European Research Studies Journal
Volume XXV, Special Issue 3, 2022

pp. 95-106

The Impact of 'Industrial Revolution 4.0' on Logistics Companies' Operations

Submitted 19/08/22, 1st revision 03/09/22, 2nd revision 22/09/22, accepted 30/10/22

Leszek Szczupak[1]

Abstract:

Purpose: *The aim of this article is to present the changes taking place in logistics companies in connection with the implementation of the principles of economy 4.0.*
Design/Methodology/Approach: *The research method used is an analysis of secondary data available in the literature and an analysis of the application of the method in the organization.*
Findings: *Due to editorial constraints, this article presents excerpts from the research findings, which illustrate the scale of the problem. The Industrial Revolution 4.0 is also having an impact on the activities of logistics companies that need to adapt to the changing economic reality.*
Practical implications: *The analysis carried out of the changes taking place in logistics companies in relation to the progressive industrial revolution 4.0 allows an assessment to be made of the preparedness of these companies for the changing conditions and methods of doing business. The result of this research indicates the directions of change that logistics companies need to implement in order to compete in the global marketplace.*
Originality/ value: *The originality of the conducted research can be assessed from the point of view of the applicability of the described solutions in the activities of logistics enterprises. The development of the economy and changing consumer preferences require the use of new management methods that respond to these changing expectations.. The research conducted is interwoven into the general body of scientific work of various, social and economic studies. The research presented provides some scientific value, with the opportunity to view the full data analysed and evaluated.*

Keywords: *Logistics 4.0, innovation in logistics, intelligent logistics.*

JEL codes: *L20, O 32.*

Paper type: *A research study.*

[1]*Assistant Professor, Department of Management, Faculty of Social Sciences, Calisia University – Kalisz, Poland, l.szczupak@akademiakaliska.edu.pl;*

1. Introduction

Multiplicity and complexity of tasks contemporary logistics and its global features are faced with causes that it becomes one of the most important elements of economy nowadays. Increasingly changeable and dynamic market, which is a place of contemporary companies' activity, causes that currently used methodology based on verification, evolution and ongoing adjustment becomes less effective. On the other hand, there is a need of implementing holistic and innovative solutions anticipating time of activity. These solutions should be of revolutionary, not evolutionary character.

The world economics undergoes quick transformations. Elements effective in logistics today may be not be a good solution tomorrow. Logistics not only has to follow current changes, but in many cases it has to anticipate or even create them, fulfilling client's expectations at the same time. Studying and forecasting changes should become a fixed component of logistics. However, it requires not only noticing new conditions and challenges for logistics, but also multi-dimensional analysis, recognizing mutual realizations and interactions.

This approach is to be used to build new concepts in logistics, which will fully use new, appearing possibilities resulting from growing pace of technological development referred to as 'technological revolution'. Logistics develops towards full automation and digitalization of processes due to new technologies. Complex algorithms instantly 'learn' new ways of problem solving. Modern services such as developed goods monitoring mechanisms and managing systems are created.

Access to information in real-time, processes' automation, smooth realization of orders and costs decrease, constitute priories stimulating trade leaders. Innovative logistics platforms which meet the highest standards are to ease cooperation within a supply chain. Advanced tools allow to recognize shippers' requirements and adjust appropriate load to a certain carrier. On the other hand, simple integration with WMS/ERP systems allows to import data, which influences cost reduction and order processing time.

2. 21st Century Logistics Development Determinants and Tendencies

Since the beginning of 1970s (Lichtarski, 1998), in a relatively short time, we have experienced a generation of different management concepts and methods. Exogenous and endogenous impulses (for example, clients' requirements increase, tough competition, changes in IT and telecommunication technologies, transformations on labor market, departure from functional approach in favor of 'process thinking' etc.), as well as company effectiveness and flexibility imperative contributed to such state of affairs (Lichtarski, 2007).

Contemporary logistics has to generate skills which facilitate effective realization of goals in current, as well as in perspective conditions. Realization of indicated objectives caused implementing various, modern concepts and methods related to management in logistics. Inclusion of development and integration tendencies of logistics, as well as building logistics for the 21st century needs and vision is of great importance while selecting these concept and methods. There are a lot of scenarios of logistics development.

