withdrawn (EINHEIT)	Base Unit of Measure (=EINHEIT)	Open Quantity (EINHEIT)
2	208436	700695	0010	23/03/2016	296.800	0.000	HL	296.800
3	208436	200033	0050	23/03/2016	0.556	0.000	KG	0.556
4	208436	201200	0060	23/03/2016	1.113	0.000	KGA	1.113
5	208436	200005	0070	23/03/2016	0.890	0.000	KG	0.890
6	208436	200004	0080	23/03/2016	9.275	0.000	KG	9.275
7	208436	200003	0090	23/03/2016	37.100	0.000	KG	37.100
8	208436	202495	0110	23/03/2016	15.397	0.000	KG	15.397
9	208436	202333	0120	23/03/2016	4.823	0.000	KG	4.823
10	208436	700071	0130	23/03/2016	74.200	0.000	L	74.200
11	211443	700695	0010	23/03/2016	333.600	0.000	HL	333.600
12	211443	200033	0050	23/03/2016	0.625	0.000	KG	0.625
13	211443	201200	0060	23/03/2016	1.251	0.000	KGA	1.251
14	211443	200005	0070	23/03/2016	1.001	0.000	KG	1.001
15	211443	200004	0080	23/03/2016	10.425	0.000	KG	10.425
16	211443	200003	0090	23/03/2016	41.700	0.000	KG	41.700
17	211443	202495	0110	23/03/2016	17.305	0.000	KG	17.305
18	211443	202333	0120	23/03/2016	5.421	0.000	KG	5.421
19	211443	700071	0130	23/03/2016	83.400	0.000	L	83.400

Fig. 2. COOISPI transaction output saved as an Excel sheet.
Source: [COOISPI n.d.].

The MB51 transaction like COOISPI can be personalized by saving your own settings as a ready Layout, making it easier to automate operations. The sample result of this transaction is shown in Figure 3, where the user follows the movement history for exemplary material 153. The MB51 report can be successfully exported to a Microsoft Excel spreadsheet file by right-clicking on any record and selecting the "Spreadsheet" option.

Material Document List

Material	Plant	SLoc	MvT	S	Material Doc.	Item	Posting Date	Qty in Un. of Entry	EUn
153	1011	1082	311		4900007369	2	27.01.2016	1.000,000	KG
153	1011	1082	311		4900007369	1	27.01.2016	1.000,000-	KG
153	1011	1082	701		4900007370	2	31.12.2015	900,000	KG
153	1011	1082	561		4900007366	1	01.12.2015	1.000,000	KG
153	1011	1011	101		5000000374	1	22.10.2014	300,000	KG

Fig. 3. MB51 transaction output for exemplary material 153.
Source: [MB51 n.d.].

FTP report creation process

By exporting data from SAP ERP COOISPI and MB51 transactions to an Excel workbook, an user can make a fully validated compliance report of the production plan with its execution (CROPPE). This kind of Report called the FTP Report is divided into two basic parts: plan and execution. The following elements will be required to prepare the plan:

- Data dump Order Headers of the COOISPI transaction – containing among others: Production order numbers, Finished product numbers, and date of orders;
- Data dump Operations of the COOISPI transaction– containing among others Production lines (from Work Center) on which the individual manufacturing operations are carried out.

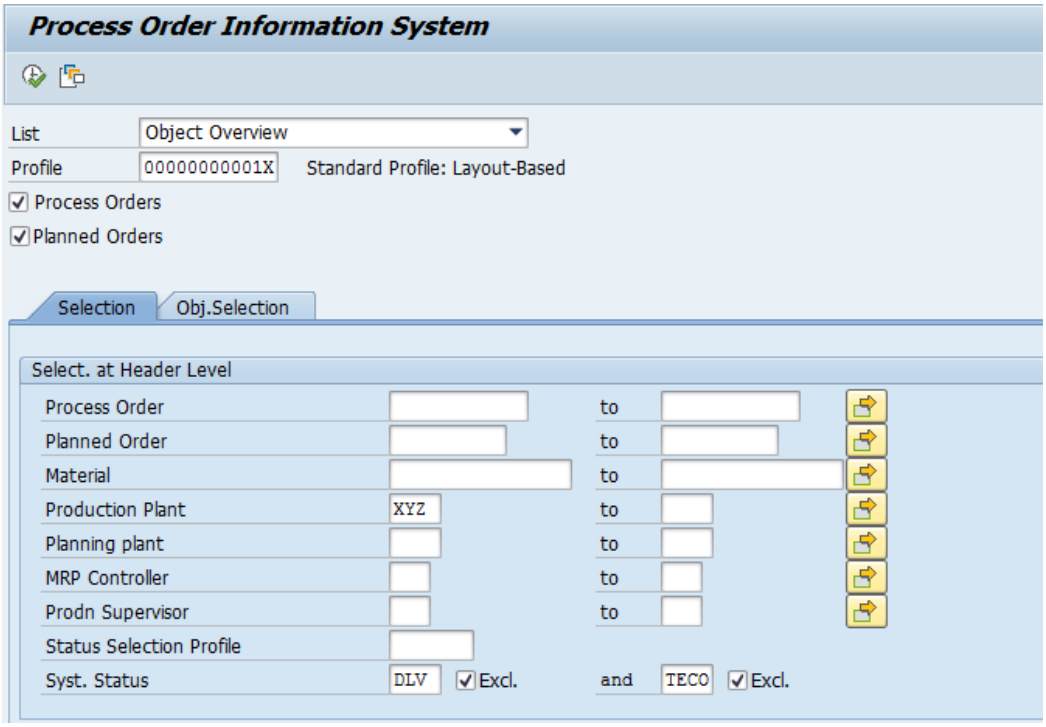

Fig. 4. COOISPI transaction with supplemented data.
Source: Screenshot from SAP ERP 6.0 system.

After preparing the production plan, you must wait until the end of its duration and then proceed to download the data from SAP ERP necessary to describe production execution. The

first stage is very much like the preparation of the production plan described above. You should also retrieve a dump of the Order Headers and Operations of transaction COOISPI for the Object Overview variant (Figure 4). In the System Status field, should be included (as Exclude option) an orders with the DLV (delivered) and TECO (technically completed) status, because they will be the predominating part of the records needed to create the execution report, so they cannot be omitted. The second change relative to the plan download process will be selection of the time range in reference to other fields. In a case of a plan, this is a Basic Start Date, but the Actual Finish Date will be completed for execution depending on the accepted period of settlement of orders**.**

To speed up data download from the SAP ERP system and their automatic recalculation and formatting, SAP Script Recorder and Microsoft Excel are used in the FTP Report application. This makes the process of creating a report much shorter and minimize the risk of human errors.

Presentation of the FTP report application

The FTP Report application allows in a very accessible way and in a short time to prepare a compliance report of the production plan with its execution (CROPPE) and indicate possible causes of non-compliance. Implementation of such a Report and analysis is an important part of PPR (Production Process Reengineering), strategy [Erwan 2017, Akhtar 2015, Dickersbach and Keller 2011]. The scheme for preparing FTP Report is shown in Figure 5.

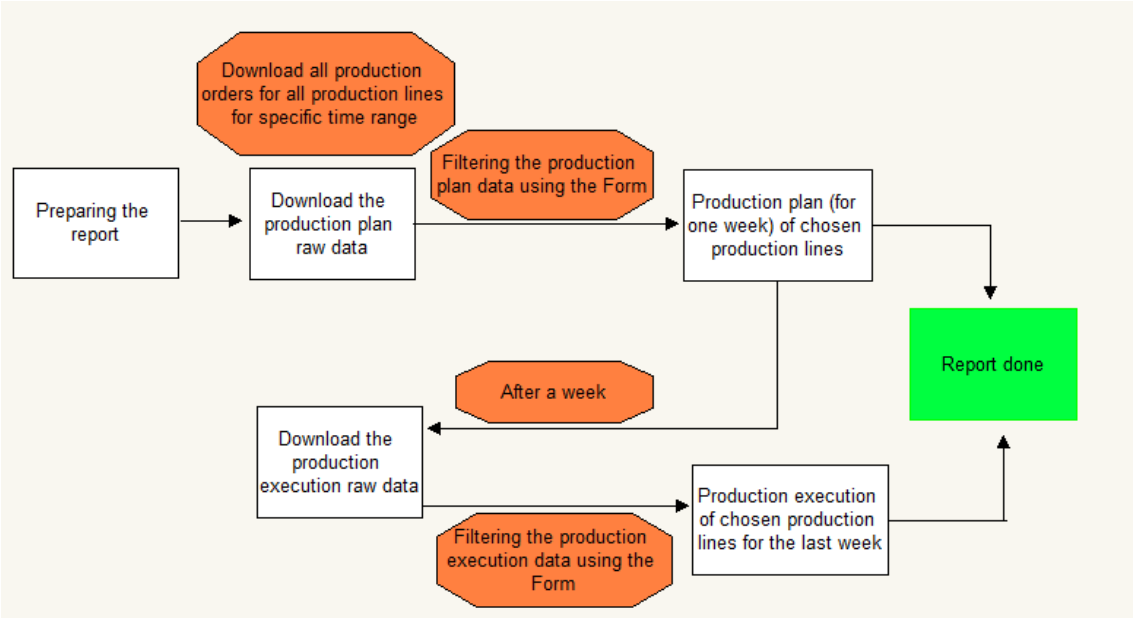

Fig. 5. The model of CROPPE Report creation.

Source: own elaboration.

Download production plan from SAP ERP system

The process of preparing the CROPPE Report should begin by picking up the production plan from SAP ERP using the COOISPI transaction. For this purpose, the FTP Report application implements the macro-coupled buttons, placed in the Excel tab "1. PLAN PANEL", which is presented in Figure 6.

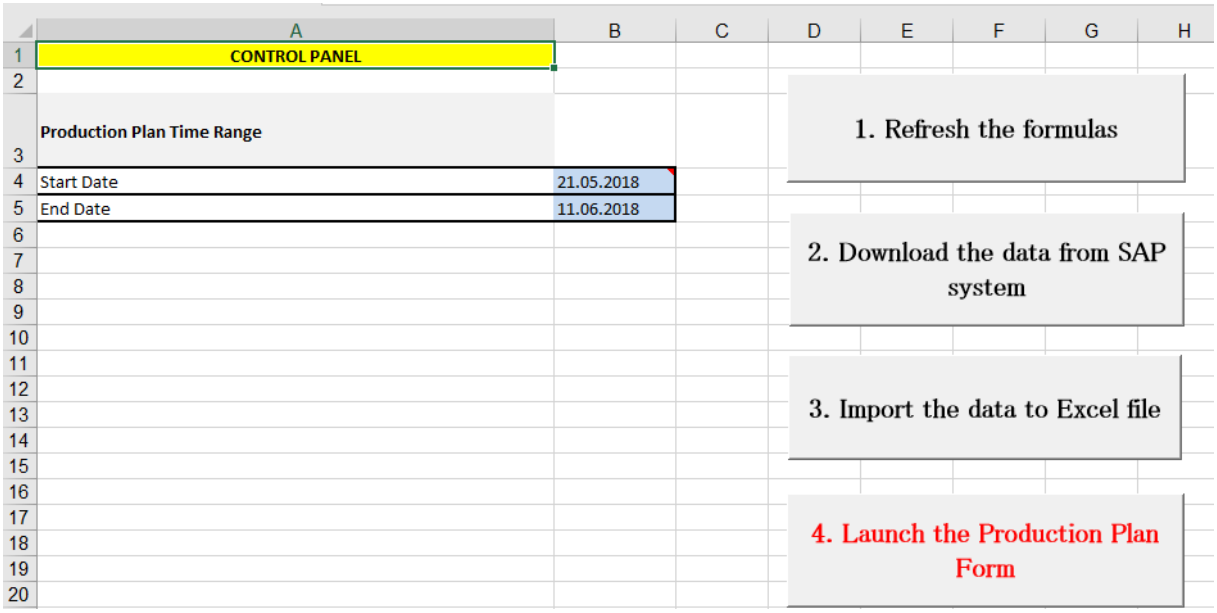

Fig. 6. Excel tab "1. Plan Panel" of the FTP Report application – download of the production plan from COOISPI.

Source: own elaboration.

In cells B4 and B5, the formulas are placed respectively, today's Day ("Start data") and the day in 3 weeks ("End data"). Both of these dates will be the scope for which the user retrieves the production plan from the COOISPI transaction. To do this, press the button "2. Download the data from SAP system", coupled with a macro called "Download data base".

The output is the spreadsheet shown in Figure 7. It contains data extracted from the COOISPI transaction: order number, material code, production line and exact planned start and end dates of the order. To copy the downloaded data to the FTP Report application, press the button shown in Figure 6: "3. Import the data to Excel file", which will run a macro to copy the cells appropriately formatting them.

	A	C	E	F	H	I	J	K	L	M	N
1	Order	Material Description	Resource	Work center description	Latest start time	Latest start date	Latest finish time	Latest finish date	Basic Start Date	Basic finish date	Operation Quantity (MEINH)
2	3000390696	PRODUKT 18	SK-X5	LINIA X5	05:16:08	2018-05-21	10:34:13	2018-05-21	2018-05-21	2018-05-25	1 000
3	3000389355	PRODUKT 25	SK-X5	LINIA X5	10:34:13	2018-05-21	12:07:05	2018-05-21	2018-05-21	2018-05-28	192
4	3000389356	PRODUKT 24	SK-X5	LINIA X5	12:07:05	2018-05-21	16:11:57	2018-05-21	2018-05-21	2018-05-28	700
5	3000384387	PRODUKT 61	SK-X5	LINIA X5	16:11:57	2018-05-21	18:16:49	2018-05-21	2018-05-21	2018-05-28	700
6	3000391906	PRODUKT 32	SK-X4	LINIA X4	07:34:30	2018-05-21	19:39:04	2018-05-21	2018-05-21	2018-06-07	32 500
7	3000385003	PRODUKT 35	SK-X5	LINIA X5	18:16:49	2018-05-21	20:22:01	2018-05-21	2018-05-21	2018-05-28	705
8	3000391227	PRODUKT 16	SK-X2	LINIA X2	12:03:00	2018-05-21	20:38:33	2018-05-21	2018-05-21	2018-06-01	3 800
9	3000391902	PRODUKT 30	SK-X3	LINIA X3	14:00:00	2018-05-21	00:27:26	2018-05-22	2018-05-21	2018-06-04	15 354
10	3000391639	PRODUKT 67	SK-X1	LINIA X1	22:00:00	2018-05-21	02:10:04	2018-05-22	2018-05-21	2018-06-04	5 000
11	3000391907	PRODUKT 78	SK-X4	LINIA X4	19:39:04	2018-05-21	02:23:00	2018-05-22	2018-05-21	2018-06-08	14 650
12	3000392819	PRODUKT 17	SK-X3	LINIA X3	00:27:26	2018-05-22	02:30:22	2018-05-22	2018-05-22	2018-06-04	396
13	3000391228	PRODUKT 97	SK-X2	LINIA X2	20:38:33	2018-05-21	03:27:34	2018-05-22	2018-05-21	2018-06-04	3 984
14	3000392818	PRODUKT 1	SK-X3	LINIA X3	02:30:22	2018-05-22	04:03:37	2018-05-22	2018-05-22	2018-06-04	430
15	3000391638	PRODUKT 80	SK-X1	LINIA X1	11:34:51	2018-05-21	04:52:23	2018-05-22	2018-05-21	2018-06-04	25 000
16	3000391801	PRODUKT 32	SK-X2	LINIA X2	03:27:34	2018-05-22	06:07:18	2018-05-22	2018-05-22	2018-06-04	960
17	3000388657	PRODUKT 38	SK-X5	LINIA X5	20:22:01	2018-05-21	06:20:49	2018-05-22	2018-05-21	2018-05-28	14 400
18	3000393368	PRODUKT 33	SK-X3	LINIA X3	04:03:37	2018-05-22	07:53:10	2018-05-22	2018-05-22	2018-06-04	2 880
19	3000391683	PRODUKT 21	SK-X1	LINIA X1	02:10:04	2018-05-22	08:08:06	2018-05-22	2018-05-22	2018-06-06	19 000
20	3000394652	PRODUKT 5	SK-X2	LINIA X2	06:07:18	2018-05-22	09:03:23	2018-05-22	2018-05-22	2018-06-04	1 104

Fig. 7. The data base of orders for production planning – Excel tab „2. BAZA PLAN”.
Source: own elaboration.

Finally, you will still need to indicate which production lines and dates will be included into the report. To do this, start the macro "4. Launch the Production Plan Form", which will display the form shown in Figure 8. The base of the production plan downloaded from COOISPI will always be the same as in tab "2. BASE PLAN" (Figure 7). By contrast, using the form (Figure 8) the user can filter the items from the base after production lines and dates, and then save them in a separate tab "3. PLAN TO FTP", which will be the input data for calculation the compliance of the execution and the production plan. This gives a lot of flexibility for the user, as it will be possible to add a missed production line or change the date range during an ongoing billing period. However, remember to refresh your data periodically, i.e. download a dump from COOISPI to have correct and accurate information (e.g. after resetting schedules).

