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# Conception of logistics coordination in the distribution networks

M. Kmiecik

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**ABSTRACT**

The main aim of following research paper is the definition of logistics coordination in the distribution network. Research paper also is aimed on distinguishing the further research steps. Research methodology focuses on the problematic of literature review in the conditions of coordination, distribution network central nodes, coordination mechanisms and occurring in the literature the phases connected with logistics coordination. Literature review allows to elaborate the logistics coordination concept in the distribution networks and sowing the further research steps in this area. Logistics coordination is occurred in the literature, but it is understood differently than following paper assumed. Author tried to define the logistics coordination and to distinguish the main elements which have influence on it. Among the most important elements which have influence of logistics coordination were mentioned factors as: actions of contemporary logistics operators, market, social and hierarchic mechanisms of network coordination, the opportunity of reaching by operators the function of demand management and possibility of usage the modern technical achievements connected with data interchange. Established elements of logistics coordination could help logistics operator in the tray of adaptation of this function in distribution networks. Among that function there worth be mentioned benefits like decreasing the stocks level, better resource and stocks allocation, reduction of logistics activity costs, increasing the customer satisfaction level, increasing the activities flexibility by coordination directed to material and information flows management. Additionally, the main distinguishing feature of this conception is the fact of logistics operator don't have the direct revenues from sales, which could also reduce the possibility of unplanned promotional actions and its influence of whole network. Logistics coordination could be defined as the activity coordination which is connected with flows management which is done by logistics operator in the area of current actions, actions connected with demand management, usage of nowadays information technologies market, social and hierarchic network coordination mechanism point of view.

**KEYWORDS:** 3PL · coordination · distribution network · logistics coordination · logistics operator · third-party logistics

## 1. INTRODUCTION

Coordination issues are commonly considerate in management sciences and it is one of its basic problems [1]. Despite its traditional origins, it is still associated with necessary element of properly constructed material and information flows. It could be stated that coordination is strictly connected with realization of the most common contemporary logistics projects and solutions. Coordination should be considerate during implementation of solution connected with Smart Logistics [1-2] short life products flows management, for example in management of fresh products flows [3]. Coordination is also one of the key factor in creating efficient reverse flows and building a green supply chains [4] or generally in the actions taking in supply chains according to green logistics concepts [5-7] such as last mile delivery. Currently, because of multichannel benefits like possibility of recipients bases extension, customers convenience, possibility of gaining new customers, balancing the risk, better market coverage [8], presser caused by customers and unpredictable situations like COVID-19 pandemic – coordination is more often considerate in the aspect of

✉ Mariusz Kmiecik
mariusz.kmiecik@polsl.pl

Silesian University of Technology, Faculty of Organization and Management, Department of Logistics Roosevelta 26, 41-800 Zabrze (Poland)

ORCID: 0000-0003-2015-1132

building such a channels. Coordination, undoubtedly is important aspect in whole activities which take place in distribution networks. Additionally, another important aspect is the activity of logistics operator (logistics operator will be used interchangeably with the 3PL or third-party logistics). Companies during striving for activities specialization are outsourced some processes and activities to external enterprises. Acting of outsourcing companies are that significant and large-scale then they are strictly connected with fluent and efficient running of distribution networks. According to author's opinion, we can speculate about occurrence of distribution networks coordination which is driven by such logistics outsourcing companies. This kind of coordination will be called as logistics coordination. The main goal of following research paper is to define the logistics coordination from the distribution network perspective. Research paper is an introduction for further research steps in the field of logistics coordination from the level of logistics operator. Research paper methodology is showed in Fig. 1.

Research showed in the paper focuses on the elaboration of definition and main elements of logistics coordination. To fulfil it, in the article will be taken into consideration the research paper databases analysis connected with the logistics coordination concepts. In the paper will be distinguished the main approaches to logistics coordination. Literature review will be narrowed to research paper in the similar field, so to the research paper connected strictly with distribution networks and logistics operators. As a result, author will detail the papers which are strongly connected with presented conception, so which are strongly connected with distribution network flows coordination by logistics operator who coordinates mentioned flows by using a proper coordination mechanism. In the article there will be also presented the approach connected with central node of distribution network in which the author sees another coordination element of the distribution network in the perspective of logistic coordination.

## 2. COORDINATION IN THE DISTRIBUTION NETWORK

Currently a lot of authors believe that coopetition actions, in which a logistics actions play a big role, is today considerate from the supply chain vs supply chain perspective than company vs company perspective [9], it means that the enterprises have a better chance to succeed by using a synergy effect and taking a holistic view on the whole supply chain or distribution network. Researches confirm among other the fact that lack of carrier's coordination has negative influence on whole supply chain [10]. However, despite the general knowledge in this area there is usually a market