According to P. Blaik these can be for example (Blaik, 2010) future logistics external surrounding and flows system structure scenarios according to I. Göpfert (Gopfert, 2006), vision of logistics in 2015 according to Th. Hueck (Hueck, 2001) scenarios of market space for logistics services in 2025. Perspective conditions, visions and concepts of logistics development have also been presented by European Logistics Association, ELA and AT JKearney company in a study entitled "Doskonałość w logistyce" – "Excellence in logistics" (Kearney, 2009).

In view of transformations directions in logistics, significant conclusions included in a study 'Global Logistics 2015+' developed by DB Schenker and University of Technology in Berlin (www.dbschenker.com, 2015) should also be indicated. It is also worth paying attention to Capgemin research performed in 2005 and published, among others, in report '2016 The Future Value Chain', edited by Global Commerce Initiative (GCI) in 2006 (2016 The Future Value Chain, 2006).

The research has been supplemented with subsequent studies and report entitled 'Succeeding In a Volatile Market. 2018 The Future Value Chain' in 2008 (Succeeding In a Volatile Market, 2008) Presented research not only define (indicate) the newest and perspective tendencies in logistics, but also show the most crucial conditions determining logistics development.

The presented documents allow to draw a conclusion that key features influencing future supply chains are changes in consumers' purchasing behaviors and greater use of modern technologies within information and physical flows. The following factors are indicated within this area (Succeeding In a Volatile Market, 2008):

- Consumer's IT skills and knowledge increase, including development of skills connected with the use of Internet;
- Multimedia access to broad information concerning products;
- Individualization of approach towards consumer;
- Offering a wide range of services along with the product;
- Quality increase of both products and services;

Special attention is also paid to three interconnected challenges:

1. Development of new ways of cooperation, including balanced changes in culture, economic cooperation and new planning of actions, as well as taking advantage of economic effects are a basic element of new ways of cooperation development.
2. Creating basics for easier and more effective information exchange through the process of building appropriate cooperation culture of companies: the report emphasizes that 'transparency helps to manage complicated supply chains in the best way' (Succeeding In a Volatile Market, 2008).
3. Only open cooperation environment can generate proper changes and flexibility of future supply chains and effectively include the impact on physical flow of products, energy prices changes, population density changes and other external forces.

Thus, it can be indicated that one of fundamental (basic) elements of presented concept is a rule of new quality in cooperation – trust increase. The final customer as a central point around which supply chain members will develop new technologies is also indicated. Final customer will have decisive role within produced and supplied products. The factor which will determine success in the future is mainly going to be the ability and skill of understanding clients' needs and using potentials of implementing new (innovative) technologies on behalf of companies.

According to the above presented concept, ensuring the possibility of development and companies' functioning effectiveness growth as supply chain links, in other words achieving appropriate competitive position will require (Succeeding In a Volatile Market, 2008):

- Direct communication – two-way dialogue with a final customer;
- Wider and easier information sharing with partners in a chain;
- Changes in a corporative culture;
- Appropriate adjustment of strategies and tactics of partners in a supply chain;
- Production synchronization - launched with a signal from the market and precisely integrated with production materials suppliers;
- Realization of sustainable development concept, incorporating ecological factors and specifically decreasing environment pollution;
- More precise integration of logistics, especially within the area of consolidated distribution, dynamic planning of routes along with sharing transport means.

3. Intelligent Logistics

ICT revolution of last decades caused incredible improvement and control of even most complicated processes. The term 'intelligent logistics', even though not new, has taken on a whole new dimension in contemporary conditions. It concerns

noticing completely new solutions by logistics, which are offered by IT technologies and their use in logistics processes.

Modern approach to logistics is, however, not a result of only progress in IT. It also refers to supplier and carrier's understanding of client's needs and the fact that fulfilling these needs may decide about logistics company existence or collapse. Therefore, IT only stands for technology which creates conditions for specific actions (enabling technology).

Thus, it is a tool which has to be integrated with whole complicated complex of logistics processes, so that they were faster, more efficient and more integrated internally and with the surrounding. As a result of such defined trends, each element of technological development in logistics significantly increases competitiveness in more and more requiring surrounding.