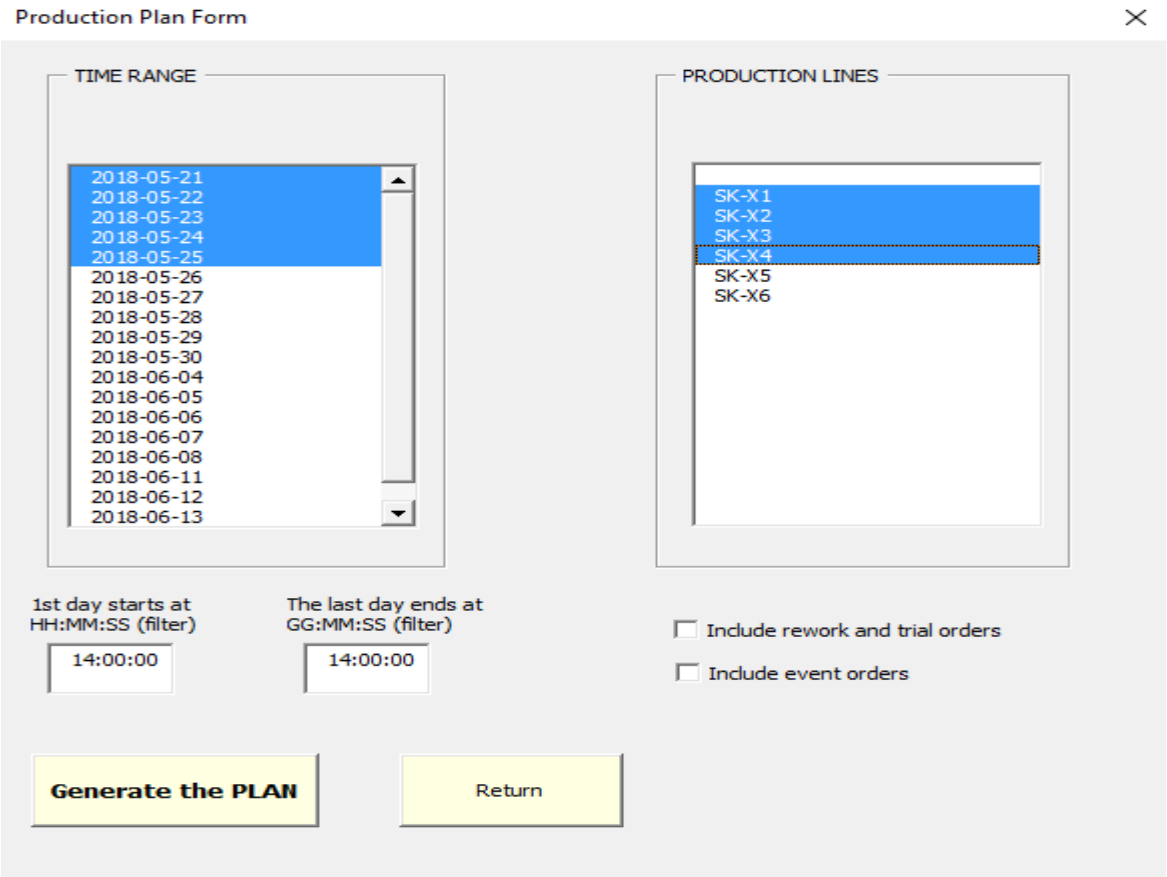

Fig. 8. Production plan form that filters data from data base (2. BAZA PLAN).
Source: own elaboration.

Download production plan execution from SAP ERP system

In accordance with the process described more broadly in Chapter 2, when the accepted settlement period of the production plan has passed, you must proceed to download from the SAP ERP production execution, data within the planned period. To do this, you will need the following data dumps:

- 1. COOISPI (orders with status "Delivered"),
- 2. COOISPI (dump containing all Process Orders included in dump 1 and corresponding Planned Orders),
- 3. MB51 (settled with an accuracy to 1 pallet the execution of orders from dump 1).

Data dumps must be performed in the sequence indicated above. The first file will indicate to the user the orders that were executed during the accepted billing period. At the time of the production plan dump, it is likely that some of the orders included in the screenshot were not

yet converted from the Planned Order into the Process Order. For a verb to be executed, it must be converted into Process Order, so it may happen that the same order could actually be in the production plan as Planned Order, while production was performed as a Process Order. Therefore, the dump No 2 is required, which assigns to each Process order a corresponding Planned Order (from which it was previously converted). The third dump in turn allows you to get data about the execution of the orders not yet completed (without the status "Delivered"), with the accuracy of the execution to 1 pallet. This allows the user to determine how much of the products have been left to pack. There may be a situation where sufficient quantity has already been produced to consider the order to be included in the Report (e.g. 90% of the packaged volume).

After downloading all the screenshots described, which was automated analogously as in the case of the production plan base, in the file FTP Report filled up with data will be Excel tab "5. Orders done", as presented in Figure 9.

This sheet contains data about the order number, the material number, the time and date of the last pallet sentence, and the aggregated order quantity. It also includes the production line information and the planned order number from which it was converted to a process order. Similarly to the production plan base, the user can filter the production plan execution base using a special form (as presented in Figure 8).

The data that were filtered by both the production plan database and the execution base forms are input to calculate the FTP Report.

	A	C	D	G	H	J	M	N
1	Order	Material description	Order Type	Actual finish	Actual finish date	Delivered quantity (GMEIN)	Resource	Planned Order
2	3000392037	PRODUKT 88	ZP01	03:16:54	2018-05-21	3 217	SK-X3	102147224
3	3000392026	PRODUKT 81	ZP01	03:18:44	2018-05-21	704	SK-X5	103610391
4	3000392663	PRODUKT 21	ZP01	05:05:51	2018-05-21	13 800	SK-X4	105979545
5	3000392819	PRODUKT 17	ZP01	10:43:26	2018-05-21	405	SK-X3	102022127
6	3000391226	PRODUKT 27	ZP01	11:03:43	2018-05-21	11 655	SK-X2	103959503
7	3000390696	PRODUKT 18	ZP01	14:26:55	2018-05-21	1 002	SK-X5	100219869
8	3000389355	PRODUKT 25	ZP01	16:53:23	2018-05-21	192	SK-X5	99793382
9	3000391638	PRODUKT 80	ZP01	17:28:27	2018-05-21	24 200	SK-X1	99060577
10	3000389356	PRODUKT 24	ZP01	20:52:14	2018-05-21	725	SK-X5	99788530
11	3000391906	PRODUKT 32	ZP01	21:16:06	2018-05-21	32 958	SK-X4	99923642
12	3000391902	PRODUKT 30	ZP01	21:19:47	2018-05-21	15 439	SK-X3	102490012
13	3000391639	PRODUKT 67	ZP01	22:43:55	2018-05-21	5 249	SK-X1	98899123
14	3000391227	PRODUKT 16	ZP01	22:48:10	2018-05-21	3 345	SK-X2	102152087
15	3000384387	PRODUKT 61	ZP01	00:32:49	2018-05-22	716	SK-X5	102269239
16	3000385003	PRODUKT 35	ZP01	03:15:05	2018-05-22	704	SK-X5	
17	3000391907	PRODUKT 78	ZP01	03:33:16	2018-05-22	14 700	SK-X4	100344581
18	3000392818	PRODUKT 1	ZP01	04:28:10	2018-05-22	394	SK-X3	106008395
19	3000391683	PRODUKT 21	ZP01	05:30:45	2018-05-22	20 575	SK-X1	102148485
20	3000391228	PRODUKT 97	ZP01	05:40:37	2018-05-22	3 968	SK-X2	102019846
21	3000392664	PRODUKT 1	ZP01	09:42:31	2018-05-22	7 200	SK-X3	102549309
22	3000393368	PRODUKT 33	ZP01	09:44:46	2018-05-22	2 952	SK-X3	105644816
23	3000391801	PRODUKT 32	ZP01	09:47:32	2018-05-22	941	SK-X2	102021071
24	3000391206	PRODUKT 23	ZP01	09:53:14	2018-05-22	9 809	SK-X1	98353704
25	3000388657	PRODUKT 38	ZP01	12:17:09	2018-05-22	14 388	SK-X5	102468278
26	3000391684	PRODUKT 10	ZP01	13:58:12	2018-05-22	11 599	SK-X1	105616706

Fig. 9. Data base of completed orders.

Source: own elaboration.

FTP REPORT APPLICATION – CASE STUDY

Figure 10 presented below shows a screenshot of the CROPPE Report prepared with use of FTP Report application (tab "8. FTP"). This sheet is called FTP Report and contains data in columns sequentially from the left:

- The order number (planned or process, planned will appear only if the order was in the production plan but was not executed or converted to process order);
- Material number;
- Material description;
- The production line on which the order was to be executed;
- The number of pieces in the order included in the production plan;
- The number of pieces made in the order;
- Tolerance, which is the percentage ratio of the quantity done to planned;
- The algorithm "extra-planned order?" giving a value of 1 for an executed order that is not included in the production plan;
- The algorithm "not started?" giving a value of 1 for orders included in a production plan but not executed;

- The "Tolerance OK?" algorithm that values 1 for an order made in tolerance (+/-10%);
- The end date of the order, if not completed, will be given the planned date of completion (date from the production plan);
- Similarly to the date above, the end time.

	A	B	C	D	E	F	G	H	I	J	K	L	M
6	Order	Material	Material description	Resource	Order quantity (GMEIN) PLAN	Delivered quantity (GMEIN) EXECUTION	Tolerance	Extra Order?	Not started?	Tolerance is correct?	Comment required? 0 = correct order 1 = incorrect order	End date	End HH:MM:SS
7	3000393753	90	PRODUKT 90	SK-X6	136800	137208	100,30%	0	0	1	0	2018-05-24	18:38:25
8	3000394838	29	PRODUKT 29	SK-X5	0	5639	0,00%	1	0	0	1	2018-05-25	08:54:52
9	3000390696	18	PRODUKT 18	SK-X5	0	1002	0,00%	1	0	0	1	2018-05-21	14:26:55
10	3000389355	25	PRODUKT 25	SK-X5	0	192	0,00%	1	0	0	1	2018-05-21	16:53:23
11	3000389356	24	PRODUKT 24	SK-X5	700	725	103,57%	0	0	1	0	2018-05-21	20:52:14
12	3000384387	61	PRODUKT 61	SK-X5	700	716	102,29%	0	0	1	0	2018-05-22	00:32:49
13	3000385003	35	PRODUKT 35	SK-X5	705	704	99,86%	0	0	1	0	2018-05-22	03:15:05
14	3000388657	38	PRODUKT 38	SK-X5	14400	14388	99,92%	0	0	1	0	2018-05-22	12:17:09
15	3000388656	69	PRODUKT 69	SK-X5	14400	14544	101,00%	0	0	1	0	2018-05-22	18:01:20
16	3000388860	43	PRODUKT 43	SK-X5	14400	14619	101,52%	0	0	1	0	2018-05-22	22:45:42
17	3000388658	57	PRODUKT 57	SK-X5	13900	14322	103,04%	0	0	1	0	2018-05-23	04:15:36
18	3000388659	38	PRODUKT 38	SK-X5	14400	14675	101,91%	0	0	1	0	2018-05-23	09:44:00
19	3000392848	18	PRODUKT 18	SK-X5	14300	14802	103,51%	0	0	1	0	2018-05-23	16:21:39
20	3000395324	12	PRODUKT 12	SK-X5	14300	14795	103,46%	0	0	1	0	2018-05-23	20:57:51
21	3000391066	32	PRODUKT 32	SK-X5	20500	21168	103,26%	0	0	1	0	2018-05-24	05:59:12
22	3000390693	80	PRODUKT 80	SK-X5	20000	20616	103,08%	0	0	1	0	2018-05-25	03:25:10
23	3000390694	1	PRODUKT 1	SK-X5	20000	14502	72,51%	0	0	0	1	2018-05-25	10:36:37
24	3000393044	69	PRODUKT 69	SK-X4	12816	0	0,00%	0	1	0	1	2018-05-24	22:53:25

Fig. 10. FTP Report (columns A do M).
Source: own elaboration.

The K column of the report contains the "required comment?" algorithm. It indicates a value of 0 for the completed orders, which meet each of the following conditions:

1. The order is not over planned and was included in the production plan (algorithm "extra-planned order" = 0);
2. The order was not skipped, was in the production plan and was executed (the algorithm "not Started" = 0);
3. The order was executed in an accepted tolerance [+/-10%]; (the "OK tolerance?" algorithm = 1).

Any order that does not meet the minimum of one of the above conditions shall be considered as non-compliant and assigned a value of 1 in column K. It is assumed that for such items the user must provide the source reason, so called "Root cause" and a corresponding comment to enrich the content entry as is presented in Extended FTP Report in Figure 11. The following columns contain a space for commenting the information described in this Extended Report (columns N and O).

	A	B	C	D	H	I	J	K	L	M	N	O
6	Order	Material	Material description	Resource	Extra Order?	Not started?	Tolerance is correct?	Comment required? 0 = correct order 1 = incorrect order	End date	End HH:MM:SS	Root Cause	Comment
7	3000393753	90	PRODUKT 90	SK-X6	0	0	1	0	2018-05-24	18:38:25		
8	3000394838	29	PRODUKT 29	SK-X5	1	0	0	1	2018-05-25	08:54:52	Machine Breakdown	X3 breakdown
9	3000390696	18	PRODUKT 18	SK-X5	1	0	0	1	2018-05-21	14:26:55	Machine Breakdown	X3 breakdown
10	3000389355	25	PRODUKT 25	SK-X5	1	0	0	1	2018-05-21	16:53:23	Machine Breakdown	X3 breakdown
11	3000389356	24	PRODUKT 24	SK-X5	0	0	1	0	2018-05-21	20:52:14		
12	3000384387	61	PRODUKT 61	SK-X5	0	0	1	0	2018-05-22	00:32:49		
13	3000385003	35	PRODUKT 35	SK-X5	0	0	1	0	2018-05-22	03:15:05		
14	3000388657	38	PRODUKT 38	SK-X5	0	0	1	0	2018-05-22	12:17:09		
15	3000388656	69	PRODUKT 69	SK-X5	0	0	1	0	2018-05-22	18:01:20		
16	3000388860	43	PRODUKT 43	SK-X5	0	0	1	0	2018-05-22	22:45:42		
17	3000388658	57	PRODUKT 57	SK-X5	0	0	1	0	2018-05-23	04:15:36		
18	3000388659	38	PRODUKT 38	SK-X5	0	0	1	0	2018-05-23	09:44:00		
19	3000392848	18	PRODUKT 18	SK-X5	0	0	1	0	2018-05-23	16:21:39		
20	3000395324	12	PRODUKT 12	SK-X5	0	0	1	0	2018-05-23	20:57:51		
21	3000391066	32	PRODUKT 32	SK-X5	0	0	1	0	2018-05-24	05:59:12		
22	3000390693	80	PRODUKT 80	SK-X5	0	0	1	0	2018-05-25	03:25:10		
23	3000390694	1	PRODUKT 1	SK-X5	0	0	0	1	2018-05-25	10:36:37	Raw shortage	component delivery delay
24	3000393044	69	PRODUKT 69	SK-X4	0	1	0	1	2018-05-24	22:53:25	Semi-Product shortage	delays on the s-p production line

Fig. 11. Extended FTP Report.

Source: own elaboration.

In order to keep track of the reasons for the pending orders in the longer term, the possible source causes of their occurrence have been formalized and consolidated. The user can select one of the following categories from the drop down list:

- Lack of raw materials,
- Machinery failure,
- Low machine performance,
- Machine regulation,
- Absences on production,
- No semi-finished products,
- Qualitative mismatch,
- Incorrect data on the system.

By using unified root causes, the user receives the information that is relevant to the question why production plans are not executed according to their assumptions.

CONCLUSIVE REMARKS

The FTP Report is an example of a highly automated application that supports production logistics processes. The formalized methodology for counting the FTP indicator, indicates how much production is in line with the predetermined plan. This is a major support for production planning in the context of research on the stability of plans and production line efficiency. In addition, the application is an example of the use of automation activities under SAP ERP and Microsoft Excel using the SAP script recorder and the VBA programming language. Manual

retrieval of data from SAP ERP system, apart from the fact that it absorbs a lot of time, is heavily exposed to human errors. The large number of fields to fill and the complex functionality of a transaction requiring specialized knowledge makes it easy to mistake. Automating the process of data retrieval, formatting and presenting allows to accelerate this entire reporting process from about 2 hours to 5 minutes. The application works flexibly so that it allows the user to change the time range or required production lines without data re-downloading.

By tracking week to week results and indicating the main reasons for failed orders, the user is able to extract a group of production lines that are not production based as planned. In addition, he can determine why this happens and how the results will be affected, e.g. increased safety stock on hard to reach materials or replacing parts of machines that often suffer from accidents.

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MARKET AND REGULATORY RISK IN CREATIVE INDUSTRIES

ABSTRACT

Background: Creative industries – also in Poland – in the 21st century are becoming increasingly important. A dynamic increase is visible in the benefits provided by creative industries through creative good (including services) in individual national economies and in the increase in the level of employment in creative professions. The relevance of research in the indicated area is also determined by the increasing role and importance of identifying risk factors and managing risk in the specified category of enterprises. The objective of this article is to identify the main risk factors related to the operation of innovative enterprises in creative industries in Poland in the areas of market and regulatory risk. The chapter also aims to identify risk perception by the owners or managers of this category of enterprises in the development of innovative activities.

Methods: Induction and deduction approach has been applied in the following empirical study The study has also applied methods of analysis and synthesis. The induction approach has been based on the CATI survey technique. The empirical data analysis has also used the k-mean method. The study has been conducted on a sample of 200 enterprises belonging to the creative services subsector.

Results: Enterprises from creative industries attempt to identify the basic risk factors and incorporate them into innovative processes. In the surveyed enterprises, market and regulatory risks deserve particular attention. The key role in assessing these risk include: the relationship with stakeholders (mainly customers), adapting to regulation, as well as taking "competitive fight". Risk is primarily a component of operational management and is usually regarded as a source of opportunities and threats.

