

ANALYSIS OF USE OF COMMUNICATION STANDARDS ON THE IMPLEMENTATION OF DISTRIBUTION PROCESSES IN FOURTH PARTY LOGISTICS (4PL)

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Received: June 3, 2018

Received revised: September 18, 2018

Accepted for publishing: September 19, 2018

Abstract

The globalisation of the trade and services market has made it necessary to focus on the key processes performed by individual enterprises in the supply chain. For this reason, logistics operators have started to play an important role in the service market. Operators, using their resources, experience and skills, guarantee to their business partners the highest level of realization of logistic processes. One of the key elements for improving logistics processes efficiency through the use of Fourth Party Logistics is the information flow integration. In this article, the authors focused on presenting an analysis of the integration needs identification of business partners with the 4PL operator. The presented methodology includes both literature analysis, case studies and business practice research, based on research projects carried out in GS1 Poland, Institute of Logistics and Warehousing and the Poznań School of Logistics.

The conducted research concerns the specific information flow in fourth party logistics (4PL), which requires information integration of the entire supply chain. The choice on this issue is related to the topicality of the problem, both in terms of literature research and business practice. Taking into account the specificity of fourth party logistics, the study included not only operators, but also their business partners in the supply chain.

Key words: fourth party logistics, 4PL, integrated supply chain, information flow in the supply chain

1. INTRODUCTION

We are currently witnessing dynamical changes resulting from the ever-growing use of various technological solutions in our lives. The development of artificial intelligence and self-learning machines changes the way in which we make decisions and communicate. It will not be long until chatbots replace humans, along with blockchain (Dujak & Sajter, 2019) and crypto currencies introducing radical changes to the financial world. The Fourth Industrial Revolution will force widespread automation in manufacturing and supply chain of raw materials, components and even the finished goods. Services, initially the repeatable ones, will be taken over by machines or software. Consequently, to make these assumptions a reality, the traditional chains of supply must evolve into a form of an integrated, shared, smart digital and highly efficient ecosystem. With this approach, such an ecosystem becomes a series of independent, discrete, largely autonomous events controlled through marketing or production activities, or through distribution to the end recipients of products. The digitization of these processes will cause a continuous change in the supply chain, one that creates an integrated ecosystem based on the transparency of processes taking place between the engaged entities, starting from the suppliers of raw materials or components, through production processes and ending with the delivery of finished products.

This condition is inseparably connected to one of the key aspects of logistics, namely the need to have precise information at a specific time, indispensable to make the correct decision. This is crucially important now that businesses exchange huge amounts of data whose flow is regulated by various communication streams. Important data are very often lost, wrongly presented or severely delayed. To overcome these problems and to create efficient data exchange chains, one must mainly focus on the following aspects:

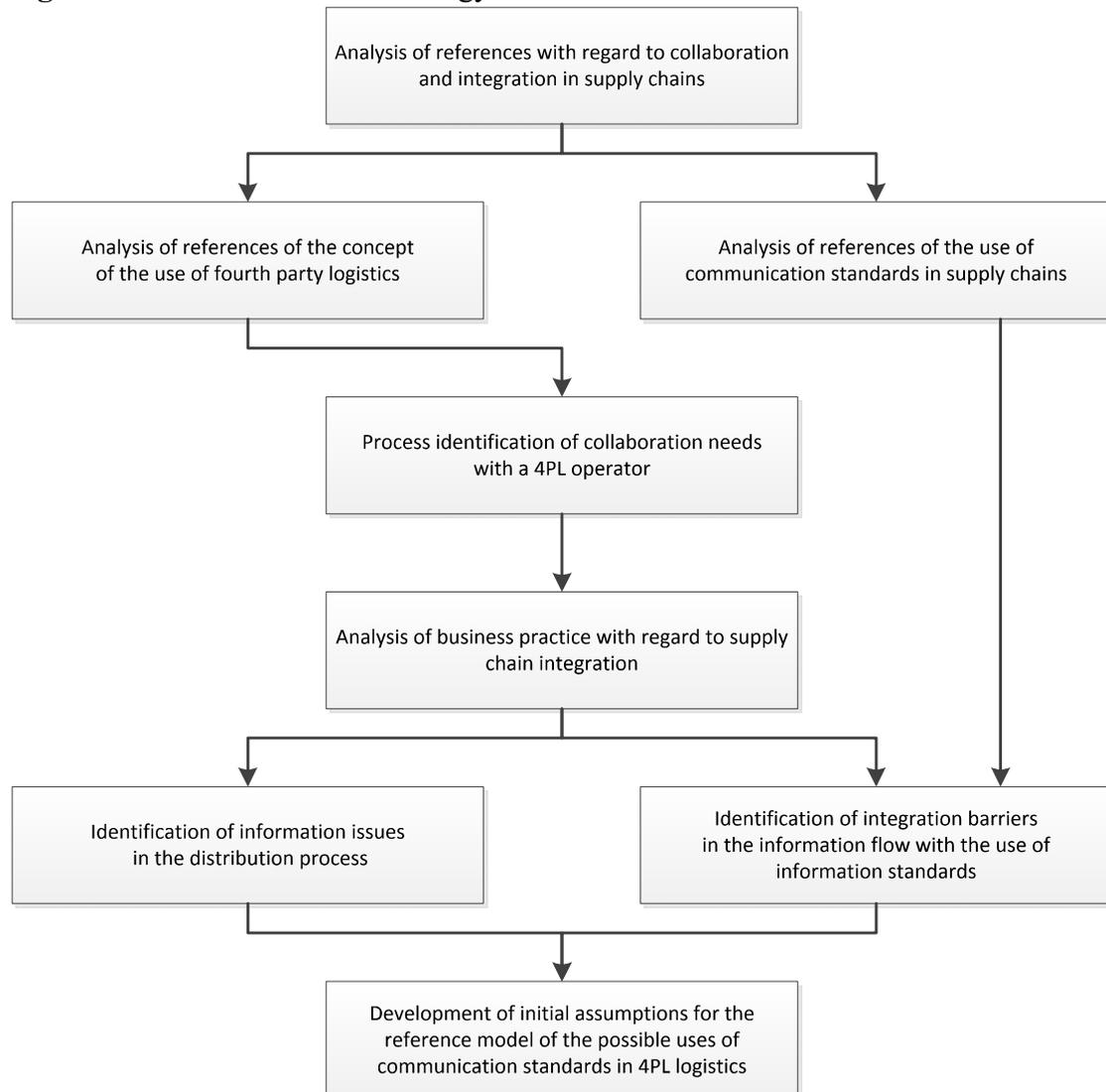
- create common data exchange platforms based on communication standards,
- use clearly defined models as the basis for their architectural structures,
- use standard solutions in the form of access points to integrate independent IT systems.

This approach will allow companies to promptly react to any interferences in the supply chain, and even to anticipate them, in order to be fully able to model them by creating scenarios and real time processes. This way companies will be able to flexibly manage their business, thus increasing the competitiveness of their products and services. Such tasks are very often handled by logistics integrators, often referred to as 4PL operators. Consequently, large businesses who manage their own logistics chains, choose to outsource the functions related to the integration of these chains by transferring competences in this field to external logistics operators, 4PL. This paper focuses on the analysis of the logistics operators' role in the supply chain and identification of opportunities for information integration in relations with them. The main research aim was to identify the basic assumptions for the development of the concept of logistic operators' information integration with partners in the supply chain.

2. RESEARCH METHODOLOGY

The identified research problem required the creation of the logic of conducting theoretical analyses and business practice analysis in the discussed regard. The possibility to conduct the research as a part of the projects conducted in the Poznań School of Logistics, the Institute of Logistics and Warehousing in Poznań and in GS1 Poland, allowed a comprehensive analysis of the discussed issues. Fig. 1 shows the methodology of research with regard to the identification of possibilities of using communication standards in the distribution process.

Figure 1. The research methodology



Source: own study

The research logic presented in Figure 1 is based both on the critical review of written sources and on business practices examined in Poland. The research lasted throughout 2017 and are being continued in 2018 as a part of the subsequent research

project of the Poznań School of Logistics. The structure of the chapter was adapted to the logic presented in Figure 1.

3. THE ROLE OF LOGISTICS OPERATORS IN THE SUPPLY CHAIN

Logistics operators are most often classified into 5 groups. The following is the specifics of each category according to its evolutionary development, starting from 1 PL, through 5 PL (from the simplest, basic configurations to the most advanced solutions).

First Party Logistics (1PL)

It represents the main firms receiving logistic services. These firms may be producers, shippers or retailers. First Party Logistics (1PL) are firms who perform their own logistics activities. First party firms do not receive logistics help from outsourcing firms.

Second Party Logistics (2PL)

It represents that first-party defined as firms refer directly to customer. These firms buy products and services from the first party firms. Logistic all activities are required to provide these products and services. A second party logistics (2PL) provider specializes in one particular area of the supply chain, usually transporting goods from one point to another. This company owns the means of transportation.