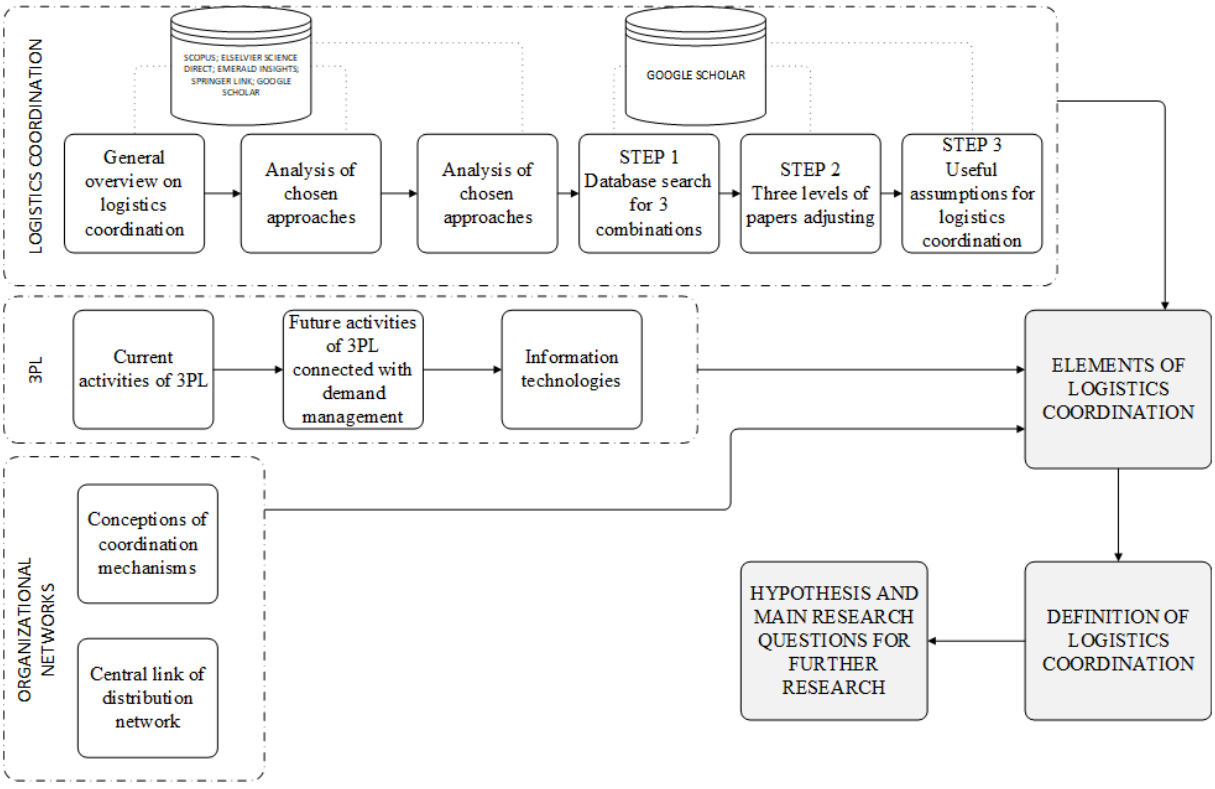


*Fig. 1:. Research methodology*

paradox where enterprises are aware that the action of whole distribution network or supply chain nodes level of coordination is the one of the key success factor and still all of this enterprises are striving for achieve their own goals ignoring the common good [4].

One of the most often exposed coordination model in distribution network is the coordination with participation of leader company [3]. In the autor's opinion it is strictly connected with centralization in the distribution network. Network participants, which acts in centralized distribution networks are divided into: [11-12]: central links and suppliers, recipients, chosen or collaborated competitors and other entities. A lot of authors believes that occurrence of central link is one of basic form of distribution networks coordination [13]. Central link in the literature is called on many ways. We can come across terms such as integrator [14-15]or leader [16]. Some of authors associate with central link the concept of brokers [17]. Brokers, as a middlemen are treated as nodes which improve the network by creating changes and value inside the network. They could do it for example by connecting separate nodes and creating information exchange channels between them [18]. Brokering is usually defined as process of platforms, connections and mediations creation between some different groups aimed to conflicts reduction [19]. Central links are also called as: orchestrator or hub company [20] or flagship unit, coordinator, creator or conductor [21]. One of the most popular approach consists of connecting central node with the conception of flagship enterprise [11] and this approach is the leading for this paper. Flagship enterprise, according to some authors, because of its wide decision-making role could be treated also as network leader [12; 22]. Synthesis of mentioned concepts is shown in Fig. 2.

According to authors opinion, flagship enterprise has the huge number of features connected with the ability of distribution network coordination. Flagship enterprise is usually a big company, which deliberately creates the network in its surrounding to achieve their own goals and easily possess the qualified workforce [23]. Not necessarily it has to be connected with logistics, its core activity could be directed to the different industry. However, flagship enterprise which do the activities connected with logistics could be defined as: logistics node, which is responsible for the synchronization of material flows and the coordination of tasks outsourced to partners in the network [24]. It is characterized by its reputation [25], and also by its market size [26]. Elements, that distinguish network models based on flagship enterprise and provide them with a competitive advantage are [27]: customer value, key competences, key resources and relations types. Flagship enterprise often use the module approach, where some of modules are outsourced. Functions of such a node in distribution network could be as follows: [21]: identifying the key competences, processes allocating to partners, administration, coordinating, ensuring the efficient information exchange, keeping the network cohesion and processes monitoring. To mentioned functions there are usually added: [24]: network initiating, market partners selection, responsibility for efficient goods delivery, creating the organizational network and establishing the new collaboration forms. As shown in previous studies, one of the links commonly found in modern distribution networks, which may predispose to the role of a central link by taking over some functions, is the logistics operator [28]. So it could be concluded – there should be such a possibility to find some features of flagship