Conclusion: Market and regulatory risk in creative industries are not always perceived as a "driving force" in developing and implementing innovations, but perceived as a business management component. Therefore, the further research should identify the basic principles and guidelines for developing a risk management system in the surveyed category of enterprises – in order to streamline innovation processes.

Key words: market risk, regulatory risk, creative industries, modern enterprise, innovative processes.

INTRODUCTION

The activities of today's enterprises highlight the role of risk – especially as a source of threats, but also the development opportunities. Risk is not just a factor which entrepreneurs and employees have to undertake a "fight" or to avoid it. Risk is taken consciously, counting on tangible business and organizational benefits. The approach to risk management is not determined only by the potential (i.e. capabilities and constraints) of the company and the peculiarity of its stakeholders, but also the scope of operation. The following empirical research focuses on the activities of the so-called creative industries that are oriented on the development and implementation of innovations in the area of broadly understood culture [Creative Industries Mapping Document: Background 2001]. Creative industries are understood (by The Department for Culture, Media and Sport – DCMS) as an economic activity, encompassing the area of creative activities of people, aimed at the creation and commercialization of culture products, especially in the form of services [based on: Creative Industries Mapping Document: Background 2001].

The main objective of this article is to identify basic risk factors related to the operation of innovative enterprises in creative industries in Poland concerning market and regulatory risk, as well as to specify the perception of risk in the development of innovative activities. The research questions are as follows:

RQ 1: What are the main and most important risk factors (in the area of market and regulatory risks) in creative industries in Poland?

RQ 2: What are the sources of the strategic risk in innovative enterprises in creative industries in Poland?

RQ 3: How is risk perceived by managers in innovative enterprises in creative industries in Poland?

RQ 4: How is risk (particularly market and regulatory one) placed in the development of innovative enterprises in creative industries in Poland?

THE ESSENCE OF RISK IN THE OPERATION OF MODERN INNOVATIVE ENTERPRISES

The activities of modern enterprises are linked to the need to cope with the volatile and unstable environment conditions [Walecka 2018]. Some of these factors have a positive impact on the broadly understood state of the company, others in turn have negative impact [Wu 2006, Vasauskaite 2013] These factors can be considered as sources of risk for current and long-term business activities [Albuquerque, Gomes Couto and Lotti 2019]. These are particularly relevant for the implementation of innovative activities, which is the basis for shaping business models [Dertouzos 1999, Kraus et al. 2018]. This is mainly due to the fact that companies, and in particular so-called creative workers should be able to identify the factors that offer the opportunity for planned and structured creation of values for the different category of stakeholders of innovative processes. The skillful identification and management of these factors is the base of the development of innovative enterprises [Özoğlu and Bülbül 2013, Arasanmi 2019].

Therefore, it is necessary to consider what the risk is and how it should be perceived in modern companies, especially those involved in innovative projects. The literature, does not offer a single and universal definition of risk. However, it can be observed that most of the approaches underline that the risk is mainly a source of losses [Sun, Chen and Hu 2018, Hrytsenko et al. 2019, Montford, Leary and Nagel 2019]. At this point, however, it should be stressed that risk does not always have to be identified with hazards and losses. According to the so-called modern mainstream research, risk is the basis for identifying and lending opportunities [Mader 2011, Krysiak 2011, Board 2011, McNally 2015, Jajuga 2015, Wysocki 2017, ISO 31000:2018] – which should be a contemporary standard in innovative enterprises.

Combining different risk definitions and approaches to risk management, it can be assumed that risk is a probability of achieving or not achieving the intended objective, i.e. the success or failure [Zawiła-Niedźwiecki and Staniec 2008, Zaskórski 2012]. In addition, defining risks and interpreting risk management processes, the operational (short term) and strategic (long term) horizon must be take into account [Wojtysiak-Kotlarski 2011, Frigo and Anderson 2012]. This

is because risk and risk management should "penetrate" the entire company. In addition, the identification of risk cannot constitute an objective in itself, "detached" from the context and peculiarity of the company's entire operation [McNally 2015]. The risk identification should be a deliberated and legitimated activity, e.g. aimed at increasing effectiveness and efficiency of innovative activities.

To summarize the above considerations, it should be noted that, in this study, authors accept the definition of risk by J. Woźniak [2019], as follows: "risk is a measure of the likelihood that planned and developed innovations will or will not be correctly implemented and/or commercialized in the environment, resulting in measurable benefits (incomes) or risks (losses) for the company, resulting in an increase or decrease in the value created for this company and/or its stakeholders" [Woźniak, 2019].

Considering the activities of enterprises based on innovative processes (especially in creative sectors), it is worth emphasizing that they are strongly geared to the development of activities under a highly competitive market [Boix, Hervás-Oliver and De Miguel-Molina 2015, Lee 2015, Buljubašić, Borić and Hartmann Tolić 2016, Porfírio, Carrilho and Mónico 2016]. In addition, creative activities are determined by a series of legal regulations, e.g. related to the patent protection, trade secret protection, design requirements and user safety standards, as well as time and working conditions, etc. [Hennekam and Bennett 2016, Patten 2016]. Both of these groups of factors are interconnected, with a strong determination of the ability of innovative companies to create competitive advantages and to provide the value to stakeholders. Therefore, the categories of market and regulatory risks will be described in further parts of this article. It is worth noting, however, that other risk categories are also important in the activities of innovative enterprises (also from creative sectors), e.g. financial, socio-cultural, technological, etc. [Wiryono et al. 2015, Strazdas and Cerneviciute 2016, Woźniak 2017] – which are particularly in the interest of researchers. Market and regulatory risks are somewhat depreciated and regarded as less important in the operation of creative industries. On the other hand, market and regulatory risks can be considered as "meta-categories of risk" for modern innovative companies, which are a "derivative" of other (i.e. more "popular") risk classes.

In the operation of modern innovative enterprises, including creative industries, a number of different risk factors can be identified (both opportunities and threats). Basic methodical and resource limitation (e.g. in human and financial aspects) is the inability to identify and manage

the majority of risk factors [Nowak and Sobolewski 2017]. Companies wishing to concentrate on the core business (i.e. innovation processes and the creation of value for stakeholders) identify and monitor the basic risks. This is often the case of the so-called "silo" (i.e. classic) approach to risk management in innovative entities in creative industries [Woźniak, 2019]. In micro- and small-sized enterprises operating in modern industries and sectors, the silo approach may be sufficient (but it is not a rule), and the formation of the so-called "informational islands" does not need to hinder risk management processes. Therefore, it is not surprising that in this category of companies, there may be a concentration on general risk categories, particularly market and regulatory ones. On the other hand, in medium- and large-sized innovative companies such activities may be insufficient [Sobolewski and Marcinkowski 2017].

The regulatory risk mainly concerns the evolution of legal provisions, and also leads to the possibility of pursuing obligations on counterparties and outstanding debts by external entities [Kasiewicz 2017, Kasiewicz 2018, Lewis 2018, Gueyié, Guidara and Lai 2019, Adler 2019]. In turn, the market risk is a consequence of achieving the company's objectives in the economy and relationships between the environment and the company. It is associated with changes in the price of assets and contracts, as well as affects the financial flows. It refers e.g. to such sub-categories as interest rate risk, commodity and stock prices, exchange rate, as well as business and non-commercial relations on the market [Zaskórski et al. 2015, The Future of Risk Management in the Digital Era 2017]. It is also worth noting that the innovativeness of modern companies operating in creative industries can be strengthened by the successive development of innovative processes aimed at developing both the creative potential of workers and increasing the value of the effects provided to customers, and thus to entities operating on the broadly understood market [Sobolewski and Wściubiak 2017]. The market risk is therefore a specific "bridge" between innovative processes, and capabilities, requirements, needs and constraints of customers.

In conclusion, it can be noted that market and regulatory risk can have a significant impact on the activities of today's innovative enterprises, including creative industries. On one hand, identified risk areas require the implementation of adaptative and improving actions, which may have a positive impact on innovative processes. On the other hand, these areas offer specific limitations in the development of this category of enterprises, being e.g. a source of

costs. The enterprises' approach to market and regulatory risk will be explored further in the following chapter – based on an analysis of results of the empirical study.

METHODOLOGY OF THE EMPIRICAL RESEARCH

The empirical study has used an induction approach. The study also has applied elements of a deduction approach, mainly in analysis of national and foreign literature. It should be stressed, however, that an induction approach has had a leading role. The study also has used methods of analysis and synthesis – as a consequence of combining deductive (literature analysis and theoretical inference) and induction (analysis of individual cases) approaches. The induction approach has applied the CATI survey technique. The analysis of empirical data also has used the *k*-mean method. In this case, it has been applied the hierarchical cluster analysis – agglomerative method (tree diagram, Ward method). Euclidean distance has been included as a basic metric [based on: Hartigan and Wong 1979, StatSoft 2006, Kajstura 2019].

The empirical study (*N*= 200) has focused on the peculiarity of risk management in innovative processes in project enterprises from the creative services' subsector – according to the classification of DCMS [see: Kasprzak 2013]. The following PKD numbers have been qualified for the study: 62.01.Z – software, 71.11.Z – architecture, 73.11.Z – advertising, as well as 74.10.Z – design.

The study has included mainly the project enterprises where innovative activities are dominant. The study has used a systematic random sampling (taking into account the criterion of the leading PKD activity profile in the creative industries) in layers (the layers have been determined taking into account the size of the company according to the number of employees) – reflecting the quantitative structure of enterprises in the population. In each PKD class, the number of entities has been equal, i.e. *N*=50 (Table 1). This has been primarily used in order to compare companies between all 4 classes and identify fundamental differences and similarities in the risk management in innovation processes between these categories of enterprises. This internal structure of the research sample for the CATI study is acceptable taking into account the lack of full representability of the sample.

Table 1. Specification of the research sample in terms of the leading business profile criterion

Basic criteria for specification of the research sample	Leading business profile – PKD								Total	
	62.01.Z		71.11.Z		73.11.Z		74.10.Z			
	N*	%**	N	%	N	%	N	%	N	%
Age of enterprise										

Less than 10 years ("relatively young")	26	13	15	7.5	12	6	18	9	71	35.5
10-15 years old ("mature")	7	3.5	19	9.5	21	10.5	15	7.5	62	31
More than 15 years ("relatively old")	17	8.5	16	8	17	8.5	17	8.5	67	33.5
Size of enterprise										
Micro (1 – 9 employees)	47	23.5	49	24.5	47	23.5	49	24.5	192	96
Small, medium and large (≥10 employees)	3	1.5	1	0.5	3	1.5	1	0.5	8	4
Level of average annual turnovers										
Less than 40 million PLN	19	9.5	21	10.5	24	12	29	14.5	93	46.5
<40 – 100 mln PLN)	12	6	6	3	11	5.5	7	3.5	36	18
<100 – 170 mln PLN)	2	1	4	2	3	1.5	0	0	9	4.5
170 mln PLN and more	0	0	0	0	0	0	2	1	2	1
Refusal to respond	17	8.5	19	9.5	12	6	12	6	60	30
Scale of the business activity										
Local (1 town/municipality/district)	12	6	11	5.5	10	5	22	11	55	27.5
Regional (1-8 voivodships in Poland)	9	4,5	8	4	14	7	8	4	39	19.5
National (9-16 voivodships in Poland)	25	12.5	28	14	22	11	16	8	91	45.5
European (at least 1 country in Europe outside of Poland)	1	0,5	1	0.5	2	1	0	0	4	2
International (at least 1 country in the world outside Europe, including outside of Poland)	3	1,5	2	1	2	1	4	2	11	5.5
Total	50	25	50	25	50	25	50	25	200	100

* Number of enterprises. ** Percentage of companies in the research sample.

Source: own elaboration based on [Woźniak, 2019] (*N*=200).

According to Table 1, micro enterprises – 96% of the surveyed units dominate in the research sample . The structure of the entire population of enterprises belonging to the sub-sector of creative services in Poland has a similar structure [Grochowski et al. 2012, Szara and Wojtowicz 2016]. In this study, the most of companies have been relatively young, i.e. operated in the market less than 10 years (35.5% of enterprises). The majority of the surveyed companies have carried out activities at the national scale – 45.5%, and at least at European scale – 2%, as well as the international scale – 5.5%. Among the surveyed companies the largest share have had the business units with the average level of the annual turnover lower than PLN 40 million (46.5% of enterprises). It is worth highlighting that 30% of respondents have refused to answer the question about the average level of annual turnovers – regarding it as "sensitive" data protection (Table 1).

RESULTS OF THE EMPIRICAL RESEARCH

Taking into account the purpose of the study, i.e. the specification of the risk perception by the owners or managers in the development of innovative activities, it is worth noting that the

majority of respondents in the whole research sample (49%) share the opinion that risk is the source of both benefits and threats. Such an "universal" and somewhat "modern" approach to risk and risk management also prevails in all 4 categories of creative/innovative service activities. It should be noted, however, that a significant percent of respondents perceives risk mainly in terms of potential losses – 39%. However, it is hopeful that, in spite of above observations, practically every tenth respondent is convinced that risk is above all the source of potential benefits (Figure 1).

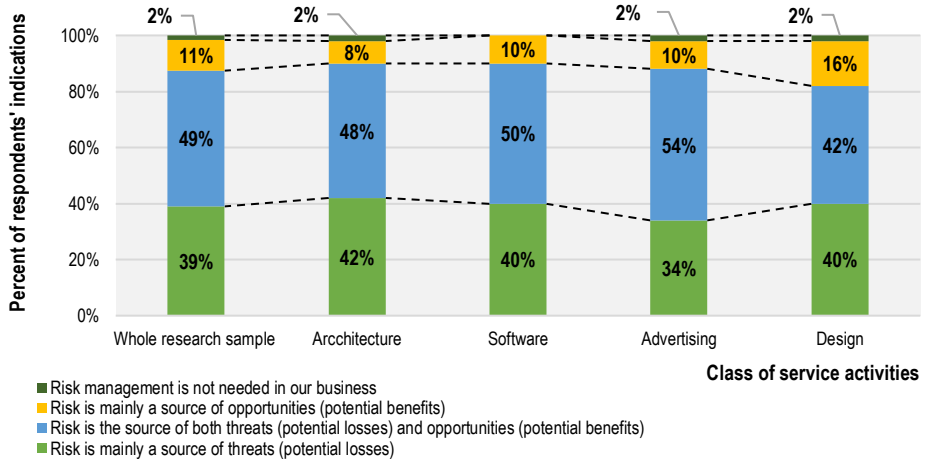

Fig. 1. Number of indications of respondents on the approach to risk perception (single choice question).
Source: own elaboration (*N*=200).

This risk perception offers a fairly good organizational and managerial basis for the correct and "modern" implementation of innovative processes. This is due to the fact that e.g. with the identification, validation and evaluation of opportunities and threats, companies can develop a relatively accurate picture of the decision-making situation [Zaskórski 2012]. This is particularly important when it is necessary to meet the requirements of new markets' segments that are not yet adequately penetrated [Sobolewski and Wściubiak 2017, Wysocki 2017]. In addition, risk perception in terms of opportunities enables workers in the creative industries to make a brave and proactive impact on certain stakeholder categories, thus to progressively "acquire" new markets [Wereda and Woźniak, 2019]. Innovations in globalized business circumstances need "courage" and "brave thinking" – and this attitude requires a particular "risk appetite", which can be defined as the level of risk that the company is "willing" to take in order to attain the objectives' set [see: Anderson 2011]. "Closing" in the context of risk thinking as a source of losses on the one hand reduces the likelihood of making mistakes, and the loss of

valuable resources, while on the other hand it limits the creative potential of workers and closes the company in a specific "low-innovation trap" [Wojtysiak-Kotlarski 2011, McNally 2015, Woźniak 2019].

On the basis of the above results, it can be simplified that risk in the opinion of respondents may be of relevance in the development of innovative activities – this does not have to be a strong impact, but it is, in principle, observed by employees and managerial staff. Respondents recognize the opportunity to manage risk and the overall potential to improve innovation processes. Here, however, it is worth focusing on market and regulatory risk. The most important market risk factors are: increasing competition on the market (22% of respondents' indications), inability to attract and/or maintain customers (9%), as well as the unreliability/disloyalty of customers (4%), and a change in the price of goods (4%). On the other hand, in the area of regulatory risk, the most important risk factors are: the need to adapt to regulatory requirements (7%), and weaknesses of regulations already implemented and applied (6%) (Figure 2).

The above results also indicate that innovative activities on the market are linked, in particular, to one specific group of stakeholders – customers. Noteworthy is the fact that customers are, on the one hand, orderers and consumers of innovations (in the form of a service), and on the other hand are perceived as one of the most unreliable elements of the innovative process. This situation is important, because today, also in the creative industries, it is a popular practice to use prosumption and exploit the potential of the so-called 4.0 customers [Wereda and Woźniak 2019]. It is worth considering the scale and scope of integrating customers into innovative processes. The question that arises is as follows: Is participation of a modern customer in innovative processes really necessary and can guarantee value not only for that customer but also for the company itself and for other stakeholder groups? Reflecting on the participation of customers with innovative processes, it is essential to link the phenomenon of customer disloyalty, their low engagement, and the demanding attitude with strong competition in the industry [based on: Wu 2006, Lee 2015, Porfírio, Carrilho and Mónico 2016, Wereda and Woźniak 2019]. Another question arises: Are customers able to guarantee the company a peculiar "element of uniqueness" that will allow to fight with other players on the market, or "only" to survive? Therefore, it is worth considering whether customers are always an effective and efficient source of values' creation in innovative processes [Patten 2016].