Modern logistics centers equipped with most advanced technologies allowing for automation of number of performed processes, which influence the price, reliability, speed and timeliness of services in a positive way, serve such an example. It is even more important due to the fact that their role and impact grows, since they are a factor enhancing economic development on a regional, national and international level.

Dynamic changes in contemporary logistics referred to this process as to 'intelligent logistics', based on using advanced IT and communicative technologies in logistics, which legitimate the term 'intelligent'. This 'intelligence' should be sought in advanced models and decisive algorithms supporting human actions aiming at increase of effectiveness and safety of logistics processes realization on all levels.

'Intelligent' planning and realization are connected with building relations between planning and implementing processes and systems allowing for installing 'cleverness' in logistics on a strategic, operation and tactic level. Integrated planning and realization are the key elements of 'clever' logistics. Freight optimization and transaction oriented realization support 'real-time optimization' and 'very precise realization' through a closed circuit and feedback matching these two factors.

'Intelligent logistics' assumes not only simple modeling of every process on the basis of gained parameters, but building systems capable of learning and adjusting to appearing possibilities, as well as coping with information shortages. These systems have to be capable of generating forecasts, indicating reaction skills and adjusting to changes.

Moreover, they have to communicate with other systems and be able to: work in real-time; use standard solutions and interfaces; be open to new sources of information; collect, aggregate, process, distribute along with data transmission; use great number of various data; adapt and scale; learn and obtain data and supply

feedback; react instantly to changes in operating conditions; develop; have modular structure and mechanisms providing safety and high reliability.

4. Innovativeness and Innovative Process in Logistics

Innovativeness and innovation process not only constitute a basis for modern economic growth strategies and companies development, but are also more often referred to as a concept and solution in competitive struggle in contemporary world. Structures of developed world economies instantly move in the direction of industries and services based on knowledge. Knowledge based economy became a basis of contemporary development. Innovativeness and innovation process are no longer perceived as single occurrences.

They are more often treated as a complex of undertakings, creating new products, models, technologies and services. The pace of changes in technology and organization causes that only companies capable of innovative changes implementation are able to survive on highly competitive market. Therefore, nowadays the majority of companies are under very strong pressure of innovativeness, often in many areas at the same time (new products, technologies, organization, relations with business partners etc.).

Entrepreneurs' effectiveness in the area of innovativeness strongly depends on competencies, management skills and implemented strategies. A growing role of environment in which companies function is also noticeable, especially in regard to politics and initiatives of authorities creating favorable conditions for innovative climate in entrepreneurship. Implemented EU or national systemic solutions specifying general framework for economy functioning (national and regional innovation systems, innovative environment etc.) are, however, also significant.

Logistics as a basic factor of enterprises' competitiveness is especially vulnerable to introducing all kinds of innovativeness. Innovations should be a fundamental aspect for future solutions in logistics. Innovativeness is essential condition of goods and services attractiveness growth which entails market and export development and thus, decides about company's market position.

Innovations should be implemented by all companies today, both these prestigious, with settled market position, and the new ones which enter the market. Innovativeness implementation should be included in company's strategy as one of the most important points.

Innovative solution are not necessarily technologies taken from science fiction films. A creative glance at one's industry may show that sometimes it is enough to introduce small changes to become innovative. Thus, it is a good idea to invest in new solutions, concepts or technologies, instead of financing solutions which have been used in the industry for many years. The question evolutionary or revolutionary

innovation? becomes crucial. Already known or new solutions, or maybe our own innovative solutions of a revolutionary character? These are very important and at the same time difficult questions in Polish conditions.

It is also worth emphasizing that human factor is extremely significant element of innovation. These are creative, educated and qualified people who have a decisive influence on innovation appearance and development. Innovation existence is possible due to peoples' creativity and their strength to implement new ideas.

Therefore, employees' education, knowledge and experience exchange is so important. New things and concepts (ideas) are created by people. According to performed analyses, the higher the company owner or manager's education, the more frequently innovations are implemented in this company. Innovativeness in logistics, in managing contemporary supply chain (network) is not limited to involvement of modern IT solutions. Common feature of projects from this area is high creativity and integration.