Third Party Logistics (3PL)

These firms are logistic service providers. Since they provide logistics services (shippers, warehouse operators etc.), they may be brokerage firms and organizers of the supply of logistics services. 3PLs provide management skills along with physical assets, labour and system technology to provide professional logistics services, relieving companies of the responsibility to perform such services themselves. 3PLs typically can provide transportation, warehousing, pool distribution, management consulting, logistics optimization, freight forwarding, transportation management, rate negotiations, cost evaluations and contract management services.

Fourth Party Logistics (4PL)

These firms provide logistics functions and present logistics solutions to companies. 4PL companies provide logistics solutions that are built around domain knowledge provided by third party logistics companies. Consequently, 4PLs emerged out of the vacuum created by 3PLs. Fourth Party Logistics (4PL) is the integration of all companies involved along the supply chain. 4PL is the planning, steering and controlling of all logistic procedures (for example, the flow of information, material and capital) by one service provider with long term strategic objectives. Fourth party logistics (4PL) has evolved as a breakthrough supply chain solution comprehensively integrating the competences of third party logistics (3PL) providers, leading edge consulting firms and technology providers.

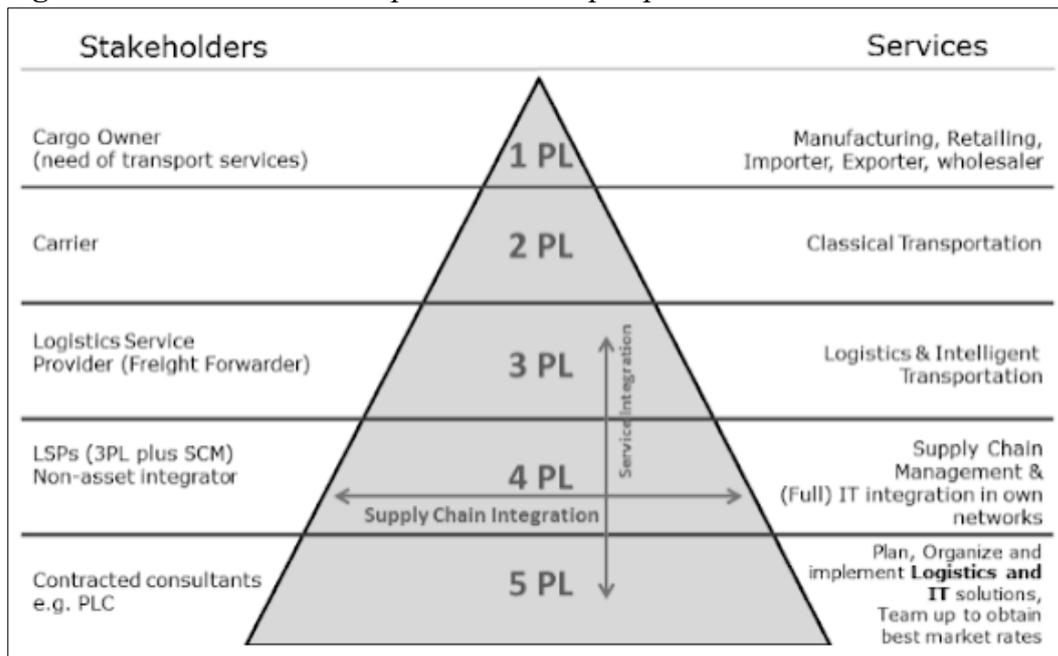
Fifth Party Logistics (5PL)

These firms are more advanced than 4PL and they focus on providing integrated logistics solutions within the scope of the supply chain. Supply chain management is the oversight of materials, information, and finances as they move in a process from supplier to manufacturer to wholesaler to retailer to consumer. Supply chain

management involves coordinating and integrating these flows both within and among companies. At every stage of the supply chain, integrated logistics services are called the fifth party logistics (5PL) (Ozovaci, 2016).

Fig. 2 presents services offered by individual xPL operators. Along with the evolution of complexity of xPL operators, the spectrum of services keeps growing. Table 1 presents the key advantage of a specific logistics operator. Under specific conditions, each market form of an xPL operator has its own niche, namely, each of them can participate in business successfully.