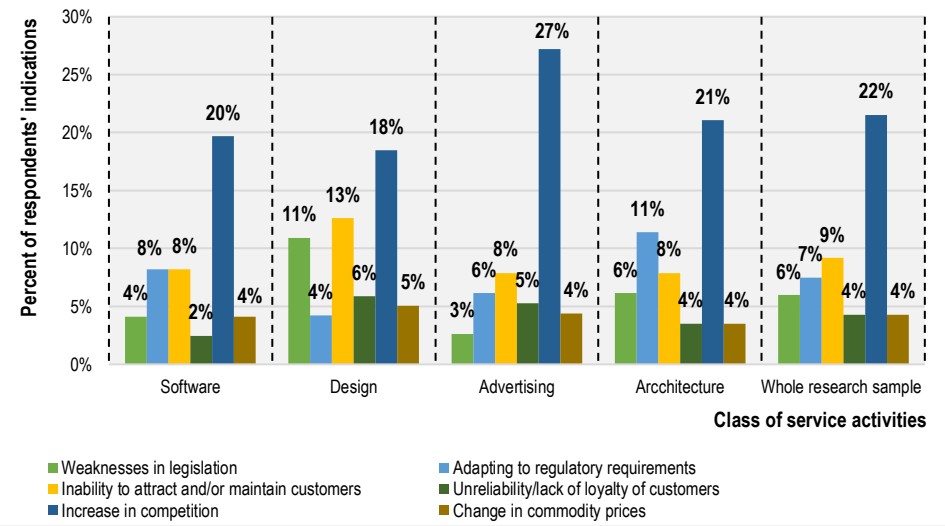

Fig. 2. Percentage of respondents' indications of the most important risk factors related to business activity (multiple choice question).

Source: own elaboration (*N*=200).

In innovative processes, expenditures are of key importance – and customer relationships are also an important source of costs [Wereda and Woźniak 2019]. Assuming that respondents treat commodity price changes as a relatively important market risk factor in innovative processes, cost optimization is necessary. Therefore, in the event of an increase in the cost of purchasing goods (as well as external services and raw materials to creative processes), it is necessary to minimize other cost groups, e.g. of stakeholder relationships [Özoğlu and Bülbül 2013, Arasanmi 2019]. The need to choose between areas of investment in innovative processes is a major challenge for executives and business owners in creative industries [Szara and Wojtowicz 2016]. Each activity and resource can be the basis for creating value throughout the innovation's lifecycle, and it is not always possible to estimate the level of this value in *ex ante* approach [Sobolewski and Wściubiak 2017]. An additional challenge is the need to meet the requirements of the digitalization of economic activities, as well as the "networking/opening" of implementation of innovative processes, and to bear the associated costs [The Future of Risk Management in the Digital Era 2017].

The need to adapt to regulatory requirements and weaknesses in already implemented and applied regulations can also determine the scale and scope of stakeholder relationships (mainly external stakeholders), as well as taking the "competitive fight" by creating competitive

advantages [based on: Kasiewicz 2018]. In innovative activities, especially in creative sectors, the protection of intellectual property deserves special attention, which is the direct basis of the creation of innovation, as well as the "mystery" and "potential" of the company [Kasprzak 2013, Szara and Wojtowicz 2016]. Regulations, despite the fact that they define the conditions of actions for innovative enterprises, also open up a specific "range" of possibilities for interpreting certain provisions. Those who skilfully "read" the chances of regulation (or, in fact, inaccuracies in the legislation) increase their competitive potential [Lewis 2018, Adler 2019]. On the other hand, it is a threat, because it causes a violation of "competitive balance" in the industry and the emergence of various "pathologies" of economic activities [based on: Kasiewicz 2018].

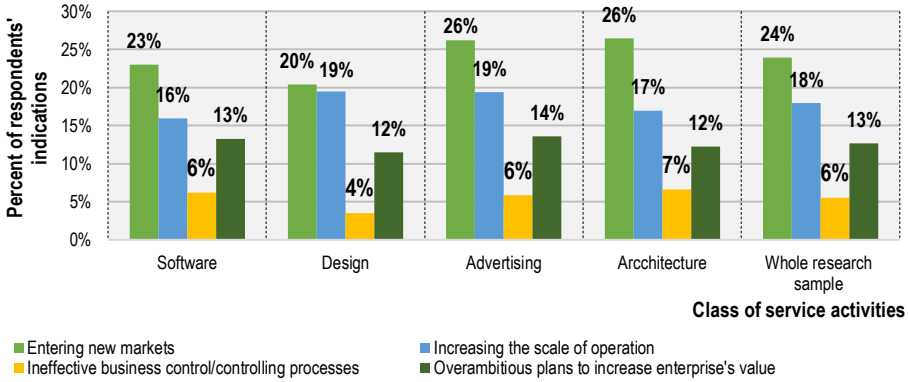

Fig. 3. Percentage of respondents' indications of sources of the strategic risk (multiple choice question).
Source: own elaboration (*N*=200).

The key market and regulatory risk factors oscillate the relationships with customers and co-operatives (e.g. with the use of modern ICTs), taking a competition battle (or coopetition) with competitors, as well as the skills of "smart" adaptation to implemented regulations, e.g. in the field of intellectual property protection, business conducting (primarily related to raising of finance for innovative activities), or the management of human resources (so-called creative workers) [based on: Wereda and Woźniak 2019]. However, these risk factors refer to the current operations of companies. In order to manage risks effectively and efficiently (as a source of both opportunities and threats), there is a need to conduct a strategic/long-term analysis [Zawiła-Niedźwiecki and Staniec 2008]. A fundamental question arises: What can be the main sources of strategic risk in the development of innovative enterprises in creative industries?

According to respondents' opinions, the biggest importance concerning market and regulatory risk is dedicated to entering new markets (24% of respondents' answers), and increase the scale of operations (18%). However, less relevance in respondents' opinion is that the company's plans are too ambitious to increase its value (13%), and ineffective control processes (6%) (Figure 3). It can be noted that, respondents, indicate more importance in the long-term development of innovative enterprises is the source of external risk, which is linked to the need to adapt to new, unknown and thus poorly predictable environmental conditions. External risk is associated to identification of different customer requirements, other antitrust laws, or specific restrictions on customer protection and creative activities. Less relevance to respondents is the risk source determined by employees and managers of companies. This may be the result of respondents' opinion/belief that internal risk sources are under greater control of employees and are more easily planned and possibly modified in the long term without exposing the enterprise and processes on additional costs and mistakes – which, however, does not always have to be true, especially in innovative service activities.

Table 2. Clusters of enterprises in the framework of the peculiarity and subject scope of risk factors relevant to the development of innovative activities

Name of cluster		Experiencing regulatory risk	Experiencing market risk
Abundance of clusters		47	27
Dominant attributes of surveyed enterprises	Size	micro enterprises	
	PKD	62.01.Z	74.10.Z
	Age	"relatively old"	"relatively young"
	Level of average annual turnovers	0-10 mln PLN	10-40 mln PLN
	Scale of operation	national	regional
	Impact of risk management on the enterprise	moderate	low
	Risk perception	source of threats	source of opportunities and threats

Source: own elaboration (*N*=200).

It can be assumed that respondents tend to recognize the need to take into account regulatory and market risk management in the development of innovative activities, but do not always introduce it into business practice. It is interesting to notice which type of innovative enterprises are oriented at managing the risk areas identified above. The study has identified

the clusters of enterprises (with the use of the *k*-mean method), which focuses mainly on the market or regulatory risk (Table 2).

Among the companies which recognize regulatory risk, are found mainly the entities having up to 9 employees (micro organizations) and operating on the market for more than 15 years, and with relatively low annual turnovers (up to PLN 10 million). These companies operate mainly in a national scale, and risk is regarded as a source of threats. In turn, the impact of risk management on innovative processes in this group of companies is perceived to possess a moderate level. This situation may be due mainly to the fact that the companies belonging to this cluster primarily deal with software activities. It is a fairly stable market, especially in a national scale, where no risk factors exist that can "surprise" entrepreneurs and disrupt the stability and continuity of innovative processes. In this type of creative activity, certain legal provisions are quite important, especially those related to the protection of intellectual property and the rules of commercial and civil law. However, these regulations, despite the high importance for businesses in operating activities, do not change rapidly (especially in a national scale) and do not "threaten" innovative processes. Regulatory risk is mainly regarded as a source of potential losses, as the company-relevant regulations are not a source of broadly understood benefits (e.g. financial ones). It is also worth noting that companies from this cluster, thanks to their market experience, as well as relatively small scale of operation and process complexity, are rather "resilient" to changes in regulation (Table 2).

In contrast, the second cluster (enterprises focused on the market risk) is mainly collected by design companies. In this cluster, there are also micro organizations, however, operating on the market for a maximum of 10 years. In this cluster, the average annual turnovers are also at a higher level – up to PLN 40 million. Companies in this cluster are mainly active in the regional scale. It is worth noting that risk in this cluster of companies has a low impact on innovative processes, and risk is perceived as a source of both opportunities and threats. Such situation can be explained by the business profile of the enterprises, where the market is mainly a source for searching development opportunities. The investigated entities (mainly aimed at design) generally take an active "fight" against competitors and try to provide the highest value to customers, which is derived from the creativity of employees/designers. In this cluster, it is also important that service innovations are implemented only within specific orders. Thus, innovations have predetermined customers who participate in innovative processes – they are

the orderers. Therefore, in principle, market risk is not considered to be particularly strong in affecting the core business processes in enterprises in this cluster – despite the fact that these enterprises actively seek opportunity factors and try to neutralize threat factors (Table 2).

CONCLUSIONS

The activities of enterprises in creative industries relate to the occurrence of various risk factors (in the form of both opportunities and threats). Therefore, this category of enterprises – oriented on innovative projects – should progressively incorporate risk management processes into their organizational system. Among different areas and types of risk dedicated to enterprises in creative industries, market and regulatory risks deserve a particular attention – which was emphasized in the article. The key role in these areas of risk is dedicated to engaging relationships with stakeholders (in particular customers), adapting to regulations and their dynamics, and undertaking "competitive fight" on the basis of the gained competitive advantages (e.g. intellectual capital, which is particularly important in services).

Summarizing results of this empirical study, it can be noted that the surveyed companies attempt to identify basic risk factors and incorporate them into the company's management system, and in particular in innovative processes. It is also worth remembering that in these enterprises risk is mainly a component of operational management, as well as it is perceived as a source of both opportunities and threats. It is also interesting that strategic management draws attention mainly to external risk factors. The risk is not always seen as the "basic force" of creating values for different stakeholder groups in the surveyed enterprises, but is regarded as a component of the "innovation system".

The limitation of the following study is the size of the research sample (N=200). The second limitation relates to the scope of researched enterprises and their innovative activities. These enterprises belong to the sub-sector of creative services – and, thus, do not embrace all activities included in the creative sectors' classification. Such narrowing of the research scope has been mainly determined by: (1) the necessity of reaching out to enterprises which are standardized (financially and organizationally), and are fully commercialized and strongly focused on the creation and implementation of innovations for customers, (2) costs and timeframe of the survey. Moreover, the study is focused only on the Polish area and does not include peculiarities of Polish and foreign creative industries.

In addition, the future research in the specified research area should be linked to the identification of potential relationships between the importance and strength of regulatory risk factors and the value of market risk factors. This "in-depth" analysis could provide the basis for shaping and developing new business models and potential strategies for action in dynamic markets for innovative enterprises in the creative industries in Poland.

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III. LOGISTICS COMPETENCIES IN DIGITAL SUPPLY CHAINS

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THE IMPACT OF CHANGES IN THE ECONOMY ON THE COMPETENCES OF LOGISTICS

ABSTRACT

Background: The purpose of the articles is to show the impact of changes in the economy in the field of sustainable environment, digitization and supply chain resilience on the development of logistics competences. The article is based on the author's personal experience as a member of the research team developing a new qualification framework for the logistics profession in the European Union.

Cognitive research goal: identification of key areas of changes in the economy over the last 6 years and learning about their impact on the recruitment and management process of logistics employees (junior, senior and strategic management), based on the opinion of experts (CEOs and directors of companies) . Three areas were selected: sustainable environment, digitization and supply chain resilience

Methodological purpose of the research: revision of the currently binding qualifications framework (ELA QF). The goal was achieved thanks to two workshops, attended by over 30 top-level managers, and individual interviews carried out by the author with the management staff of logistics companies and manufacturing companies in Poland.

Results: under development; **partial results:** verification should be carried out in Business Principles, Core Management Skills and Supply and Logistics Design.

Practical aspects: revision of the ELA QF in 2020, add new competences that will take into account new trends.

Conclusions: Level 4 competences should be higher than before in the above areas. There is a large variation in the meaning of the three areas mentioned in relation to business. This may indicate some immaturity of the above concepts.

Keywords: revision ELA QF, resilience in logistics, sustainability in logistics, digitization in logistics, competences of logistics

INTRODUCTION

A frequent feature of world economic developments in the 2010s has been a simultaneous occurrence of two opposing trends, something which Zygmunt Bauman referred to as a time of interregnum [Bauman et al 2017]. In the ensuing commotion, old paradigms tend to disappear while new ones have yet to emerge – and this also impacts the way the new phenomena are being analyzed. Previously social scientists (or mathematicians for that matter) resorted mostly to methods that were specific to their particular discipline, while only rarely taking an interdisciplinary approach. But the present day's complex process can no longer be understood by following that trodden path, and hence the need for interdisciplinary teams, whose members' diversified knowledge and different points of view offer better chances of grappling with the intricate realities of today's world.

Such a team, comprising five representatives of different academic communities and different countries, has been established with the purpose of reviewing – and, possibly, revising – the Qualification Standards for logistics competence which were laid down by the European Logistics Association (ELA) back in 1998, and which were subsequently, from 2014, aligned to the EU's European Qualification Framework (EQF). The standards, which have been developed with the participations of experts and subject to their consent, can be instrumental in assessing professional logisticians' knowledge, skills and competences. They cover 13 areas of competence (modules) and three competence levels: Level 4 (Supervisor/Operational Management), Level 6 (Senior Management) and Level 7 (Strategic Management).

Out of the many changes taking place in the 21st century's second decade, three have been found to exert major influence on supply chain operations: threats to environmental sustainability, digitalization, and supply chain resilience (speed of adaptation to ongoing changes). Consequently, the team members proceeded to find out – working with practitioners – how these changes will influence logisticians' present and future competences. It was assumed that, just as in the existing version, the structure of the competences model should be in line with the European Qualification Framework, thus translating into 13 areas and three levels of competences.

The first major challenge encountered by team members – this author among them – was to reach a common understanding of the trends under discussion. With managers pointing to a very wide variety of their different aspects – depending on the sector and operational scale, i.e.

regional, European, or global – it was agreed that individual team members would propose approaches to the trends in question that would be as objective as possible. That provided a point of departure for further discussion (after obtaining the managers' approval). Below, the reader is presented with an aggregate approach taken as a result of the ensuing analysis.

ENVIRONMENTAL SUSTAINABILITY, RESILIENCE AND DIGITALIZATION IN SUPPLY CHAIN – BREAKING DOWN THE NOTIONS

ENVIRONMENTAL SUSTAINABILITY

In analyzing Environmental sustainability in supply chain, the following comes to the fore:

1. Reducing the company's carbon footprint [Centobelli et al 2017] by cutting down on emissions through reduction of the overall number of miles driven, and deployment of autonomous vehicles, starting with the electric-driven; the focus must be on developing sustainable solutions to transporting many goods across great distances;
2. Reducing the amount of waste products driving with the empty truck from a destination to a distribution center in another city;
3. Alignment with Governmental Regulation and Goals depending on a company's location (it could face many different environmental regulations and status for production and shipment); Government-driven regulations have a basic goal of ensuring future regulation the resources to survive and it has a share in this responsibility;
4. Reducing the amount of energy consumed: shipping a single item is inefficient; shipping multiply items by consolidation could be less damaging than shipping 20 different trucks across multiply states;
5. Thinking beyond cradle-to-grave (circular economy and loop-of-supply chain).

Sustainability is a complex affair, and so partnerships and broad collaborations are crucial to solving the greatest challenges that emerge here. The goal of a sustainable logistics system is to improve profitability and reduce environmental impact for long-term performance [Carter and Rogers 2008, Gimnez et all 2012]. Table 1 illustrates one way in which the question of sustainable environment in logistics can be approached.

Table 1. Sustainable Logistics Perspectives

Perspectives	Criteria	Sub-criteria
Economics	Quality	Quality of Product Lead Time
	Responsiveness	Demand Responsiveness
	Cost	Manufacturing Cost Logistics Cost
	Profit	Return of Investment Market Share Profit Margin On Sale
	Mobility	Intensity of Goods Transport
Environment	Resource Usage	Energy Usage Water Usage Land Use Raw Material Use
	Pollution	Air Pollution Water Pollution
	Emission	CO2 Emission
	Waste	Waste Disposal
	Eco-Efficiency	Product/Service Value Environment Influence
Social	Health and Safety	Employee Safety Health Care Benefits
	Quality of Life	Accident Education and Training Working Condition

Surce: Wichaisri S., Sopadang A., Sustainable Logistics System: A Framework and Case Study, 2014 DOI: 10.1109/IEEM.2013.6962564

RESILIENCE VS VOLUNTARIBILITY VS SUSTAINABILITY IN SUPPLY CHAIN – THEORITICAL VIEW

Under the Gallopin model [2006], resilience, vulnerability and sustainability are mutually related with each other. In the absence of unequivocal definitions of these notions, though, (perhaps, a result of their being used in multiple fields of knowledge) it is not possible to pinpoint the direction of these relationships [e.g., Pettit 2010]. In the opinion of the present author, supply chain vulnerability has to do with the structure of the entire supply chain and the role of its individual links. If there is a single dominant link, then the vulnerability of the whole chain will be largely influenced by the vulnerability of that particular link. But where there are several key links, it is the relationship between them and the strength of their interconnections that will define

the vulnerability of the entire supply chain. A useful tool in such analysis may be provided by network theory, as applied in sociology [Sztompke 2007]. Where networks are inclusive towards potential new partners we also have inclusive supply chains (networks). Too strong relationships between partners, in this writer's view, may impair the resilience of the entire chain, just as the case would be with too weak relationships. And strong relationships may result in the supply chain's inclusiveness turning into exclusiveness towards outsiders, in what could be described as a kind of supply-chain tribalism. Similar situations occur in other particular links. For example, as demonstrated by research conducted by the present writer, the openness of logistics operators to new recruits from other sectors is fairly low, indicating an exclusivity-oriented organizational culture, preventing influences from different cultures.