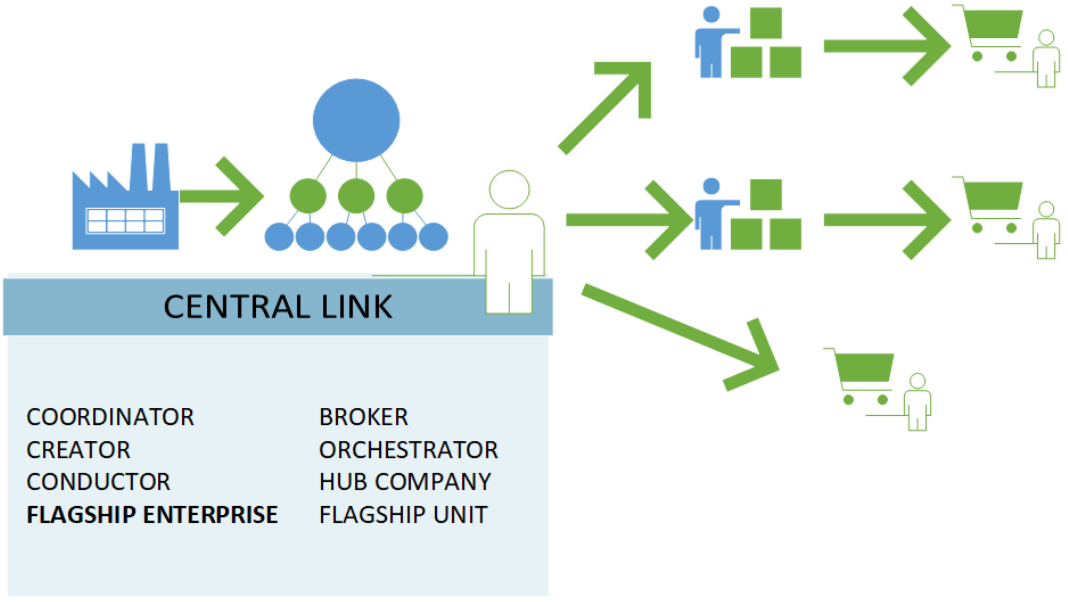


*Fig. 2.: Central link in centralized distribution network*

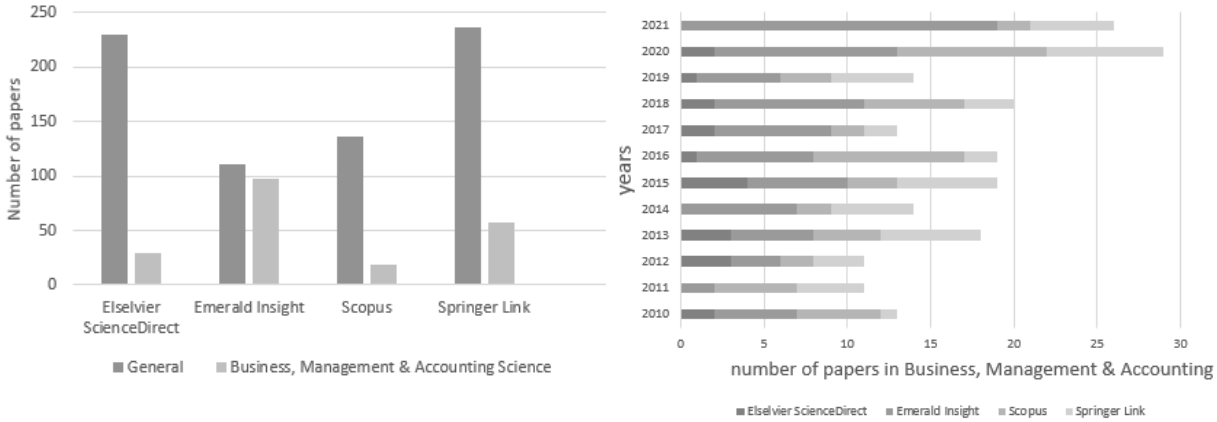


*Fig. 3.: Quantity of published papers include „logistics coordination" in the chosen databases.*

enterprise and network coordination in the logistics operator. Coordination which is doing by logistics operator will be the form of logistics coordination – because the main activities of logistics operators are directed on activities aimed to improving and keeping the proper quality of material and information flows.

## 3. LOGISTICS COORDINATION IN THE LITERATURE

Concept of logistics coordination appears in the published papers. Google Scholar databases gives 3 490 results of published papers and other publications includes „logistics coordination" – in these 2 710 results from year 2010 to 2021. Additionally, the popular research paper databases as Elselvier ScienceDirect, Emrald Insights, Scopus and Springer Link are also include this sentence (Fig. 3). It is worth noting that the state of the databases was given at the end of January 2022.

The largest number of resources in the field of management sciences, which include „logistics coordination", is in Emerald Insight. Logistics coordination is considered in a lot ways in the literature. Considering the main field of following paper and authors research interests the main source papers will be the papers in the management sciences, Concept of logistics coordination appears also in this publication (table 1).

*Table 1: Chosen approaches to logistics coordination*

| Choosen approach | Approach enthusiasts |
|---|---|
| Logistics coordination treated as seciurity for materials and products flows continuity, which contirbutes to implementation of synergistic effects between internal and external activities of the company, and it is necessary to create alternative structures. | Kauf (2005) |
| Logistics coordination as a effective (according to costs) coordination of enterprise subsystems which are the part of clusters initiatives. | Dmuchowski and Szmitka (2016) |
| Logistics coordination as a sum of reconciliations and relations from the perspective of process analysis. | Słowiński (2008) |
| Logistics coordination as a coordination from the perspective of financial budget management (financial logistics coordination). | Averkyna and Shulyk (2018) & Averkyna and Karlova (2017) |
| Logistics coordination as a measurable concept for integration which based on coordinated participation of whole logisitcs chain nodes in the management and flows. | Makovetskaya (2019) |
| Logistics coordination as a key element of humanitarian logistics activities. | Tatham and Spens (2016) & Dolinskaya et al. (2011) |
| Logistics coordination as a logistics system participants activity coordination like material, information and financial flows coordination, which helps to manage the activities of particular nodes. | Stepura (2021) |

Source: own elaboration based on: [29-37]

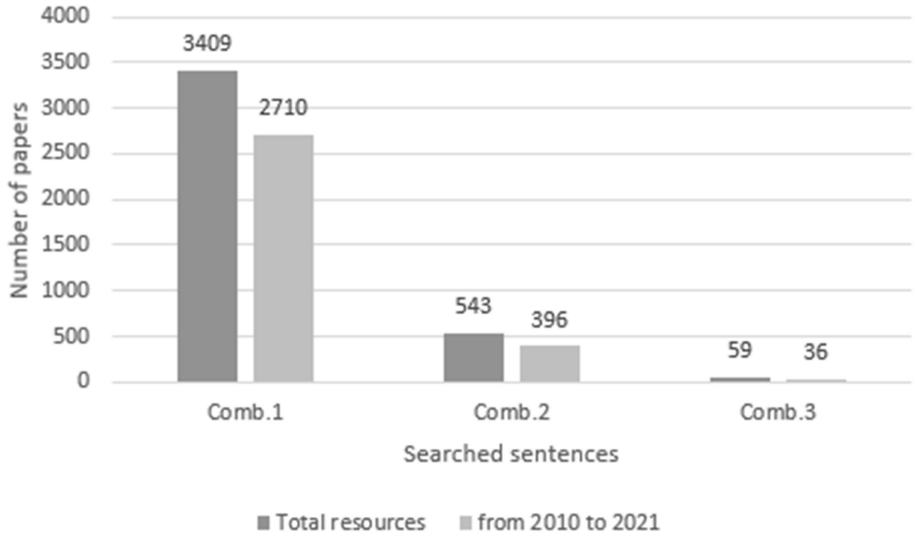


*Fig. 4.: Results for quantity of resources according to different key words combinations in Google Scholar*