Figure 2. Evolution of xPL operators - 5PL perspective



Source: (Sergebillogistics, 2017)

Table 1. Specification of the key advantage of an xPL logistics operator

xPL	Description	Can be advantageous when:
1PL	Companies own equipment: A company or an individual that needs to have cargo transported from A to B by using its own equipment	<ul style="list-style-type: none"> • Critical mass and low fluctuation to utilise • Specialised equipment with limited possibilities of synergies through xPLs
2PL	Carriers, airlines and trucking companies: An asset-based carrier with specialised sector knowledge. Actually owns the means of transport	<ul style="list-style-type: none"> • All logistics planning activities are handled internally and considered a differentiator • High volume to support attractiveness of 2PLs

3PL	Freight forwarders: Provide an array of logistics services to customers, for selected areas. Sub-contract all or much of the services to specialised transport companies	<ul style="list-style-type: none"> • Volume spreading across large geographical area and/or means of transport • Valuable expertise accessible, combined with flexible and agile solutions
4PL	Logistics management: Independent and non-asset-based integrators with the ability to combine own technology, resources and capabilities with 3PL to design, build and operate comprehensive supply chain solutions	<ul style="list-style-type: none"> • Starting up or in very fast-growing industries combined with low logistics capabilities • Multiple logistics services are required and driven by technology
5PL	Supply chain management: Logistics services providers who develop, implement and control, preferably in close consultation with the customer, the best possible supply chains or networks. 5PL logistics are often linked to e-com	<ul style="list-style-type: none"> • The supply chain is considered not business critical to success • Alternative solutions are less attractive

Source: own study based on (Implement Consulting Group 2016)

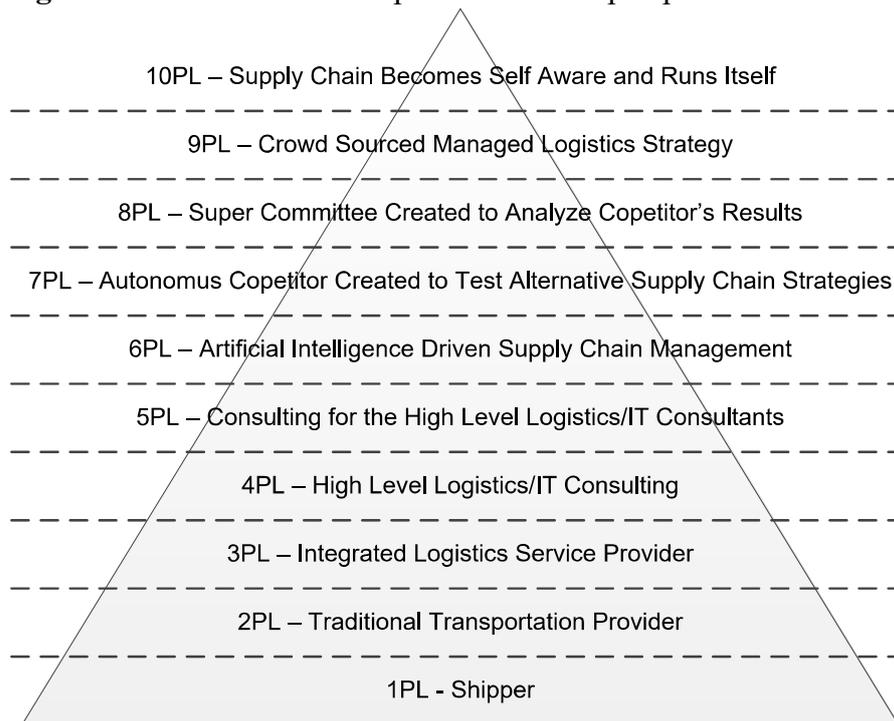
Examples of cooperation between logistics operators and customers (BCR 2014):

- 1PL: Australian red meat supplier Samex is a 1PL as it exports goods to wholesalers, distributors and supermarket chains worldwide;
- 2PL: Shipping lines which charter or lease their own ships, or airlines that are contracted to use their passenger flights to transport air freight from origin A to destination B;
- 3PL: BCR is a 3PL service provider specializing in domestic and offshore warehousing, international freight forwarding and customs brokerage, but also provides e-fulfilment, specialised export services and other supply chain management services for your business;
- 4 PL: BCR has performed 4PL functions such as consolidating a plethora of suppliers and carriers to provide a single-invoice solution that streamlines the supply chain process;
- 5 PL: Will plan, organize and implement logistics solutions on behalf of the contracting company with a focus on utilizing the most appropriate technologies. Essentially, a 5PL manages networks of supply chains with an extensive e-business focus across all logistic operations, other than 3PLs and the parent company.

Figure 2 and Table 1 highlight the increasingly important role of information in a supply chain, whose natural materialization is manifested in more and more

advanced IT solutions (IT support for communication processes). Coordination is considered a fundamental component for achieving a higher level of supply chain efficiency. Information and communication technology (ICT) is essential enabler of supply chain coordination and synchronization (Evangelista, 2011). It was the importance of information that led to the further evolution of the xPL concept. Currently, with the methods of communication of the customer's organization with the logistics service provider in mind, the further development of xPL categorization has taken place, from level 5PL to level 10PL (Fig. 3).