In identifying the characteristics of the notion of supply chain resilience, another valuable instrument may be provided by analyzing the notion of elastic (flexible) thinking (understood here as "resilience") in respect of particular persons' traits, as applied in psychology. Psychologists usually see elasticity as capacity to swiftly and effectively adapt to the circumstances, and to cope with adversities. Within the analysis conducted by this author, the term "adaptiveness" could also be used. In psychology, people with elastic minds are seen as exhibiting features such as ability (based on experience) to work out a strategy to avoid repeating errors; emotional balance and calm in stress situations; realism (optimism) resting on solid argumentation; and confidence in their own potential. Such people are empathetic (meaning that they understand not only the feeling of another but also the context of particular situations); they can motivate themselves to action and focus on responses to a given problem. People's behaviors is precisely the stuff of behavioral economics, in its search to better understand economic process. A system's capacity to react to unexpected developments is described by N.N. Taleb [2013] using the notion of "antifragile". Actually an antifragile system has the capacity to learn, by inputting shocks and disruptions (whether external or internal). So we see here more of "resilience plus" (this author's designation), rather than a typical case of resilience where, in accordance with what physics teaches us, a substance yields to an external force and then springs back into shape. We can describe such a system as self-learning, and this also holds for the supply chain understood as a system (network) of interconnected elements.

From the systemic viewpoint, it is important to understand the interdependencies between various activities taken within the supply chain, so as to ensure that the system is in a state of

dynamic balance. Consequently, it is recognized [Fiksel 2006] that resilience (speed of adaptation to new environment) should take into account the economic, environmental and ethical factors that add up to sustainable development.

DIGITALIZATION IN SUPPLY CHAIN

The notion of digitalization, just as those previously mentioned, has not been unequivocally defined, which translates in practice into a multitude of approaches and interpretations. For the most part, though, writers point out to the outcome of digitalization, namely a change in the company's business model and its strategy. Digital transformation begins with what is known as digitization, involving analogue-to-digital data conversion [Rachinger et all 2018]. The process of digital transformation is applied to the restructuring of economies, institutions and society at the systemic level [Brenne and Kreiss 2016, Unruh and Kiron 2017]. In the context of the supply chain, a useful definition is provided by Gartner company, a global digital-technology consultant: "Digitalization is the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business" [Gartner IT]. Another definition comes from i-scoop: "Digitalization means the use of digital technologies and of data (digitized and natively digital) in order to create revenue, improve business, replace/transform business processes *(not simply digitizing them)* and create an environment for digital business, whereby digital information is at the core" [i-scoop.eu]. A still broader notion is that of digital transformation, understood as a complete rethink of how technology and a business interact – a true transformation that puts the user at the heart of everything the business does, whether it concerns its staff, its customers or its partners. The key pillars of digital transformation are mobile, cloud, big data and social. According to Mc Kinsey [McKinsey&Company 2016], the transformation of a traditional supply chain into a digital one requires two enablers: capabilities and environment. An organization should have a built-in digitalization potential, which means it should recruit employees with adequate competence profiles. Another factor activating supply chain transformation has to do with the deployment of a two-speed enterprise architecture, where a separate division with a start-up dynamic and culture is built into the company's organizational structure. Featuring flexible organizational arrangements and equipped with state-of-the-art IT systems (running independently of legacy systems), such division enables fast development, trials and deployment of new solutions.

In the context of these analyses yet another factor should be taken up, one which actually comes to the foreground, given the growing complexity of ongoing processes in the economy and absence of advanced artificial intelligence solutions. This is the risk factor. Nowadays standardized processes in unmodified form can only rarely be seen in practice. And yet they provide a point of reference in building Scenarios A, B, C and D – depending on how the event that has disturbed the standard is classified. It is important here that a value map is drawn, as a compromise between the expectations of the client and the resource constraints on the contractor.

EXPECTATIONS OF LOGISTICIANS' FUTURE COMPETENCES IN THE CONTEXT OF THE RESEARCH CONDUCTED

RESARCH METHOD CHOSEN BY THE INTERNATIONAL TEAM

It was in 2018 that the European Logistics Association (ELA) decided that the qualification standards for logistics competence (all levels: 4, 6 and 7) would come up for review, reflecting the dynamic changes in the economy and the fairly long time that had passed since the previous edition of the European Qualification Standards for Logistics Professionals (ELAQS). A five-member team was appointed, headed by the ELA president and comprising academics from Italy, Austria, Estonia and Poland, who specialize in logistics while simultaneously having practical experience with the sector. The team set themselves the task of sounding business representatives on key challenges expected to emerge in coming years and on the competences logisticians would need to respond to these challenges. The year 2020 was set as the deadline by which to revise the existing qualification framework. The proceedings of the team, conducted in cooperation with practitioners, are presented below, in Table 2.

Table 2

Deadline	Participants	Activities	Purpose	Method
May-August 2018	ELA president, working with national chapters	Setting up a research team of five academics from ELA member countries	Providing methodology support for managers with a view to reviewing the qualification standards for logistics competence (2014 version)	Discussion and recommendations from national chapters, in the course of the Logistics Congress in Poznań in 2014
October 2018	ELA president	Sending a letter of invitation to ELA national chapters, to name representatives who would	Enlisting a group of top and middle-level managers to contribute to the review of existing qualification framework	A written invitation to heads of national chapters

		attend a December 2014 workshop		
December 2018	Research team and practitioners	Diagnosing key changes in the economy, of crucial importance for supply chain architecture	Identifying the competences that will be useful in a changed supply chain architecture	Moderated discussion, individual work, working in pairs, brain storming, using online tools (mentimeter)
January-February 2019	Research team	Checking the results obtained	Setting the results obtained results in order, and defining their hierarchy	Comparing notes, posting the results on Dropbox (accessible to all team members)
March 2019	Research team and practitioners	Checking the results obtained in the second group (managers)	Double checking on the search for new competences	Individual work, use of online tools, discussion, sharing cases

Source: Author's compilation

Following the research process, a set of competences were identified and assigned to individual areas on Level 4 (Supervisory/Operational Management level European Junior Logistician), Level 6 (Senior Management level European Senior Logistician) and Level 7 (Strategic Management level European Master Logistician). The pattern of areas for which competences analysis was made is visualized in Figure 1 (in compliance with ELAQS 2014).

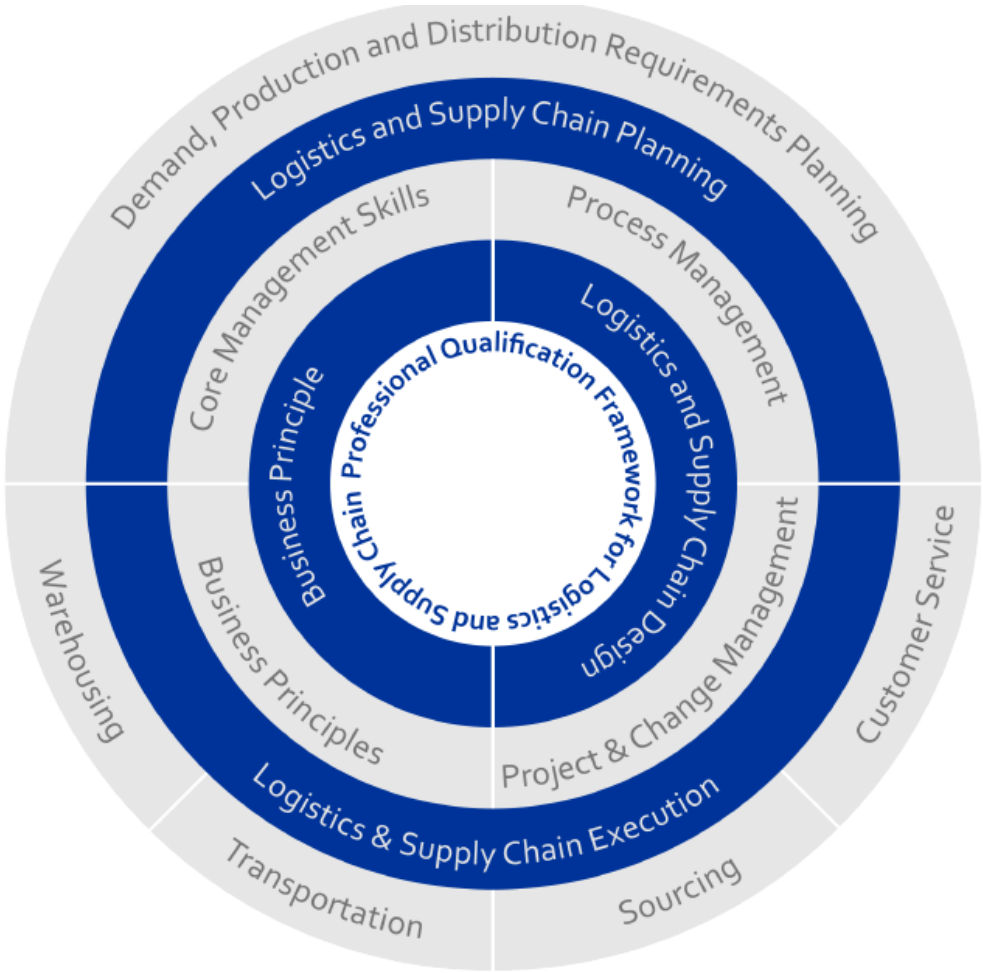

Fig. 1 Professional Qualification Framework for Logistics and Supply Chain.
Source: European Qualification Standards for Logistics Professionals 2014

The obtained results are presented later in this chapter.

PERSONAL INTERVIEWS

Additionally the present writer opted to conduct personal interviews in Poland with three top-level managers representing suppliers of logistics services (two globally operating foreign family firms, and one Polish company) and two other managers, from the automotive industry and the FMCG sector. These were standardized interviews, consisting of three parts. Information was sent by e-mail, and subsequently a conversation was held, either directly or by phone. Interview structure and questions for discussion are presented below:

1. How does the manager's company understand the notions of digital innovation, environmental sustainability and supply chain resilience, and how does it translate into particular business activities?

2. How can digital innovation, environmental sustainability and supply chain resilience be measured at the manager's company and in the entire supply chain? Are any metrics already applied?
3. In the manager's opinion, which competences are of help when taking on these challenges? Are any persons at the manager's company who already have such competences (even in part)?

The interviews lasted from 2 to 5 hours (three telephone conversations to specify the subject matter in greater detail). In one case, during a meeting with two managers, a discussion broke out between themselves, each trying to clarify the meaning of the notions in question.

KEY TAKEAWAYS FROM THE RESEARCH

The most important conclusions from the workshops and interviews are these:

1. If changes to the existing standards are to be made, these should cover the key areas of Business Principles, Core Management Skills and Supply Chain Design, at all levels: operational, managerial, and strategic. In respect of the other areas, it was found that changes in the described competences are possible, but not necessary.
2. Given the complexity of ongoing processes, the biggest challenge is posed by employees' soft competences, especially related to leadership qualities (for 6 and 7 grade managers), teamwork in diversified groups (in terms of culture, gender, age, religion, etc.), and effective communication.
3. Awareness of the context of the changes being introduced is important also on Level 4, to ensure more effective operational activities.
4. The present qualification framework, in the opinion of some experts, goes into too much detail, and so consideration should be given to aggregating certain sections.

Tables 3, 4 and 5 present aggregate proposals concerning future competences for logistic professionals, supply chain managers and supply chain strategists, based on the findings from two workshops and personal interviews conducted by the present writer.

Table 3

Level	Expected future competences
Supervisory, Operational Management level European Junior Logistician (EJLog)	Understands the value of resilience and operates within the guidelines Able to learn and obtain new qualification Ability to execute the solutions

	Ability to understand different point of views Capability to explain problems to the manager Understands and executes the new processes defined Understands link between shareholder value and sustainability development Understands the impact of supply chain disruption Understands the basic tools for supply chain resilience improvement Understands new technologies and the importance of data mining to better manage orders and procedures Is able to utilize & analyze different supply chain data to evaluate strategic logistics improvement projects Conducts risk mitigation projects (as preventive actions) Demonstrates "data-mining" skills and combines them into transparent set of supply chain parameters Expertise and adeptness in areas such as analytics, artificial intelligence, workflows and the Internet of Things Executes & shares best practices to include in the guidelines for environmental sustainability Executes actions required to deliver customer required value within the agreed timeframe and budget Prepares and presents complex business case analysis for decision making Understands application of different modes of transport / road: FTL, LTL, groupage network, parcels/ sea/ air / rail

Source: Author's compilation

Table 4

Level	Expected future competences
Senior Management level European Senior Logistician (ESLog)	Listens to all team members carefully and combines lean thinking with agile (leagile) Defines sourcing strategies for resilience Incorporates new tech in SC processes and decision making Is leader to project teams and processes improvement initiatives at regional level Builds a culture of "best in class" thanks to right approach to events Able to plan and arrange collaborative actions (together with suppliers and customers) in order to raise SC resilience Ability to carry out an appraisal interview and give the feedback Represents ability to work seamlessly within and across companies, cultures, functions and geographies to drive change and action Plans risk avoidance and mitigation strategies Mediates flow of innovative initiatives throughout the organization Is able to calculate the footprint of the operation of company Agent of sustainability in the organization Analyzes and interprets the solicitations of the environment Identifies & recommends sustainability development opportunities in the supply chain with highest environmental & social impact Uses lean techniques and tools to deploy operating standard for end-to-end supply chain Presents high problem solving skills – is able to make rapid decisions based on large amounts of information Understands the crucial importance of searching for and implementing innovations

Source: Author's compilation

Table 5

Level	Expected future competences
Strategic Management level European Master Logistician (EMLog)	Demonstrates knowledge & expertise in supply chain processes transformation capabilities using lean, continuous improvement and innovation techniques Translates market into strategy (fast and agile methods) Mandates, reviews and makes decisions on resilience/risk management system Understands the cost of non-sustainability Defines a compliance system Sets the sustainability agenda (be a moral leader) Develops and achieves sustainability targets to reach strategic organizational goals Identifies strategic opportunities to execute sustainability initiatives by design, development and implementation Interacts, connects & leads cross-functional teams across Europe Researches markets for best practices and innovations in supply chain Cultivates relationship with external and internal suppliers and customers to develop programs and achieve organizational goals Has knowledge and is able to develop teams to use innovative tools & techniques which would help reduce costs, inventory levels and transit times Has high multi-level leadership skills which help achieve targets on a global, multi-channel, cross-functional basis

Source: Author's compilation

CONCLUSIVE REMARKS

This chapter presents an approach to verification of the 2014 European Qualification Standards for Logistics Professionals. The verification process, necessitated by the changes taking place in the global and regional economy, has yet to be completed, but the workshops and interviews conducted as part of the project outlined herein helped diagnose competences of key importance for logisticians in the effective discharge of their responsibilities. Special emphasis was placed on communication skills, teamwork, quick adaptation to change, risk management, and technology proficiency. Much importance was assigned to discussion, seeking to understand what approaches practitioners take to the trends impacting supply chain management. Three trends were identified as key drivers of much needed change in the recruitment and training of logistics professionals, namely: sustainable environment, digitization and supply chain resilience. As it turned out, the understanding of these trends differed widely among managers, which may indicate that the development of these concepts remains very much in a nascent state. Also, some experts urged that the organizational structure

of the company of the future be flattened, so as to expedite decision-making and shorten the distance between management layers, thus resulting in improved supply chain resilience.

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HOW MATURE ARE COMPETENCIES IN SLOVENE LOGISTICS SECTOR? AN OVERVIEW OF THE COMPETENCE MATURITY AND PLANS FOR THE FUTURE

ABSTRACT

The goal of the article is to present logistics competence maturity model and place Slovenia with its logistics development according to this model. Competencies can in general be describes as skills, knowledge and abilities needed for successful work (in our case in logistics). We will present the Slovene study system of logistics (Faculty of logistics), Slovenian logistics association and development of logistics competencies in Slovenia in general.
In the end we will according to our own research try to place Slovenia into competence maturity matrix.

Key words: Competence, logistics, competence maturity matrix

INTRODUCTION

The aim of this article is to present the skills, competencies and knowledge needed for successful work in logistics and supply chains. We will present logistics competence maturity matrix. Slovene logistics sector was not included in this research, so we will present results from different researches in competencies in logistics in Slovenia. Based on our own research we will try to fit Slovenia and Slovene logistics sector in this map of competence development.

COMPETENCIES

Competencies can be in general described as “capability or ability” (Boyatzis, 1982, McClelland, 1973). The behavioural approach describe competencies as a “set of related but

different sets of behaviour organized around an underlying construct called the intent" (Boyatzis, 2011).