Logistics coordination, like it could be concluded from table 1, is mainly connected with flows management and activities which striving for different entities activity integration which participate in the mentioned flows. A lot of publication considerate this concept with flows efficiency which is possible by reduction of traditional logistics costs like transportation and warehousing costs or even the alternative costs (like for example lost sales costs caused by insufficient stocks management). Some research papers also mention about logistics coordination from the perspective of humanitarian logistics, which has a different mechanism and different priorities than traditional, commercial logistics. Fig. 4 shows the quantity of Google Scholar resources by various of key words connected with logistics coordination combinations.

Fig. 4 shows the quantity of resources responding for following words combinations:

- Comb.1 includes: „*logistics coordination*".
- Comb.2 includes: „*logistics coordination" & OR("distribution network";"logistics operator"; "3PL"; "logistics services providers").*
- Comb.3 includes: *„logistics coordination" & „distribution network" & OR("logistics operator"; "3PL"; "logistics services providers").*

According to the research about 14-16% of resources connected with logistics coordination considered also the distribution network or logistics operator. This means that such a number of about all works is located on a subject similar to the presented article. However, by comparing a resources included logistics coordination,

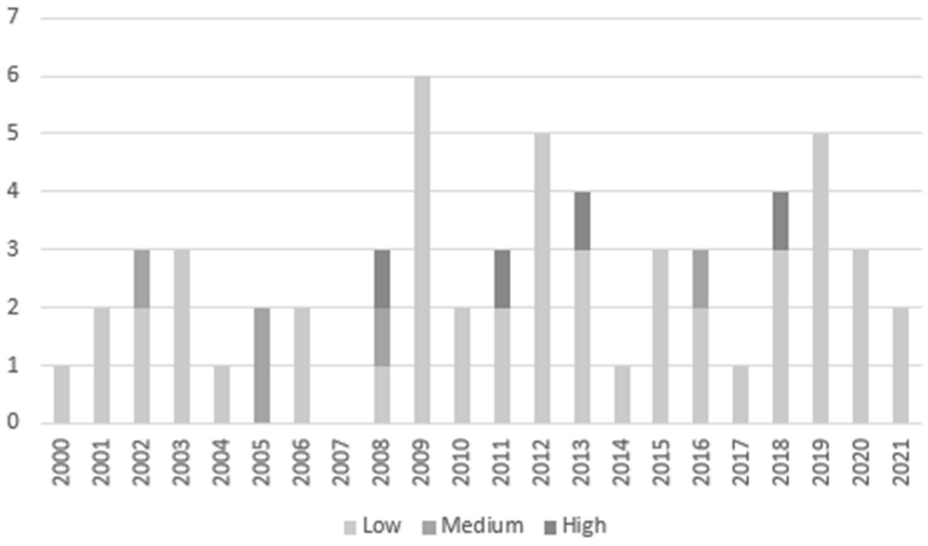


*Fig. 5.: Number of publications in the particular adjusting groups divided by the publications years*

distribution network and logistics operators and logistics operators we can reduce the papers quantity to 1-2%. And this niche is the main topic of following paper. Additionally, author did a research on the articles classified to this 1-2% and compared it to the following paper topic. Publications were classified by author to the three main groups (Fig. 5):

- Low – which is characterized by low adjusting to following research paper topic.
- Medium – which is characterized by general adjusting to following research paper topic.
- High – which is characterized by the high similarity level to following research paper topic.

Based on presented research, author distinguished the few papers which are the source of inspiration for further logistics coordination divagations. First assumption is a influence of logistics operators on services quality in the whole distribution networks and supply chains. Gupta et al. [38] show precisely the logistics operators activities areas, which have direct influence on provided services during the products flows to final customers. These activities are inventory management and warehouse management, transportation, creation of value-added services and orders processing. Additionally, the authors like Cai et al. [39] show the supply chain model with strictly distinguished logistics operator which has direct influence on supply chain actions, so he is able for actions coordination connected with production costs, transportation time and costs and also who has indirectly influence on demand for products.

Conception of supply chain coordination which is seems to be a really relevant from the following article point of view is the conception elaborated in 2008 by Arshinder et al. [40] and extended by these same authors in 2011 [41]. Mentioned authors show, among the others, the functional coordination which includes separately logistics, inventory management, forecasting and product design and the coordination connected with interface of supply chain, which is divided into coordination at the meeting point of supply and production, production and inventory, production and distribution, distribution and inventory. These same authors also considerate the different issues connected with information sharing and technologies, which in their approach are treated as a one of coordination mechanisms. Information sharing and ensuring the proper technological level are important, but the author of following paper, decides to considerate the coordination mechanism from the different approaches. The coordination mechanism concept which is more suitable for the topic of logistics coordination, in the author's opinion, is the conception presented by Czakon [42] and by Joshi and Campbell [43] which assumes the three main network coordination mechanism: market, social and hierarchical. To concept connected with consideration about transportation, inventory