These are technologically complex projects. Fundamental concept of all these solutions is better adjustment to environment changes and gaining faster reaction to market needs skill. At a time of continuous and unpredictable transformations in business environment, companies which aspire to succeed in 21st century, have to be able to react quickly in this difficult and permanently changeable surrounding, also bearing in mind growing responsibility for natural environment. Research performed within 'Innovation Excellence in Logistics' (www.elalog.org, 2007) study allowed to indicate areas of logistics innovation and formulate general and specific recommendations with regard to certain potentials of improvements.

The following premises have been indicated: logistics services modularization along with costs reduction is currently a fundamental goal set towards logistics innovations; innovations directed towards costs will be replaced by client directed innovations; creating new services in order to meet current requirements and creating, as well as answering new demands is going to be the most important objective for innovations; actions allowing to achieve greater transparency of operations should be performed; projects directed towards clients constitute stimuli for suppliers to develop innovations; understanding dynamics of values perception for a client entails significant possibilities of innovation development in logistics; modern achievements in IT systems and communication technologies have crucial innovative potentials; concept and virtual reality, as well as automated systems constitute especially important areas for innovation development improvements of standards which will favor supply chains interoperability and actions transparency.

Company's innovativeness potentials depends on building of enterprises' knowledge bases which are created with the use of internal, as well as external relations with partners. Lack of them or insufficient human and capital resources are the main reason of failures in logistics operations.

Logistics systems and networks characterized with great adaptive abilities and flexibility have the largest potentials to implement innovations. Companies with high indicator of innovativeness bear basically lower costs connected with logistics or gain higher margins.

Innovativeness and modernity in logistics are not only referred to solutions based on faster computers. It is also, and maybe first of all, the way of thinking. Maybe this is too high concentration on technology which causes that more and more popular modern concepts and philosophies widespread abroad, are in a broader sense practically unnoticed in Poland.

Innovative solutions in logistics are far more than improving logistics processes. It is also ongoing development of a team realizing these solutions, so implementing conceptual, clever thinking, as well as continuous verification of work and engagement. It is also ongoing taking care of the quality of actions, operations transparency and honesty towards clients. This solution requires continuous concentration on work, on a co-working team, on implemented practices and shared values. These are also permanent actions oriented on finding new, better ways of logistics tasks realization. Finally, it is satisfaction from performed work, clients' respect and further development possibilities.

The success of contemporary logistics is determined by not only innovative approach to related challenges and tasks, but also by high specialization, mutual trust, culture of work, rigorous management of costs and speed and effectively of resources exchange within network. It is also worth emphasizing at this point that, notwithstanding, indicated values of innovative logistics, today there is no such model, concept or way of even the most innovative logistics management which would prove its effectiveness in each situation.

The two above indicated areas are strongly interrelated. They are based on the same modern and innovative considerations and constitute a mutual stimulus. There are many shared elements, they work within the same conditions and often use identical approaches or concepts. 'High speed changes' concept is an example.

According to this concept assumptions, for example, achieving and maintaining competitive predominance of a certain company depends on creating organizational culture which can adapt to fast changes quickly. This concept concentrates on changeable market conditions and individual needs. It implements market changes into performed actions and strategies in a quick way within the frames of generally accepted organizational culture.

The essence of operation, as well as success depends on mental, organizational and cultural preparation for these kinds of actions, and awareness that only small minority are capable of creating and maintaining such pace of extensive changes and adaptations, create and implement improvements and innovations in a very short

time. Due to 'high speed' concept, a company achieves very high level of flexibility and efficiency of actions.

5. Companies' Preparation for Modern Logistics System Implementation (Logistics 4.0)

We have been witnessing 'technological revolution' for several years. It predominantly changes our way of living, thinking and communicating by setting new and growing demands. New challenges and contemporary society's proposals are directed towards different areas of our life including logistics.

Contemporary logistics inherits various solutions and concepts from the previous periods. Their ongoing development is noticeable, especially in the context of the ways and concepts connected with realization of logistics tasks. Their range increases all the time, the scale of complexity, processes' dynamics, the range and way of use and implementation of more and more complicated tools, being a result of operational, tactic and strategic actions in local, regional and global terms also grow. They have to generate skills which will allow to realize tasks in current and perspective conditions in an effective way.