Kohont (2005, 33) describes competencies as "a whole of interrelated skills, knowledge, motivation, self-image and values that an individual knows, wants and is able to successfully use in a given work situation".

COMPETENCIES IN LOGISTICS IN SLOVENIA

Several researches in field of competencies in logistics in Slovenia have been conducted in last years. Slovene companies expect from logistics experts following competencies (Mlaker Kač and Fošner, 2016):

- "good analytical thinking;
- good communication skills;
- good knowledge of foreign languages (in most cases English, in many cases also German or Croatian);
- good negotiation skills;
- accuracy;
- good in quick learning and willingness to learn;
- innovativeness;
- good in working with many information and databases;
- good in reporting the results,
- flexibility;
- quick in decision making;
- good leading skills;
- good in supervision and control;
- good in organizing work and co-workers;
- good general planning skills.
- knowledge of legal filed connected to logistics;
- knowledge of competition in their field;
- good knowledge of outsourcing activities and their providers;
- good knowledge of warehousing;
- good selling and consulting skills in logistics and supply chain management;

- knowledge of managing logistics costs;
- good knowledge of specific documents related to logistics (for example documents related to purchase orders, delivery notes and invoices);
- knowledge and understanding of different logistics techniques and technologies."

STUDY PROGRAMMES OF FACULTY OF LOGISTICS AND INTERNATIONAL ACCREDITATION

Faculty of Logistics University of Maribor is the only specialised faculty in this field and »aims to encourage and inspire students, employees and the broader public to study logistics in greater depth, as an interdisciplinary and multidisciplinary discipline. Our aim is also to promote logistics in Slovenia and abroad through the pursuit of education, science and research« (Faculty of Logistics, Mission, vision, strategic guidelines).

Special emphasis is on:

- »facilitating co-operation and collaboration with partner institutions,
- designing contemporary and interactive study programmes,
- facilitating personal and professional development of an individual,
- integrating theoretical and practical knowledge,
- developing strategic research,
- facilitating diversity and experience,
- finding sustainable, reliable and professional solutions,
- keeping track of and co-operating in standardisation and legislation projects.« (Faculty of Logistics, Mission, vision, strategic guidelines).

Faculty of logistics University of Maribor also makes a positive influence on (Faculty of Logistics, Mission, vision, strategic guidelines)

- »the students – by implementing quality full-time and part-time studies and life-long learning and integrating research work,
- employees – by providing a safe and pleasant work environment and promoting personal and professional development,

- the users of our services – employers of our graduates will be more successful when developing and offering efficient logistics services and products,
- the broader social environment – by developing new knowledge being socially responsible in all activities.«

Strategic guidelines of Faculty of Logistic University of Maribor are: »providing continuous quality in all areas of education and research, keeping the leading role in the broader regional area, integrating into international education and research networks, facilitating research activities, developing new study programmes, implementing e-learning and video-conferencing, creating a student-friendly environment, establishing new education centres at home and abroad, managing human resources, building a strong organizational culture" (Faculty of Logistics, Mission, vision, strategic guidelines).

Study programmes (Professional degree programme, University degree programme and Master's degree programme) of Faculty of Logistics University of Maribor are accredited by ECBE, the European Council for Business Education, and ACBSP, Accreditation Council for Business Schools and programmes.

ECBE is an international not-for-profit educational organisation, registered in Brussels as an AISBL – Association Internationale Sans But Lucrative. It is committed to supporting academic and professional learning institutions in business and related fields. It provides advice and consulting services to encourage and support institutions to commit themselves to continuous improvement by engaging in its accreditation processes. It also creates valuable networking opportunities for schools interested in internationalising their curriculum and contacts. These services help to enhance the learning environment and career opportunities for students of business. (European Council for Business Education).

ACBSP's accreditation process follows the Baldrige model. The accreditation focuses on recognizing teaching excellence, determining student learning outcomes, and a continuous improvement model. ACBSP's student-centred teaching and learning approach, which is measured and analysed for quality, ensures that students gain the right skills from their educational investment. Institutions with programs accredited by ACBSP are committed to continuous improvement that ensures their business program will give students the skills employers want. (Accreditation Council for Business Schools & Programs)

According to these two accreditation Faculty of logistics is better recognized all over the world and follows educational standards prescribed by the international accreditation houses. Therefore, Faculty of logistics annually updates our study programmes and put modern contents in the curriculum according to trends in Logistics.

SLOVENE LOGISTICS ASSOCIATION

Slovenian Logistic Association is »free, independent and non-profit organisation of members and supporters« (Slovenian Logistic Association, Introduction).

Main goal of association is »professional acting and networking on the field of transportation, traffic and business logistics. Association connects experts, entrepreneurs, managers and other people, who act in this field and want to contribute to the development of transportation, traffic and business logistics« (Slovenian Logistic Association, Introduction). Expected benefits of membership at Slovenian Logistic Association are: »networking, experience exchange, best practices, fair visiting, less expensive access to best professional events, friendship, professional training, access to top experts" (Slovenian Logistic Association, Expected benefits of membership).

The main goals of education and trainings that are provided by Slovenian Logistics Association are »to share knowledge among SLZ members through workshops, presentations, trainings and exchange of different experiences from practice. Through such events organisation would like to raise awareness about quality of logistics services within SLZ members and external experts. Organization would also like to include other organizations and experts to support the exchange of knowledge ideas among members« (Slovenian Logistic Association, Education and trainings).

Key activities in area of education and training are: presentations, workshops, general and professional courses, trainings, best practice share and fair visits. (Slovenian Logistic Association, Education and trainings).

LOGISTIC COMPETENCE MATURITY MATRIX

Logistics competence maturity matrix presents stakeholder guideline for logistics competence development. Countries are divided into three different groups: basic logistics

competencies maturity, intermediate logistics competence maturity and advanced logistics competence maturity. Details are explained in Figure 1.

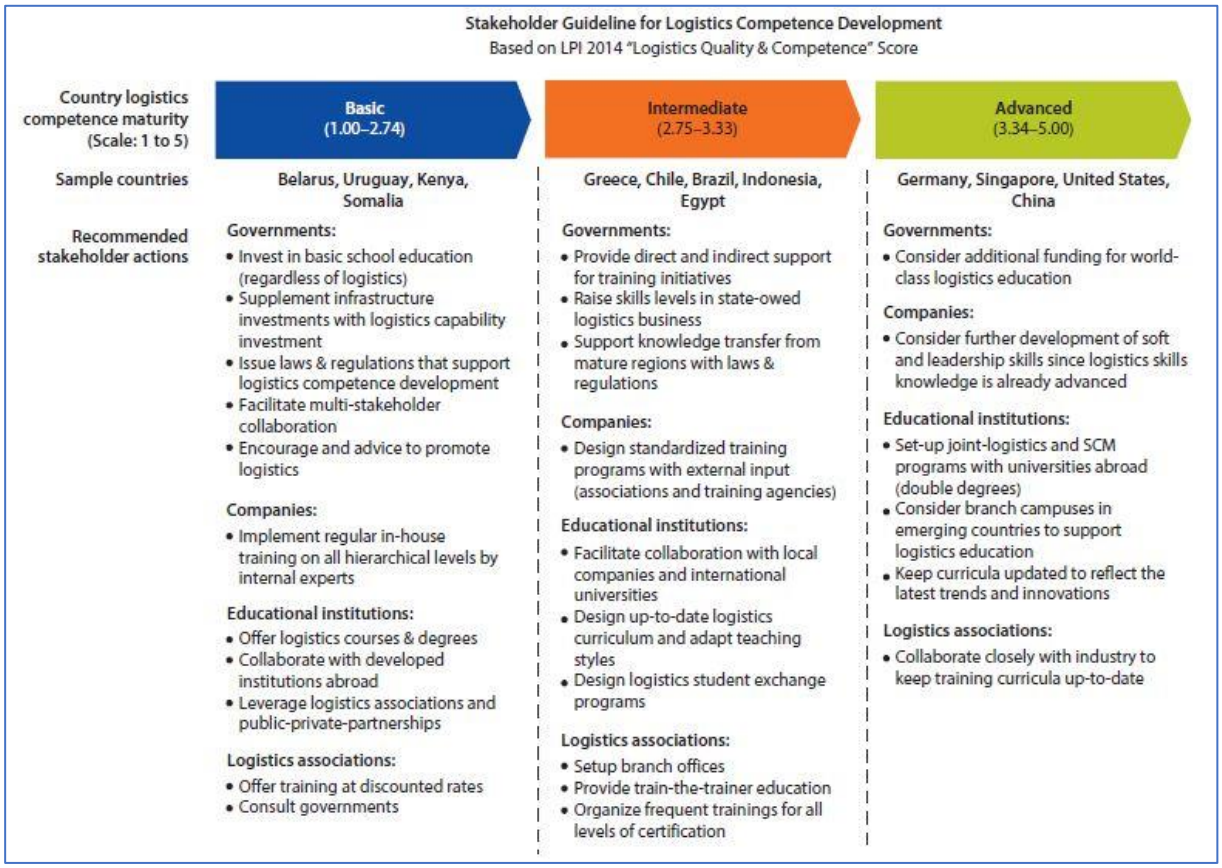

Fig. 1: Logistics Competence Maturity Matrix.

Source: McKinnon, Flothmann, Hoberg & Busch, 2017, p. 68

Slovenia has not been included into research. But from our own research presented in this article we can claim that Slovenia is very well developed in logistics competency maturity (we would place it at the beginning stage of the advanced level).

Logistics sector is increasing rapidly in Slovenia and logistics companies are developing very quickly.

Slovenia has a good bologna study system, programmes at Faculty of logistics are modern, well developed and internationally accredited (ECBE and ASBSP accreditations).

Slovenian logistics association is also well developed. They organise different education and training programmes and conferences where partners and companies can improve and develop their logistics business ideas.

CONCLUSION

This article presents short theoretical background of competencies and competencies in logistics. Furthermore we discussed the development of logistics competencies in Slovenia and the importance and contribution of Faculty of logistics University of Maribor and Slovenian Logistics Association to well-developed field of logistics competencies.

The future plans are mostly connected to improvement of cooperation between all stakeholders: especially companies with core business in logistics sector, Faculty of logistics and Slovenian Logistics Association. All stakeholders together and their cooperation in projects, education and training programme can lead to better logistics competencies.

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STUDY ON THE DEVELOPMENT OF TRANSVERSAL COMPETENCES OF STUDENTS OF LOGISTIC

ABSTRACT

Background: In the dynamically developing enterprises of the TFL industry, the demand for educated and competent employees is still growing. The educational process at the academic level should not only broaden the level of knowledge in this field but should also promote the development of transversal skills, such as entrepreneurship, communicativeness, creativity, and cooperation in the group.

The article aims to examine the effectiveness of using three selected heuristic methods to develop transversal skills in the field of Logistics at the Maritime University of Szczecin. The research also pertains to the pace of growth of these competences during the implementation of educational processes using the indicated methods.

Method: The method of accelerating the development of transversal competences in the process of students' practical education was used to test models of cross-functional skills development processes. The competence growth assessment was carried out in three stages, with the use of brainstorming, meta-plan and psychodrama. The competence level test was taken into account before the evaluation of the learning process models and after their completion. Nonparametric tests of multiple comparisons were used to analyze the results obtained. A matrix for the dependence increase in the applied case was based on the applied heuristic method.

Results: The considerations are illustrated by the results of calculations regarding the development of transversal competences of students, as well as the effectiveness of using selected heuristic methods used to raise them.

Conclusions: It was pointed out that after applying the proposed methods to students, the level of examined competences in most cases increased. The level of students' awareness of the knowledge of their transversal competences has also increased. Despite the complexity of the research, the method applied proved to be useful in studying the change in the level of transversal skills of students. There were no significant differences between the methods used and the rate of increase in competences depending on the specialty. Women, in most cases, develop their transversal skills better than men regardless of the mode of study.

Keywords: transversal competences, higher education, brainstorming, meta plan, psychodrama

INTRODUCTION

In knowledge-based economies the researchers working in particular fields emphasize the role and significance of transversal competences more and more [Amstrong 2005, Goliński et al. 2017] as opposed to core competences [Sutherland and Canwell 2007]. They help in self-realization, personal and professional development, achievement of social integration and proper citizen's attitude. These skills are commonly referred to as general or interdisciplinary ones and constitute the amalgamation of knowledge, skills and attitudes necessary for the attainment of social goals [2006/962/EC].

Entrepreneurship [Zioło and Rachwał 2019, Błaszczyk 2019], creativity [eur-lex.europa.eu], teamwork and communicativeness stimulate the decision-making and risk management processes. They influence building of strategies not only in economic but also social systems [Sawyer 2006].

The labor market expects from academic institutions that their graduates should excel in entrepreneurship, creativity in problem solving and communication in teams [Szaniawska and Wolnowska 2015]. The examination of transversal skills and the determination of methods which could improve them are crucial for all the involved people: students, graduates, entrepreneurs and institutions [Srikanthan and Dalrymple 2004].

The aim of the article is to examine the effectiveness of three selected heuristic methods for the development of transversal skills in the study specialization „Logistics” on the Maritime University in Szczecin. The research concerns also the rate of rise observed in terms of the above competences during the realization of education processes based on the use of these methods.

RESEARCH METHODOLOGY

The main tool used herein for the testing of transversal skill development process models was the „Method for accelerating the development of transversal skills in the practical students' education process", which, in the opinion of the scientists from Poznan University of Technology, facilitates the quicker acquisition of transversal competences such as entrepreneurship, creativity, teamwork and communicativeness [Graczyk-Kucharska et al. 2018, Szafrański et al. 2017, Spychała et al. 2017].

The method is a result of the works carried out within the project financed as part of Erasmus+ Program, and has been developed by a Polish-Finnish-Slovakian-Slovenian team for the purposes of educating the students (future employees), but it may also be applied for the education of students and within continued (post-graduate) education [Graczyk-Kucharska et al.2019a, Graczyk-Kucharska et al.2019b].

The estimation of competence rise has been carried out in three stages, using the methods of brainstorming, metaplan and psychodrama, while taking into account the results of the competence level tests carried out before the commencement of education process and afterwards. The process is presented graphically in Figure.1.

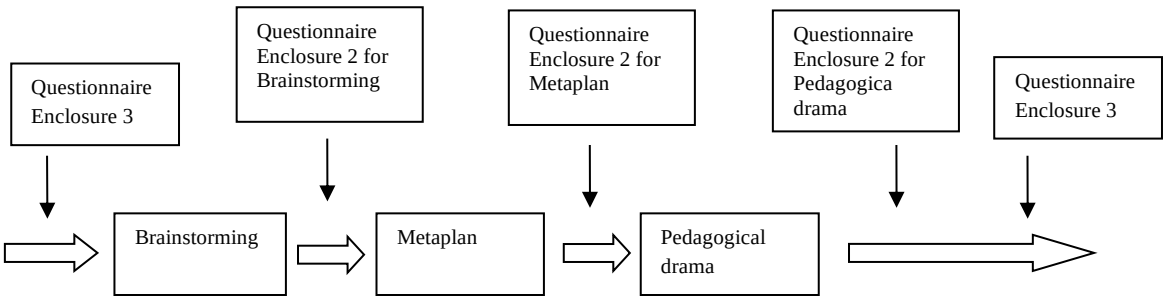

Fig.1. Phases of the application and evaluation of methods used for practical education in the process under design. Source: own elaboration based on the [Graczyk-Kucharska et al. 2019a].

Two questionnaires have been used for the execution of the research, included in:

- Enclosure no.3, used at the beginning and in the end of research – The questionnaire for the assessment of students' transversal skill levels during practical education, which includes questions regarding entrepreneurship (6), creativity (3), teamwork (7) and

communication (8). The level of each skill was assessed by the tested subjects using a six-steps scale from 0 (no skill) to 5 (skill mastered in a very high degree).

- Enclosure no.2, used after the course based on each one of the three methods – The questionnaire for the assessment of improvement in the students' transversal skills, which includes indices regarding entrepreneurship (7), creativity (4), teamwork (8) and communication (9). The improvement in scope of each skill was assessed using a six-steps scale from 0 (no improvement in the skill) to 5 (skill improved in a very high degree).

Brainstorming is a method frequently used for the solving of various problems, from simple to more complex ones, in the field the economics, production and social sciences. It has been developed in 1938 by A.F. Osborne who proposed some specific rules for its use, including the number of session participants ranging from 6 to 12 (same men as women). The team should include people directly involved in the problem as well as such persons who are going to stimulate the works of the group.

Brainstorming is a method which requires high creativity, ingeniousness and unfettered imagination from the participants, so that the number of generated ideas can be as high as possible.

During the session, the ideas brought forward by its participants should not be criticized, no matter how crazy, innovative or outlandish. The session may be extended with incubation time depending on problem complexity. In accordance with known phases of creative thinking, this is a phase when we already know the problem and are interested in some overheard preliminary ideas, but we haven't yet reached the solution which would be satisfactory for us. The group selects the most interesting solution and also the one which would be most beneficial for interested parties, in the course of discussion encompassing all the proposed ideas.

Due to its simplicity and versatility brainstorming is often used, both in its classical form and in derivative versions which include: Gallery Method, 635 Method, Trigger Method, Pin-cards technique, Wildest idea method, Successive Integration Of Problem Elements (SIL) method, Brainwriting technique, Nominal Group Technique and others.