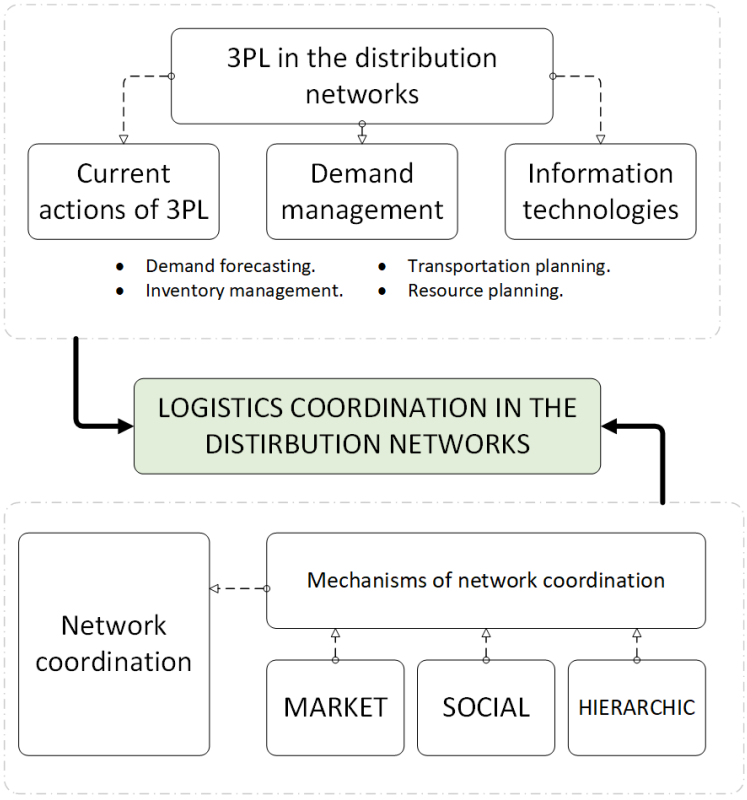


*Fig. 6.: Conception of logistics coordination in the distribution networks*

management and demand were added the considerations of [28] about possibility of taking the function of entity which creating a demand forecasts and managing the inventory in the distribution network by logistics operator and information technologies which, in the current days, needs to appear to whole actions doing in distribution network. In this way, the concept of logistic coordination in the distribution network was outlined (Fig. 6).

## 4. CONCEPT OF LOGISTICS COORDINATION IN THE DISTRIBUTION NETWORK

Conception which is presented by the author assumes the possibility of creating the logistics coordination in the distribution network. It is mainly about creating the coordination activities leading by 3PL in the conditions of information and material flows in the distribution channels from production plant to final customer. This conception assumes the connection of current functions of logistics operators in the distribution networks with the functions connected with inventory management, transportation management, resource planning and demand forecasting and planning. Supporting function in this area will be the function connected with possibility of demand management and the knowledge about contemporary information exchange technologies. Additionally, in the author's opinion, it is worth to considerate the theory of coordination and mechanisms of network coordination in the field of logistics operators.

### 4.1. Current actions of 3PL in the distribution networks

Currently there is still a trend of logistics operators as a field of research work – it was shown, among the others, in the research of Premkumar P. et al. [44]. Mentioned researchers examined the popularity of publications about logistics operators from 2008 to first half of 202 and confirmed this trend. In the contract logistics the logistics operators of 3PL (third-party logistics) takes a serious role [45]. They provide a wide range of various services, where the most popular are: external transportation, negotiation and concluding transport contracts, warehousing and loads consolidating [46]. Some of logistics operator salso broaden their services by complementary services (like assembling or products installation). Majority of available 3PL definitions confirms that the main aim of their activity is providing the logistics services. [45]. Some authors quote also a origin theory of third-party logistics as a third element between manufacturing enterprise (first party) and enterprise which receives the product (second-party). [47]. Logistics operator is defined as enterprise which creates, manages, controls the supply chain of other entities. Logistics operator depends on the contracts between two enterprises and could provide the services connected with supply, transportation or distribution. Coordination of material streams requires the access to data and skills with data usage. This data could be use, among others, to creating the forecasts and inventory management [28].

Now, the customers wants eveything, according to [48], currently the customers wants the benefits of ecommerce distribution models (like wide range of assortment) and the benefits of traditional brick-and-mortal model (like product personalization). Logistics operators help the enterprise with meeting the increasingly growing customer requirements by generating added value in logistics processes. One of the most common barriers during development of collaboration with logistics operator are unreal requirements of enterprise which outsourced their processes to 3PL [46]. Next barrier is the common occurred lack of flexibility to unexpected actions of both sides of contract. 3PL helps also reduce the costs for the companies which decide to change their activity to the different model connected with multichannel [49]. 3PL enterprise, because of their important meaning of nowadays markets and distribution networks, can contribute to shaping modern distribution networks, as well as perform more and more complex functions related to the provision of complementary services and often go beyond the logistics itself in order to gain a competitive advantage and provide their clients with appropriate conditions to co-create flexible and dynamic market systems in the form of reliable networks distribution. One of the perspectives for development as a new service offered by 3PL is demand forecasting in distribution networks [28], which, as a result, may lead to the development of a demand management system in the distribution network, which in addition to forecasting may include support for the operator's activities in the field of transport management, inventory and resource planning.

### 4.2. Demand management from the perspective of 3PL

Demand management could be defined as a process striving for estimation of future demand quantities to synchronize the activities in the area of some enterprise (manufacturing, commercial or service) [50]. Demand management facilitates the optimization of available enterprise capabilities [51], and it is often recognized as one of the core processes of the SCM (Supply Chain Management) concept. A lot of problem occurs directly on distribution network is considered as an implication of incorrectly working process of demand management [52]. It could be concluded that the properly matched demand management system has a positive influence on enterprise but also on the activity of it's suppliers and customers [53]. The goal of demand management is not so much to generate sales as to provide a set of activities for the most advantageous options [54] and focusing on balancing customer requirements with the capabilities of the distribution network [53]. Usage of conception of

demand management requires the choosing of proper strategy and adjusting the organizational, process and resource structures to the chosen strategy. Usually, this focuses on the performance of joint activities by companies that allow a better understanding of the market and customers, and allow you to manage the creation and satisfaction of demand for products and services.