Nowadays, new determinants evolve as an answer to changes in world economics. These determinants are going to specify enterprises' direction of operations now and in the future. The most frequently mentioned conditions are as follows:

- Change of business centers' location; Asian countries and Africa still become more important;
- Globalization and regionalization appearing at the same time as an answer to transforming economic environment and turbulences in world's economy to a different extent in different countries;
- Urbanization increase;
- Developing ecological movement, increasing significance of sustainable development in companies' strategy;
- Dynamic development of e-trade, network economy.

Increasing global nature of production processes, purchases and distribution is a key trend shaping the process of planning and realization of logistics tasks nowadays. A problem with 4.0 logistics implementation in enterprises results from lack of clear information about what 'thinking in 4.0 category' may really stand for with regard to company's real profits.

Together with concept development, the following questions inevitably appear: 'Is Logistics 4.0 an answer for a trend connected with growing clients' requirements and more individualized needs related to fast and flexible way of material flow adjustment?; 'What are its consequences for warehouse logistics?; Does 4.0 logistics

implementation in a company allow to achieve predominance on a highly competitive market?'

4.0 industry, Internet of things and networks are all topics which are a lot more than megatrends. Logistics requirements grow all the time. There is an increasing pressure for the products to be supplied to clients in a faster and more flexible way, in just-in-time or express mode and obviously in competitive prices.

At the same time, the same clients require greater transparency and real-time access to their supply status. All these aspects increase the necessity to optimize logistics processes through implementation of intelligent systems which will join, exchange data and allow to follow the flow of goods in an ongoing way both for final customers, as well as for distributors and producers.

Different consulting companies have been performing a lot of research, the aim of which is checking the level of enterprises preparedness to implement solutions within logistics 4.0. The results of these research clearly show that there is a kind of blockade at the crossroads of willingness to invest in new technologies and lack of clear information concerning associated economic benefits. Notwithstanding great awareness of these technologies accessibility 'at hand availability', investments are often stopped due to the fact that seeming risk prevails potential benefits (https://dataconsult.pl).

Other conclusion that brings up after the analysis of performed research is the fact that understanding 4.0 logistics concepts is connected with possessing appropriate IT infrastructure level in a company. This level is correctly perceived as a basis for implementing new systems. Logistics specialists constitute a group with one of the highest levels of readiness for adopting new solutions and most often notice a strong need to implement these solutions. However, unfortunately, they often depend on companies' possibilities in this scope.

Companies, which had not implemented any projects connected with logistics 4.0, argued that it would cause too strong dependence on system suppliers. Too high costs of company restructure and the whole investment were also an obstacle. Some companies admitted that they lack well qualified workers who could supervise such implementation. Lack of clearly calculated future profits of a company is also a significant problem.

Entrepreneurs are also afraid that they would not have a proper protection of their data in such system. Advising, planning and developing concepts are the fundamentals of satisfactory logistics 4.0 implementation. Decisive people have access to information concerning kinds of systems adjusted to a company, possibilities of material flow optimization, for example: automation. Other question which may be answered through such consultations are: 'what kind of unused

potentials is hidden in your company and what types of benefits will be brought due to new system implementation?'

Appropriate IT implementation is the basics of reliable 4.0 logistics. A lot of companies are already well prepared and undertook preliminary steps in the process of implementing the concept of 4.0 logistics in the organization. It is a good idea to become familiar with kinds of technologies which will be used and the way they will be interconnected to achieve maximal benefits.

Future solutions are perceived as, among others, flexible to use mobile systems, such as smart phones and tablets. Together with appropriate software, they are perfect to use in a warehouse and outside. Nowadays, mobile devices are far more than effective gadgets. Intelligent and mobile devices will be a standard equipment in logistics in few years time. Pilot projects have already shown potentials of such devices as AR glasses. Augmented reality solutions also have growing significance.

Visual support in routing and completion process limits the number of errors, reduces number of complaints and optimizes whole logistics processes. Finally, every company has to choose what kinds of technologies are right in their environment. Finding the most effective approach and using it within own processes is the key element.

6. Conclusion

Why there is still lack of real projects if so many companies understand 4.0 logistics concept and declare readiness to invest? On the one hand, there is lack of infrastructure and on the other hand, lack of qualified workers. Workshops, trainings and presentations are the solution. It is worth devoting some time and find a business partner who will show the way of using theory in practice.