Another tested method was „Metaplan" which is also called a placard technique and which belongs to such a group of problem-solving methods where a graphic form is used for recording the arguments used in discussion. The form used is systematic and resembles a placard where

issues are divided by aspects: how things are, how should they be, why it isn't as it should be and conclusions. This method, even though it is not really often referred to in literature, is still frequently applied in various economic branches such as construction industry, information technology, education at all levels and in all fields [Campagna 2016]. It is possible to use Metaplan for individual analysis, but the most typical application is to use a group of maybe up to a dozen or so people. The time given to the team is usually limited by the moderator or leader who does not take part in the discussion and the development of the placard.

Teamwork is dynamic and teaches concentration, quick analysis, systematizing the existing knowledge and also the knowledge streams supplied continuously by other participants. It allows for developing communication and negotiation skills, creativity, and communicativeness by stimulating the linguistic competences [Ovchinnikova et al. 2015], expressing personal opinions, conducting the discussion and working in a team.

The last method used was „Drama", also known as „Pedagogical Drama". It consists in one or more persons playing the roles given to them by the moderator. It is conducted in three phases:

- The leader outlines the initial situation,
- The participants prepare to play the roles assigned to them,
- The roles are played,
- The executed performance is discussed.

Similarly as with other methods, Drama can be applied for solving various problems which may be more or less complex and interdisciplinary [Kalidas 2014, Toivanen et al. 2011]. The difference here is that each of participants plays his/her role individually, which boosts their activity. This method is good for developing spontaneity, imagination and at the same time quick reactions in decision-making on the basis of own knowledge and immediate analysis of evolving situation in which the participant is immersed [Kemeh 2015]. It allows for expanding one's limits [Lehtonen et al. 2016] and capabilities in life, within the professional and social environment that one faces, and also facilitates the perception of limitations, perspectives and consequences of decisions made by one. It constitutes a challenge for both learners and teachers at various education levels [Muszyńska et al. 2017].

DATA ANALYSIS AND DISCUSSIONS

The research into effectiveness and justification for the use of the three selected heuristic methods as means to raise the level of transversal competences have been carried out at the Maritime University in Szczecin in the period from October 2018 to the end of January 2019.

The students participating in the research were enrolled in full-time and part-time modes of study at the Logistics specialization on the Faculty of Transport Engineering and Economics. Detailed data concerning the respondents is included in Table 1.

Table 1. Information concerning responds (LP – Logistyka Przedsiębiorstw (Logistics of Enterprises), LM – Logistyka Metropolitalna (Municipal Logistics), LiZwEST – Logistyka i Zarządzanie w Europejskim Systemie Transportowym) (Logistics and Management in European Transport System).

Direction	Specialization	Level of study	Mode of study	Year of study	Research period	No. of students/ no. of respondents	Subject used for research tests
Logistics	- LP - LM - LiZwEST	I level	Full-time	III	10.2018-01.2019	100 /82 people Erasmus 4 people	Quality normalisation and management in logistics
Logistics	No specialization	I level	Part-time	II	10.2018-01.2019	39 / 37 people One person – pause in studies	Quality normalisation and management in logistics

Source: own elaboration.

The purpose, the methodology of research and its schedule were explained to the students with regard to their various modes of study. Each test was preceded by a theoretical and methodical introduction to maintain clarity and good comprehension of the method by respondents. The tests were carried out during lectures and exercises.

With the full-time students the brainstorming and Metaplan exercises were performed in the same six 12-persons teams and one 10-persons team. In case of part time students three 12-person teams were formed. The test subjects used were related to the field of education and specialisation, e.g.

- Increasing the percentage of persons using the municipal transport means of in the city Szczecin,
- Reducing the traffic congestion in the streets Cukrowa and Przestrzenna in the direction of Przecław,
- Expansion of the range of quality management methods and tools used by small and medium-size enterprises.

A different procedure was used in case of Pedagogical Drama, where the full-time students role-played the situations occurring during an internal audit of a quality management system following the requirements of ISO 9001:2015 standard. The part-time students on the other hand played the roles of owners of transport, forwarding and logistical processes (TSL).

During brainstorming session each of the groups selected a moderator, who performed a preliminary assessment of each student's work after the performed session. The teacher leading the tests would assess the involvement of each student after a given session was finished, summarised and its effects evaluated. The students would assess their own improvement in terms of particular competences using a questionnaire.

When Metaplan was used as a template for an exercise, each group would select a leader, a secretary and a reporter. The leader would perform the final assessment of particular students taking into account their self-assessment. Similarly as before, the students would fill in a related questionnaire and this way assess their own improvement in tested competences.

The analysis of the results of executed tests, carried out by means of a change dynamics questionnaire referring to the assessment of possessed transversal competences, provided for a finding that improvement took place for each of the competences i.e. entrepreneurship (E), creativity (Cr), teamwork (T) and communicativeness (Co). The levels and the distribution of competences for all the respondents, as well as by modes of study (full-time and part-time) are similar. The results are presented in detail in Figure 2.

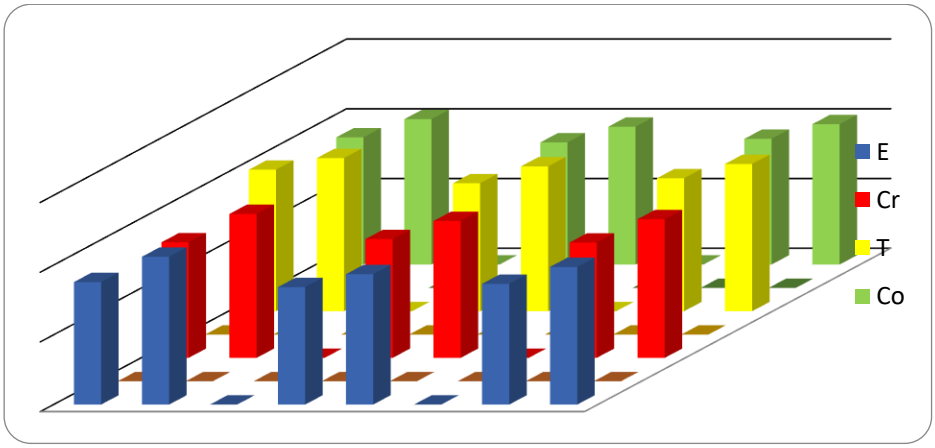

Fig. 2. Changes of competence levels for all students.
Source: own elaboration.

It can be seen that the part-time students assessed their competences higher than full-time students. However, only the difference in competence E rise is significant statistically, which is shown in bar graph in Figure 3. This is also confirmed by a t test: the value of test statistics amounted to (-3.122), which translated to probability value p=0.023.

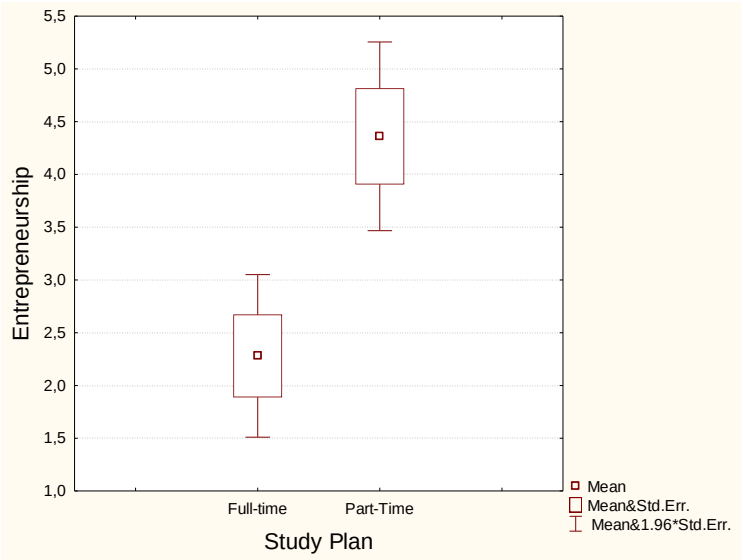

Fig. 3. Rise in E competence (entrepreneurship) for full-time and part-time students.
Source: own elaboration.

In spite of a general rise of competences among students, many of them (13%) indicated a lower level of competence at the end of study in comparison with its beginning. This means that the awareness of students about the level of own competences has risen as well, which applies in particular to full-time students whose percentage amounted to 15%.

The statistical tests did not show significant differences in the results achieved by males and females, while females had higher results more often, which is illustrated in Figure 4.

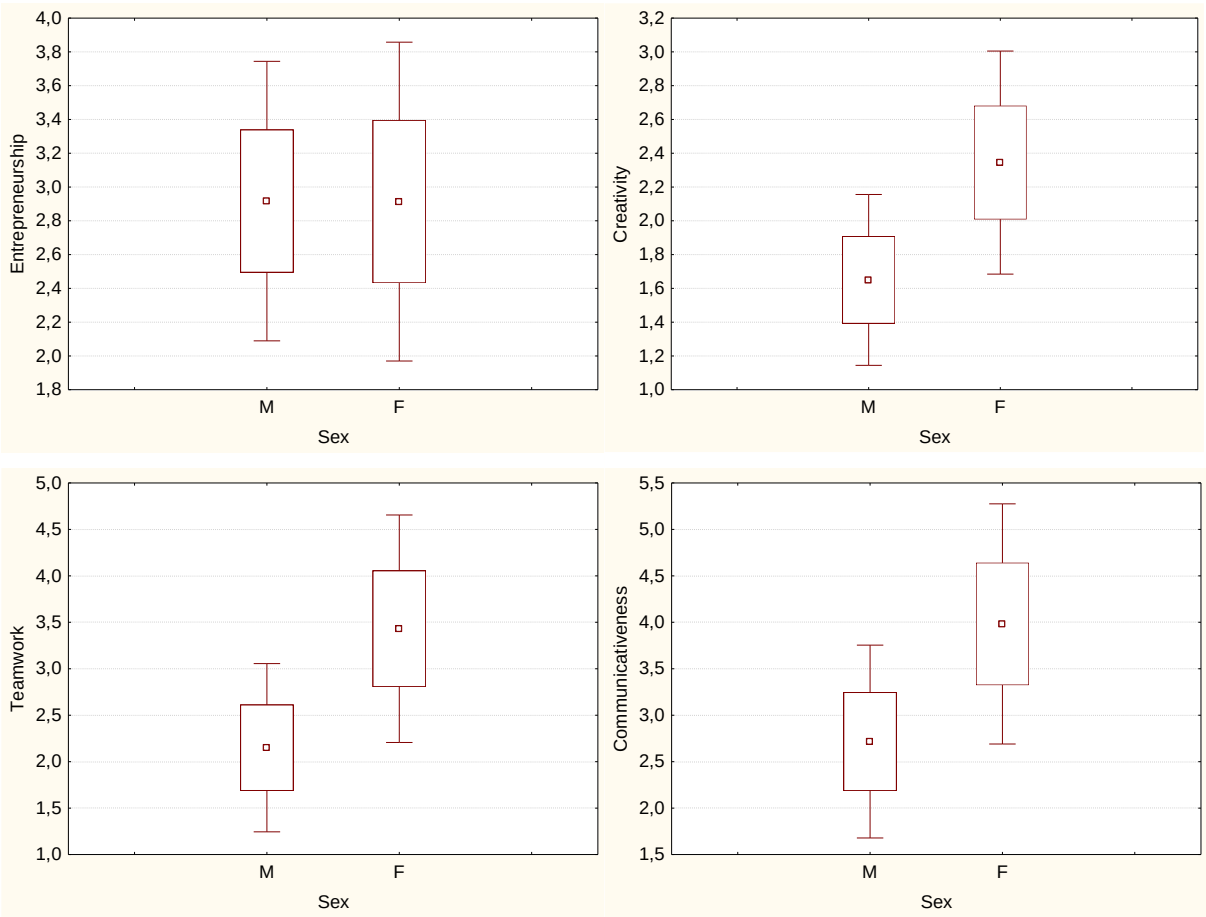

Fig. 4. Rise in competences depending on gender.
Source: own elaboration.

For full-time students the results attained by students of different specializations have been compared using a single-factor variance analysis ANOVA. The assumptions necessary for this analysis have been checked, i.e. the normality of result distributions for particular specializations as well as variance uniformity which has been verified using Lavene test (statistics F=1.02, p=0.36).

No grounds have been found to reject the posed statistical hypothesis stating that the average rise in competences is uniform for all specializations. The results of variance analysis are shown in Table 2.

Table 2. The results of variance analysis

Sum of Squares - Treatment	Degrees of Freedom- Treatment	Mean Square - Treatment	Sum of Squares - Error	Degrees of Freedom - Error	Mean Square - Error	F-value	p - value
96.46	2	48.23	11069.49	79	140.12	0.34	0.71

Source: own elaboration.

The graph below shows some differentiation in results, however it is not significant statistically, see Figure 5.

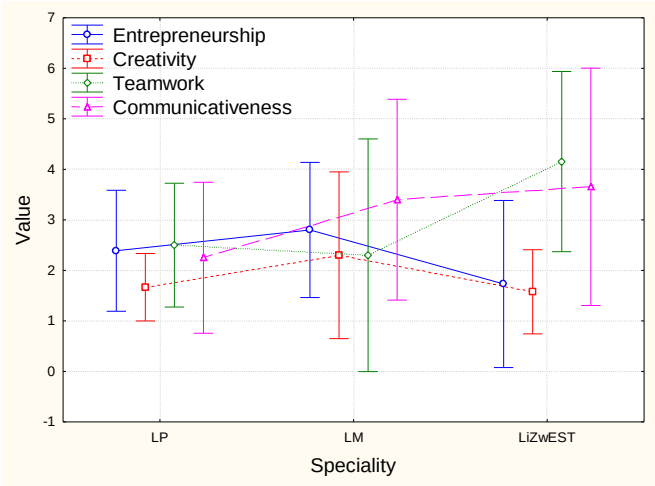

Fig. 5. Graph of averages and confidences intervals for the results in particular specialisations.
Source: own elaboration.

The following analysis refers to the rise of competences achieved by particular methods. The application of single-factor analysis did not show any significant influence of particular methods on the competence level rise. It is worth noting that the results attained by the Metaplan method were the highest for all the competences while the brainstorming method turned out to be the least effective one, see Figure 6.

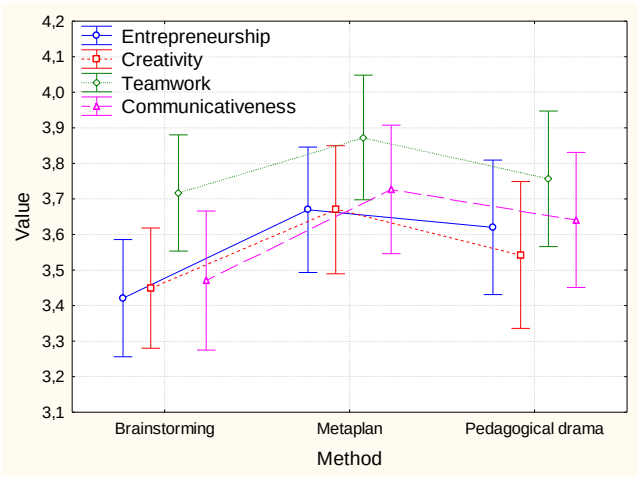

Fig. 6. Comparison of the results achieved in average competence rise for particular methods.
Source: own elaboration.

No significant differences could be found in the competence rise values achieved by particular methods while taking into account modes of study, see Figure 7.

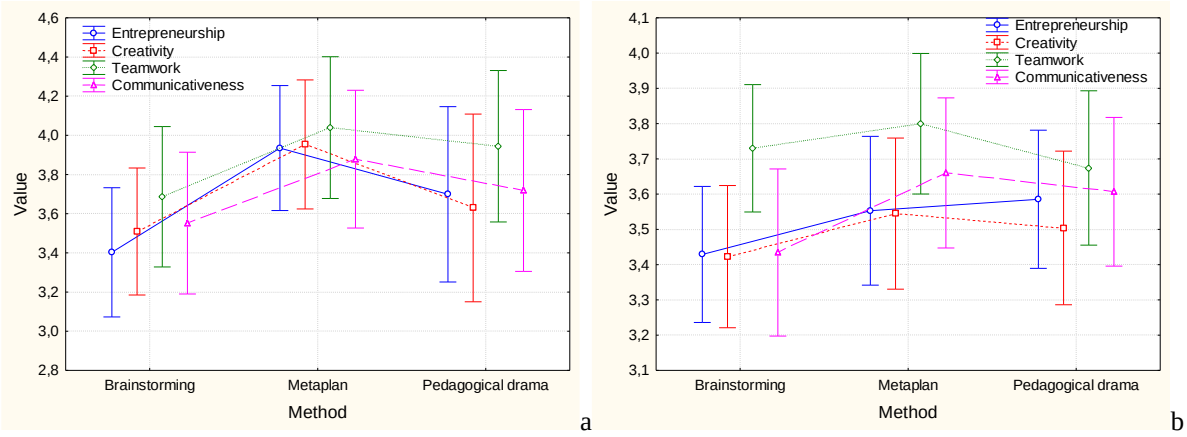

Fig. 7. A comparison of competence rise values achieved by particular methods a- part-time studies, b – full-time studies.
Source: own elaboration.

The most interesting comparisons of methods as used for particular competences (taking specific skills into account) are presented in the form of radar plots. For part-time studies the rises in particular skills after the application of tested methods were uniform for most of competences. Only in case of Creativity the differences in skill rises became apparent, with the capability to use the creative thinking techniques rising proportionally less for Drama, Figure 8.