#### *4.2.1 Demand forecasting*

One of the most common strategy to predict the future quantity of demand is a usage of forecasting methods. Forecasts are the critical input element for deciding in the area of supply, production, supplies and warehousing [55], which is mentioned in the literature a lot of times. A lot of authors also agree about mentioned thesis and they added the areas like: demand planning, inventory replenishment, production planning and inventory control, where the forecasts are the basic issue to making many decisions at the managerial level. Additionally, the forecasts are useful in realization of many contemporary logistics conceptions like mass customization [56]. Demand forecasting could allow to forecasts aggregation in short-, medium- and long-term dimension [57]. Possibility of easy forecasts aggregation, forecasts horizon and geographical and product aggregation issues allow to adjusting the forecasts to requirements of different customers. The basis of an efficiently operating forecasting system is a well-adopted forecasting strategy, which includes, inter alia, selection of appropriate forecasting methods and methods related to the flow of information. One of the most frequently mentioned algorithms for forecasting demand in logistic flows are algorithms based on ARIMA, machine learning [58] and neural networks [57]. Due to the repeated inability to use high-level input data or to adjust automatic, algorithmic solutions to forecasts, many forecasts are made or modified by human judgment. According to Perera et al. [59] human factor currently greatly influences the verifiability of forecasts. In forecasting, product history and promotion schedules have the greatest impact on the quality of forecasts [60], but also elements related to the coordination of the distribution network and the relations occurring in such a network.

Forecasting is also becoming associated with logistics operators. Operators are associated with forecasting by some authors strictly due to the fact that operators often forecast the financial profitability of some projects [61]. Very often, operators are considered as units forecasting the demand in the area of transport operations or forecasts of cross-docking activity [62], but it is not an implementation approach in the perspective of the usefulness of this function for the entire distribution network, and more based on the appropriate use of data occurred in 3PL companies. The increase in the complexity of the distribution network, in particular related to the development of omnichannel systems [63] is an additional stimulus for the development of forecasting systems at the level of logistics operators, which take over, in this system, the role of logistics processes coordinators [28]. Logistic operators can therefore, under appropriate conditions and having appropriate attributes, make demand forecasts, which would be one of the components of the broadly understood demand management system. Demand forecasting may lead to the creation of a base for further activities related to sales, product allocation, production planning throughout the distribution network. Logistics operators, forecasting the demand, could have an impact on these elements and, acting on the basis of their knowledge in the field of flow management, could coordinate them. Forecasting from the perspective of a logistics operator could also have a significant impact on warehouse management [28], so for the another element of the logistic coordination concept.

#### *4.2.2 Inventory management*

Inventory management is an area that, on the one hand, is of great importance in reducing unforeseen fluctuations in demand and ensuring an appropriate level of customer service in distribution networks, and on the other hand, an area that largely depends on the adopted strategies for planning and implementing demand plans. Inventory management can reduce the impact of disruptions in the reception of demand and is one of the key factors for achieving success in the operation of enterprises, this applies to both enterprises operating on the traditional market, but also on the e-commerce market [64], m-commerce [65] and also in the conditions of mass customization, where the participants of distribution networks or supply chains are required to prepare for both the stock-driven environment (i.e., inventory management for the standard products) and the order-driven environment (i.e., inventory management for those further customized items) [56].

An interesting fact is that while stocks are generally held to meet demand, in some situations they are held to stimulate demand [46] through e.g. active influence in the sphere of customers. In the literature, this effect is called the psychic stock effect. It is closely related to retail sales and consists in the fact that purchases made by consumers are stimulated by the amount of goods they see on store shelves; this stock may also imply a bullwhip effect. The bullwhip effect spreads through entire distribution networks and supply chains, thus causing uncertainty in production plans, forecasting imperfections, and high costs of creating inventory. Eliminating the bullwhip effect, in addition to the implementation of advanced software and modern telecommunications systems, also requires the development of a system for sharing information between nodes in chains and networks [66]. According to the author, a logistics operator could both manage inventories for the purpose of their effective deployment in particular places in the supply chain and attempt to

eliminate the bullwhip effect. These aspects could be positively influenced by the operator's experience in the implementation of logistic tasks and the ability to react quickly and adapt activities to the requirements of individual cells.

Undoubtedly, nowadays the biggest challenges from the perspective of inventory management are: fluctuations in demand, reverse logistics, stockouts and management from the level of individual SKUs (Stock Keeping Units) [64]. Fluctuations in demand can make it difficult to plan operations in the distribution network and add an element of uncertainty about future volumes of demand. Reverse logistics makes it difficult to plan efficient flows, because in addition to the standard flow, there is also a reverse flow to be considered. Stockouts have a large impact on the bullwhip effect as they can create speculative stocks (if a possible stockout is detected) and there is a risk of opportunity costs for no sales or customer loss when a stockout occurs. Management from the level of individual SKUs is problematic in terms of the amount of data and information that is associated with it. The solution may be management based on Big Data, which logistics operators often use in their operations. Inventory management based on Big Data can lead to the achievement of advantages such as [67] improving operational efficiency, maximizing profits and sales, increasing customer satisfaction rates, reducing IT infrastructure costs by migrating to the cloud. Logistics operators currently provide a number of services related directly to inventory management, and with sufficient information being collected from the distribution network, they could also carry out inventory management activities for the entire network. Inventory management from the perspective of the entire network would enable its efficient coordination by means of planning and implementing assumptions related to, inter alia, with the allocation of inventories and their effective use. The very distribution of inventories in individual nodes is connected, in turn, with the planning of transport operations in the network.

#### *4.2.3 transportation planning*

Nowadays, we are dealing more and more often with the one delivery day standard in transport operations [62]. Logistics operators are struggling with the need to meet the increasingly demanding order deadlines, especially in the area of road distribution. As highlighted by some authors, 3PL, through appropriate transport planning, can reduce flow times and reduce inventory levels [61] by increasing the speed of reaction and eliminating the need to maintain high safety stocks. Coordinated actions in this area may also lead to shortening of transport routes and bring savings [68]. Transport operations, and in particular the ability to carry them out efficiently and flexibly, play a significant role in the coordination of the distribution network. The fact that logistic operators can coordinate and perform transport operations in distribution networks is influenced, among others, by the fact that these enterprises usually either have TMS (Transport Management System) class systems or have an easy ability to adapt such systems to their structures [69], the same is the case with the implementation of other solutions related to ICT (Intelligent Transport System) [70]. In addition, many companies from the 3PL group provide transport services. There are so many of these enterprises that the problem becomes the choice of the right operator to provide transport services - hence, numerous mathematical models appear in the literature, which are used to assess and select the operator. The example could be the model presented by Yayla et al. [71], which distinguishes three main criteria for assessing the operator's ability to perform transport services efficiently:

- Possibility of developing sustainable cooperation, which mainly manifests itself in generating low transport costs, good financial condition, correct reputation and showing similar values between enterprises.
- Ensuring an appropriate level of service quality, which is mainly manifested in keeping the on time delivery ratio at a high level, speed of response and reliability of deliveries.
- The ability to continuously improve, mainly related to technological sophistication, solid infrastructure and the ability to optimize operations

Currently, an increasingly important criterion is also the ability of the operator to meet the assumptions of sustainable development, CO2 emissions and adaptation to modern solutions related to, for example, Smart Cities in the area of urban logistics in the long term [72]. Undoubtedly, these criteria must be considered when choosing an operator that will be able to coordinate the company's activities in the distribution network. Of course, not every operator who is able to provide transport services can coordinate the flows, but the ability to plan and organize transport operations is, according to the author, one of the necessary requirements for the implementation of the assumptions resulting from logistic coordination.

#### *4.2.4 Resource planning*

Another important element of logistic coordination is the ability to plan and allocate resources. It is about both human resources and technical resources in the form of, for example, internal transport infrastructure. According to Gupta et al. [73] correct resource planning is one of the key success criteria for today's 3PL companies. Logistics operators must plan resources in an appropriate way to stay on a competitive market and to successfully implement processes with high added value for the customer, while reducing financial, material and personnel costs. Efficient resource planning by logistics operators is therefore essential in creating a value chain [74]. Logistics operators

specializing in contact logistics services take particular care of the aforementioned value chain created in the flows generated for customers. Interestingly, some authors also point to the importance of the appropriate allocation of resources in reverse logistics. Ibrahim et al. (2018) pay attention to the importance of resource planning also in the activities of Green Logistics, where the appropriate use of resources.

A properly constructed forecasting system can be used as a support for resource planning by a logistics operator [28]. The operator can plan the deployment of resources in the form of the necessary manpower and infrastructure and thus coordinate the operations taking place in the distribution network. Of course, when planning resources in an extensive and complex distribution network, it becomes necessary to use modern technologies for information exchange.

### 4.3 Information technology

A properly constructed information exchange system and the willingness to exchange information between different enterprises is the basis of an efficiently functioning enterprise network. A properly created information exchange system is also recognized by some authors as one of the key elements of the coordination of entire supply chains [40]. Very often, even when basing mainly on human decisions when planning activities, these activities are supported by advanced decision support systems [59]. Information flows and the possibility of using them in an appropriate manner are inextricably linked with the necessity to implement solutions of digital and computer technologies. Digital technologies and computer technologies that support the flows in networks are extremely important. We can distinguish, for example, electronic exchanges, which allow you to easily coordinate some transport activities [10] and which are one of the simpler mechanisms of such coordination.

One of the important elements to consider in contemporary considerations on coordination is the active inclusion of technological solutions in human activities and the ability to coordinate also the operation of these solutions. [75]. Currently, the assumptions related to the creation and implementation of EDI (Electronic Data Interchange) are still important, but this is not only the only requirement for a well-designed information flow system. The broadly understood digitization pushes retailers and other enterprises operating in the network to adapt their business models to, for example, the modern conditions of multi-, cross- and omnichannels functioning [76]. Among the factors, which positively influenced on logistics processes coordination the authors like Zhang [1] disthinguised cyber physical systems, which, in combination with modern technologies, such as IoT (Internet of Things), allow for more efficient coordination of activities in networks and supply chains. The authors also emphasize that system support, including, inter alia, current information about individual SKUs and stockouts [67]. One of the current directions related to the application of technological achievements in the area of logistics flows is the use of blockchain technology. Blockchain technology is considered a technology that already affects or will affect many aspects of our lives, such as supply chains, business, healthcare, manufacturing and data management [77]. These technologies are believed to be able to support logistic processes [6], these processes may focus on improving the exchange of information. Another concept that is increasingly exploited both in terms of science and practice is the Digital Twin concept. This concept is based on a very strong digitization of activities and the possibility of creating an accurate computer model of the company's activity. Digital Twin, as some authors say, can also derive information from the demand forecasting system adopted by the

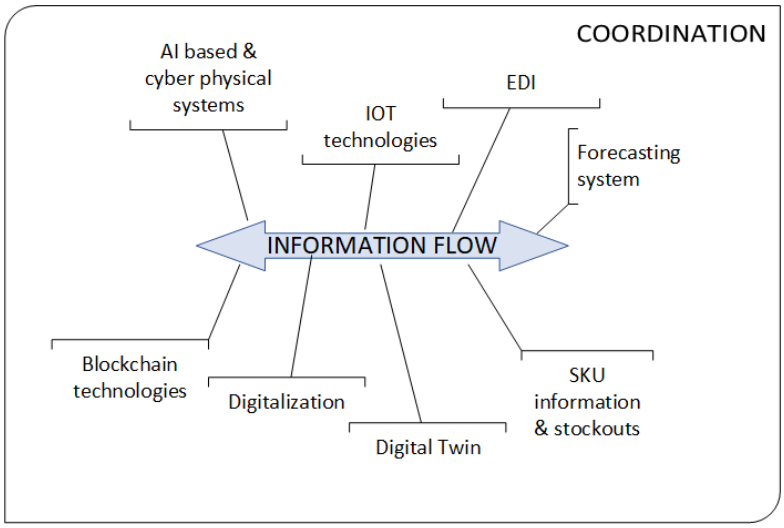


*Fig. 7.: Technologies and solutions which support coordination of information flows in distribution networks*

company [78-79], which gives grounds to think about the implementation of Digital Twin solutions as an additional element of demand management. In Fig. 7, the author presents concepts and solutions, which, in his opinion, have the greatest impact on a properly constructed information management system in the distribution network.