Thanks to that future system, users have a chance to go through all processes in a supply chain step by step and check which technologies and functions are the best solution and meet their needs. The next step is adjusting the whole company to work with new systems through clear indication of benefits arising from an implemented solution for both users and the whole organization.

When economic benefits and company's development potentials are clearly indicated, the implementation of selected systems is likely to be successive. In conclusion, the following thesis should be formulated: there is no reverse from 4.0 logistics. It is high time the way of thinking and approach should be changed.

Rational implementation of new assumptions, gaining knowledge and competences connected with operations in such new environment and relations should be considered instead of spreading doubts whether it is going to work. It is worth to appear pragmatically and creatively in this system before it becomes a requirement

and necessity in order to continue cooperation with the ones who created or implemented this concept.

References:

Blaik, P. 2010. Logistyka. Koncepcja zintegrowanego zarządzania. PWE, Warszawa.
Blaik, P., Matwiejczuk, R. 2008. Logistyczny łańcuch tworzenia wartości. Wyd, Uniwersytetu Opolskiego, Opole.
Blaik, P. 2010. Projektowanie wizji rozwoju logistyki w przyszłości. In: Logistyka międzynarodowa w gospodarce światowej, ZN UE w Poznaniu, nr 157, Poznań.
Brdulak, H. (ed.). 2012. Logistyka przyszłości, PWE, Warszawa.
Ciesielski, M. (ed.). 2009. Instrumenty zarządzania łańcuchem dostaw, PWE, Warszawa.
Ciesielski, M., Długosz, J. (ed.). 2010. Strategia łańcuchów dostaw, PWE, Warszawa.
Gołembska, E. 2012. Współczesne trendy i kształtowanie wizji logistyki przyszłości, Gospodarka materiałowa i logistyka nr 6/2012, PWE, Warszawa.
Gołembska, E. 2011. Współczesne zagadnienia logistyki międzynarodowej w przepływach gospodarczych, „Ekonomia" 1(13)/2011.
Göpfert, I. (Hrsg.). 2006. Logistik der Zukunft - Logistics for the Future, 4. Aufl., Verlag Gabler/ GWV Fachverlage GmbH, Wiesbaden.
Göpfert, I. 2006. Die Anwendung der Zukunftforschung für die Logistik. In: I. Göpfert (Hrsg.), Logistik der Zukunft - Logistics for the Future, 4. Aufl., Verlag Gabler/GWV Fachverlage GmbH, Wiesbaden.
Hueck, Th. 2001. Logistik aus volkswirtschaftlicher Sicht: Perspektiven und Visionen. In: H.Ch. Pfohl (Hrsg.), Jahrhundert der Logistik. Customer related - glocal - e-based, Erich Schmidt Verlag, Berlin.
Lichtarski, J. 2007. Podstawy nauki o przedsiębiorstwie, Wyd. Akademii Ekonomicznej im. Oskara Langego, Wrocław.
Lichtarski, J. 1998. Współczesne koncepcje zarządzania przedsiębiorstwem – istota, relacje, problemy stosowania. In: Nowe kierunki w zarządzaniu przedsiębiorstwem – koncepcje przekrojowe, Prace Naukowe Akademii Ekonomicznej, Nr 784, Wrocław.
Succeeding in a Volatile Market. 2018.
The Future Value Chain, Global Commerce Initiative, Capgemini, SAP, HP, 2008.
The Future Supply Chain, Global Commerce Initiative, Capgemini, May 2008.
The Future Value Chain, Global Commerce Initiative, Capgemini, Intel 2006.

Internet sources:

Differentiation for Performance Excellence in Logistics, ELA and AT Kearney 2004. http://www.elalog.org/.
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0144:FIN:PL:PDF.
http://www.dbschenker.com/site/logistics/dbschenker/com/en/about_dbschenker/best _practice/ innovation/global_logistics_study2015.html.
https://dataconsult.pl/logistyka-4-0/.
InnovatioExcellence in Logistics 2007, ELA and AT Kearney 2007. http://www.elalog.org/.
Innovation Excellence in Logistics 2007, ELA and AT Kearney 2007. http://www.elalog.org/.
Supply Chain Excellence admits the global economic crisis, ELA/A.T. Kearney, Bruksela, 2009. http://www.elalog.org/.