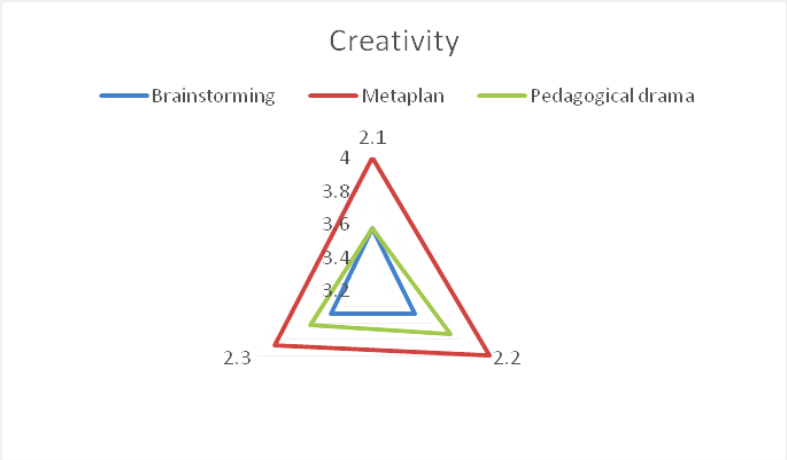

Fig 8. Creativity rise divided by particular skills, for part-time studies.
Source: own elaboration.

In case of full-time studies disproportional rises have been noted for all competences. For entrepreneurship improved by means of brainstorming the skill 1.2 noted a disproportionately low rise (the ability to notice and critically evaluate the opportunities for enterprising endeavors). For creativity improved by means of Metaplan method there was a disproportionately low rise of skill 2.2 (the ability to create original and useful solutions of problems). In case of teamwork competence, the skills would rise differently for practically each of the methods. In case of communicativeness however, the skill 4.8 (the ability to perform in public and present the self) rose disproportionately little when trained using brainstorming method, Figure 9.

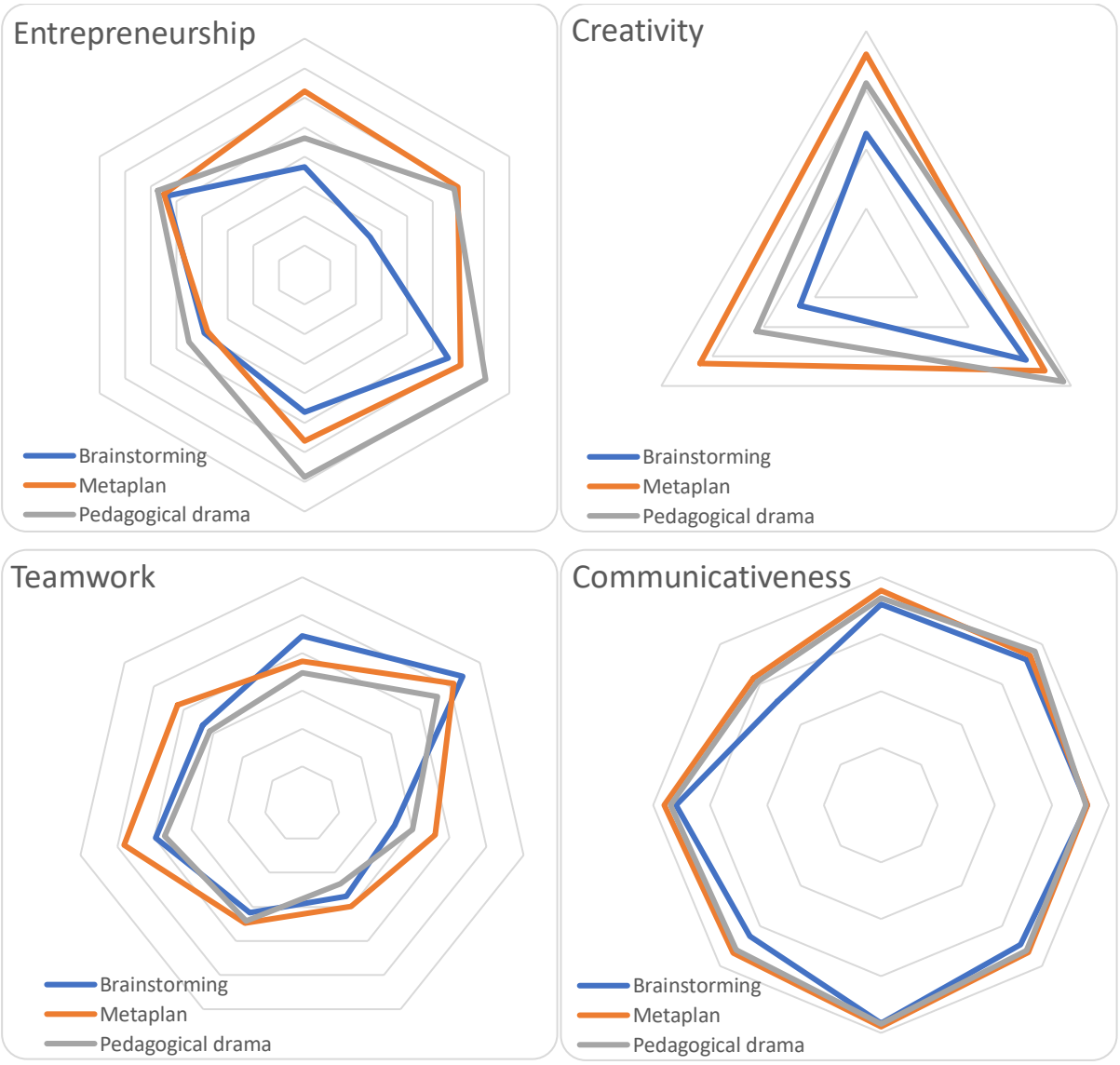

Fig. 9 Competence rises divided by particular skills, for full-time studies.
Source: own elaboration.

CONCLUSION AND RECOMMENDATIONS

In each case, the levels of proposed competences did rise among logistics students as a result of applying the proposed methods, same as their awareness and familiarity with their transversal competences (negative difference between the declared and final skill level). In spite of complexity immanent to such a research, the method as applied turned out to be effective in increasing the levels of transversal competences among logistics students. No significant statistical differences could be discerned between the particular training methods, however the highest rise of competences was achieved using Metaplan.

No significant differences in the competence rise rate were observed among particular specializations. while the lowest rise of competences was noted among the full-time students of LP specialization. A similar story was seen when comparing the development of skills between the two sexes. even though women do in most cases develop their transversal skills better than men disregarding the mode of study. Anyway, the statistical tests did not show significant differences in this regard. When the mode of study is taken into account, a higher rise of competences can be observed among the part-time students of Logistics, which particularly applies to entrepreneurship. This may be a sign of their higher maturity and professional experience.

The research results obtained basing on the selected specializations and study mode do not prefer any particular method with regard to its effectiveness in scope of transverse skill development. The continuation of research on other study directions is thus recommended.

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Defined on the basis of the term creativity as set out in http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008D1350&qid=1445885985313&from=EN

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DERIVATIVES AND CRYPTOCURRENCIES AS THE INSTRUMENTS OF NEOLIBERAL POLICY

ABSTRACT

Background: The aim of the paper is an evaluation of the doctrinal foundations of the derivatives and cryptocurrencies as well as their empirical implementation results. The neo-liberal policy is based on two elements: a libertarian idea of the minimal state and monetarism of Milton Friedman.

Methods: Comparative analysis of various instruments of monetary policy situated within neoliberal policy context.

Results: Financial assets, even toxic but required by Samuel Konkin's left wing version of libertarian agorism(open market) and his counter-economics ideas.

Conclusions: Cryptocurrencies and derivatives markets' growth exceeds theoretical borders of neoliberal monetary, and even, general economic policy becoming a part of neolibertarian order of world economy.

Keywords: Cryptocurrencies, Derivatives as the Instruments of Neoliberal Policy

INTRODUCTION

In the linguistic sense, the prefix neo- means a newer version of what was. In the economic sense, neoliberalizm means a newer, and implicitly, better version of Adam Smith's liberalism. Because in the history of economics as science has happened so many times, there were already several versions created, called neoliberalism. The primary doctrinal basis of the existing socio-political current, called neoliberalism, can be considered as the results of the venture of the

famous laisseurist, i.e. the preacher of free market economy rules, Friedrich Hayek. At the end of the 1940s, the international scientific community he organized assumed that it was necessary to counteract the phenomena considered to be dangerous to human civilization: the reduction of the role of the individual for the sake of state power, the depreciation of the principle of private property and the free market, and preventing the emergence of dispersed power as guarantor of full freedom of socjety (Blinder A. S.).

It should be recalled that the defects of the state formulated in this way did not resort to the already known in more distant history, but propaganda allegations that the central government robs society and uses Violetce against individuals. Hayek and his followers meant the scientific form of argument used to reject the classical theory of liberalism and its version refined by J.M. Keynes and P. Samuelson. Already after the first meeting in 1947, Hayek's MPS (Mont Pelerin Society) announced that in the fight against identified threats to Western civilization one can not rely on the classical theory of liberalism. This theory, along with Keynesianism, was replaced in the following years by the Hayek-Friedman doctrine, based on minarchism, i.e. the firststage of libertarianism, in combination with the monetarism of Milton Friedman. The matter became so serious that from the 1980s the implementation of economic and social policy began, according to the model of the New world order, about whichProfessor Immanuel Wallerstein wrote: "Anti-systemic movements - or a family of anti-systemic movements – will confirm the will to transform in specific operational activities capitalist world economy in a worldwide libertarian order that will be egalitarian and fraternal [Guzek, 2019].

The main theses of this paper stem from the claim that the current of thought built on the foundation of minarchism and monetarism, called neoliberalism, has little in common with liberalism. It can be best regarded as its degenerated form. However, this did not prevent the spread of neoliberalizm under the screen as a radical, improved version of classical liberalism. Thus the neoliberale appropriated the name "liberalism", as a result of which opponents of neoliberalism, who were in fact advocates of classical liberalism and Keynesianism, were forced to disseminate the opinion thatliberalism is defective and liberal sarepests. Neo-liberal opponents call them selves conservatives with out clearly defining their links with the classical liberalism from which they were evicted.

DERIVATIVES AND CRYPTOCURRENCIES – TOOLS OF NEOLIBERAL POLICY

The aim of the paper is an evaluation of the doctrinal foundations of the derivatives and cryptocurrencies as well as their empirical implementation results. The neo-liberal policy is based on two elements: a libertarian idea of the minimal state and monetarism of Milton Friedman.

In democratic systems politicians develop the strategy and tactics of accomplishing that doctrine supplemented with more neoliberal elements by Friedrich Hayek.

1. **It was from neoliberal ideology, which idolises the free market and fights the state, and has been readily assimilated since the 1980s by corporations as well as politicians and state officials, that arbitrary activity of investment and commercial banks unsupervised by the state emerged, only to be followed by a capital volcano under the name of derivatives market.**

Prior to the financial crisis eruption in 2007, the value of the world derivatives market exceeded 600 trillion dollars. At present it is much bigger. The fact that this market as many as ten times exceeds the annual world GDP is an indication of its sheer size (Knowlton B., 2008).

Although all three main forms of derivatives, i.e. interest-rate, credit and currency derivatives, develop after the outbreak of crisis on this market, it is the second type – namely credit – that can become a particular source of shock, one stronger than before.

2. **The derivatives market is associated with generating enormous amounts of credit money as a result of credit operations carried out by commercial banks in line with the "debt breeds money" principle. It was in such conditions that a circulation of enormous virtual dollars emerged, and the world supply of credit money was adjusted to suit the needs of the derivatives market, i.e. assets, even though toxic but required by Samuel Konkin's left wing version of libertarian agorism (open market) and his counter-economics ideas** [Koniki, 1980].

Pessimists believe that a next outburst would have to lead to a total collapse of the dollar, and possibly to the collapse of the other world currency, i.e. the euro. What is also interesting is the attitude of economists. The majority of economists would probably feel much better if a terribly huge derivatives market were not referred to at all. They prefer not to mention it, but wishing – for professional reasons – to reveal a minimum of interest in threats to financial markets and they express anxiety about the fortunes of these markets.

3. **Some economists show concern with vast reserves of dollars in the world, but find strong reassurance in categorising them as "reserve money", because they do not circulate in commodity markets. However this type of money can be spotted on a peculiar grey capital market in the company of fat rolls of paper which constitute toxic assets, in which money finds a specific backing** [Roubini, 2008].

A question is who takes care of the balance between this "backing" and the amount of virtual dollars? First of all it must be the United States that had become the first victim of the ideology of neoliberalism which originated with the Chicago school of economics and its partner, Harvard University, supporting to implement the idea of deregulation of the banking system. The next question is, what can bring about a new explosion?

4. **Theoretically speaking, what can be deemed the main causes of a new world crisis are crisis-generating factors present in the neoliberal doctrine, which remains the foundation of economic policies, and application in policy of faulty anti-crisis therapy named austerity which increases dysfunction of the state and degeneration of markets** [Guzek, 2019].

As far as the direct cause of crisis outbreak on the derivative market is concerned, in line with several critics of modern-day corporate capitalism, one can predict it will be, first, an imbalance on the grey world financial market, when the supply of credit derivatives will exceed the ability of the market to absorb them without excessive depreciation of the dollar as credit money, and later on the market of the genuine dollar as the world currency due to over excessive depreciation of the dollar.

5. **Maintaining further balance on both world markets of the dollar, i.e. grey and genuine until the US manages to rebuild its position of the main monetary power in the world should be enough. An important role in achieving this objective will still be played by the quantitative easing policy. Although it is mainly considered a method of supporting US economic growth, bond redemption carried out as part of the policy, which makes it possible to lower the level of toxic assets on the derivatives market, is even more important.**

If we add to it opportunities for the US to become an energy power, not only self-sufficient in terms of production of gas and oil, but also able to develop significant exports of these materials,

which would have an anti-crisis effect, one can conclude that suspecting the USA of an intention to withdraw the dollar from the function of the world, or even national currency, is unconvincing.

More complicated are doctrinal premises of cryptocurrencies.

6. **The zero backing of the bitcoin by anything is completely at odds with the Austrian school theory, or even with monetarism of Milton Friedman, who demanded that the size of the central bank's new issues be adjusted to the growth of the national income. The very neoliberal ideology does not explain causes of the cryptocurrencies popularity. More convincing explanation can be found in deeper libertarianism** [Sławiński, 2006]**.**

Influenced by the present world crisis, certain eminent libertarians expressed critical opinions about the Chicago school of economics, which – together with representatives of Harvard University associated with it – was blamed for excessive deregulation of the banking sector and outbreak of financial crisis. As the real 21st-century world is transformed and complemented by the virtual world promulgated by the internet, we can observe occurrence of phenomena, which once would have been deemed preposterous.

7. **The present form of libertarianism, which is shaped by the Austrian school, approves of a global currency in the form of bitcoin and other similar forms of virtual money, so that they can compete with each other. Thus, an attempt to seriously modify the Austrian school's monetary theory is taking place. The officially tolerated presence of the cryptocurrencies in circulation over the world can be accounted for in that the edge of this "money" is aimed directly at replacement of the genuine currencies** [Guzek, 2019].

The significance of the seemingly nonsensical threat from the non-money to the global currency market reveals itself. Tolerating such "money" by the leading powers can be explaned with the minimal state rule, requiring a sufficient level of helplessness even of the powers. One of the most radical Polish libertarians has let slip the ultimate aim of introducing massive amounts of cryptocurrencies all over the world:

8. **"Making use of cryptocurrencies is fast and safe. We don't pay any commission and conversion fee. Except that cryptocurrencies make the traditional money as well as the central banks – and even any bank in general – redundant"[3].**

However, recent opinions of some scientists predict a collapse of cryptocurrencies. Professor Nouriel Roubini in his interview given in Poland was asked about the bitcoin.
Roubini's viewpoint: "First of all, I would separate the blockchain from the bitcoin. Blockchain creates an enormous chance to increase productivity in many companies and I think the technology to be something very good. But the bitcoin and other cryptocurrencies – this is something entirely different. In my opinion, there is a gigantic speculative bubble related to the bitcoin, because this is neither a serious method of payment nor a good way to store capital. The bitcoin feeds on itself. There are no fundamental reasons for its price to reach such levels. What's more – it is also used by criminals, for their shady business. I think that more and more countries will start to make cryptocurrency exchanges illegal like China did. New regulations will be adopted. So, this will find its end"[4]. Let us hope that Professor Roubini's expectations will be fullfield soon.

CONCLUSIONS

The following economics in transformation sinclude the most important doctrinal projects of neoliberalism:
1) conversion of classic and Keynesian dem and economics into supply economics [Haberler, 1985].
2) rejection of Keynes's investment multiplier theory.
3) replacement in the Fisher Irving model of the explanatory variable in the form of the number of transactions with the size of national income as the basis for determining the size of the Money issue.
4) inclusion of Lucas' national expectations hypothesis in economic theory [Roberts, 2013].

[3] Stodolak S., „Pieniądz bezpaństwowy" ('The Stateless Money'). „Dziennik Gazeta Prawna" ('Daily Law Journal'), Warsaw, 20 October 2017.
[4] businessinsider.com.pl

Each of these transformations serves the main purpose of libertarian philosophy in its first stage, i.e. minarchism, in the form of a "minimalstate". If the state can influence demand, and supply is determined by entrepreneurs, let demand be excluded from the economy as a field for the state to act. Depriving the government of the ability to achieve a multiplier effect as a means of preventing recession is to help remove the state from the economy
and crisis and stimulating economic growth. Private banks are expected to help remove the state central bank or at east replace it. They make a significant part of the annual currency issuance in the form of credit money, especially when the increase in national income is insignificant, but market transactions served by private banks can be large, conducive to the principle of "credit gives money".
And finally, everyone in socjety needs to be convinced that it is the free market that all actors act rationally, so the states hould not disturb them with its interventionism.

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