**4.4 Network coordination and mechanisms**

The network itself is recognized as a means of coordinating interaction [80], which may indicate that to talk about a network of cooperating enterprises, there must be some coordination mechanisms. The subject of coordination is extremely important, especially in view of the frequent occurrence of problems related

*Table 2.: Network coordination mechanisms*

| Mechanism | Mechanisms description | The most important elements | Paradoxes |
|---|---|---|---|
| Market | It is based on the premise about the key role of price in allocating resources and shaping the market equilibrium. In addition to the price, the parties also determine the quantity and quality subject of the contract, and they formalize their arrangements in the form of a contract. Means are two effects: cost (the need to find the right contractor, preparation and negotiation of contract terms, performance monitoring this contract, its settlement, and in the event of disputes – use the road judicial or extrajudicial) and risks (orientation for the future of each contract. The parties, when concluding contractual provisions, are not able to foresee all the circumstances in which it will be possible to implement it). | – Price.<br>– Contracts.<br>– Two-sided security. | Attributed efficiency, but the need to protect against opportunism, limits these benefits. |
| Social | Otherwise known as a category of trust. It is treated mainly as a mechanism to protect against opportunism. In the narrow sense, trust is associated with expectation positive attitude in cooperation. Another distinguishing feature of the social mechanism of observed coordination there is a rich information exchange in the networks, significantly exceeding the needs of the current transaction. | – Social norms.<br>– Trust.<br>– Extensive information exchange. | Social mechanisms reduce opportunism, but may limit effective decision-making due to environmental pressure. |
| Hierarchical | This mechanism causes resistance among some authors associated with perceiving the network as devoid of hierarchy. However, you have to emphasize that it is not only about the presence of a piled up organizational structure, but rather about the tools for coordinating activities typical of bureaucracy, such as: control systems, budgeting, specialized organizational units in coordinating the activities of others, etc. | – Structures and control systems.<br>– Organizational integration.<br>– Bureaucratic allocation of resources. | Hierarchy makes coordination effective, but limits flexibility and innovation. |

Source: elaborated based on [42; 81]

to differences in the goals of individual elements of the network or supply chain - an example may be, for example, the problem of coordination of activities at the interface between supply and production or production and distribution [41]. Coordination mechanisms are defined in various ways. Some authors include among them. [40]:

- Supply chain contracts.
- Information and resource sharing.
- Joint decision and actions making.

However, as the leading approach in this topic, the author adopted the approach presented, inter alia, by Czakon [42] and by Joshi and Campbell [43], which lists three specific mechanisms of network-related coordination: market, hierarchical and social. The description of individual mechanisms is presented in table 2.

The market mechanism in the case of a logistics operator in logistics coordination could consist in specifying in the terms of contracts and contracts that are already concluded by operators, issues related to logistics coordination, such as service standards, determination of logistic minima, inventory levels and efficiency of individual elements of the logistics flow. In addition, logistics operators can significantly influence the development of the final price of the product by carrying out actions in the distribution network aimed at reducing logistics costs related to, among others, with storage, transport, but also the opportunity costs related to preventing the lack of sale through a properly constructed inventory management system.

The social mechanism with regard to logistic coordination in the perspective of being carried out by a logistics operator would be based on the trust of individual links in the activities of a logistic operator. The trust would be created based on the operator's reputation and the trust developed during the cooperation. This mechanism can also be driven by the fact that modern logistics operators strive to develop increasingly sophisticated, efficient and information-rich flows.

The hierarchical mechanism would mainly manifest itself in organizational and operator integration of flow management activities. It would be necessary to develop mechanisms related to the control of the implementation of assumptions by individual links and the ability to supervise them by a logistic operator. In this mechanism, it may turn out that the operator has features related to selected features of the central unit, i.e. flagship enterprise in the distribution network. However, it is important to examine what features of the central unit the operator must have in order to be able to logistic coordination and whether, through logistic coordination, the paradoxical features of individual mechanisms will be reduced or perhaps exposed.

## 5. CONCLUSIONS

Logistic coordination, according to the author, can be defined as the coordination of activities related to the management of flows carried out by the logistics operator as part of the currently implemented activities, activities resulting from the possibility of demand management, the use of the necessary achievements of information technology as part of the use of the market, social and hierarchical network coordination mechanism. Such an approach is of course related to formulating a hypothesis that will be verified during further research on the subject of logistic coordination. This hypothesis is as follows:

*H1*: A logistics operator with selected features is able to take over the logistic coordination function in the distribution network.

This hypothesis will also be related to the research that allows answering the following research questions:

*RQ1:* What are the obligatory features of a logistics operator to take over the logistic coordination function in the distribution network?

*RQ2:* Is the logistics operator able to take over the logistics coordination function for all types of distribution networks? Including for networks related to e.g. the flow of pharmaceutical products, dangerous goods or for networks with different levels of multichannel development?

*RQ3:* Does logistics coordination reduce the undesirable effects of implementing individual coordination mechanisms?

*RQ4:* To what extent will a logistics operator be able to influence network activities using individual coordination mechanisms?

*RQ5:* How would the model of information exchange between individual links in the distribution network look like and what information would have to be shared in the perspective of logistic coordination?

The answer to these research questions and the verification of the hypothesis will make it possible to develop guidelines and guidelines related to the possibility of a logistics operator taking over the function of logistics coordination of the distribution network. The approach to logistics coordination in terms of its implementation in the distribution network may bring many tangible managerial benefits. Among them you can find, among others reduction of inventory levels, better allocation of resources and inventories in the network, reduction of logistic costs of network operations, increase in customer satisfaction and the

possibility of increasing flexibility in the operation of the network through coordination aimed at managing material and information flows. Additionally, a distinguishing feature of this concept may be the fact that the logistics operator is excluded from direct sales profits, which may also reduce the negative impact of ill-considered and unplanned promotional campaigns on the entire distribution network. Additionally, the aforementioned discriminant may positively influence the social coordination mechanism and encourage retail enterprises to share sensitive information with the operator. The author is aware, however, that the topic taken up requires further research in this area.

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