Figure 3. Evolution of xPL operators - 10PL perspective



Source: (EDI Matters, 2013)

Therefore, some logistics services providers expanded their services even further. The detailed pyramid of services and functions offered by 10PL operators, step by step, is shown in Figure 3.

To function correctly, the supply chain must be integrated in terms of IT. In the case of IT system this means that every information should be introduced into the company's IT system only once (the STP principle - straight through processing). This way the cost of obtaining data is minimized and it is easier to maintain the coherence of the collected and exchanged data. Additionally, there should be no delays in transferring the data within the supply chain (the ZLE principle - zero latency enterprise), meaning that the information uploaded to the system should be made available directly (online) to all users for whom they are relevant in any way. Positioning the integration of information is one of the aspects of shaping the nature of relations within the more extensive supply chain strategies used by the company (Speier, Mollenkopf, Stank, 2008).

The information integration is realized via communication channels and technologies that support the flow of information in the supply chain between businesses (Leuschner, Rogers, Charvet, 2013). One of the most often formulated goals of the management of supply chains in the logistics perspective is the minimisation of the total cost of flow of products and information while maintaining the quality of delivery service required by customers - the so-called savings logistics. The integration of the participants of the chain is based on the use of modern IT technologies and broadly understood partnership (Hadas, et al. 2015; Trojanowska, Varela, Machado, 2017). The capabilities of informational technology and sharing information have a significant impact on the integration of logistics (Prajogo, Olhager, 2012).

The integration of information allows to reduce the internal reinforcement of demand and eliminates delays resulting from the flow of information, thus reducing internal uncertainty and variability with regard to the demand, making it possible to focus on proper customer service. The integration of information may be increased by optimizing the level of cognitive, social and institutional proximity.

The obstruction of information channels results in insufficient knowledge of the possibilities and conditions of the exchange of goods in the market. In this light, the task of the logistics operator in the supply chain is to close spatial and temporal gaps and other inconsistencies between production and consumption. Modern technical and organizational solutions supported by IT system created new growth possibilities for businesses providing logistics services - production and trade companies use external service providers more and more often. The main task of logistics operators is to create and serve information chains.

4. IDENTIFICATION OF THE NEED TO COOPERATE WITH A 3PL/4PL OPERATOR

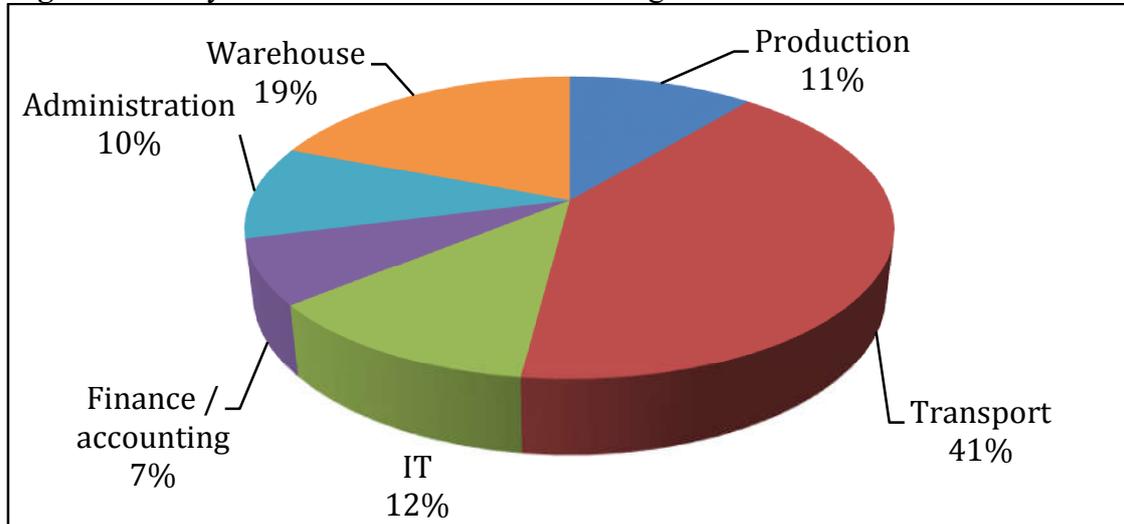
The genesis of the use of logistics support coming from a 3PL/4PL operator stems from the economic aspect of managing a business. The continuous search of process and cost optimization gave rise to a tendency to relay certain services, and even entire processes, to be handled by external companies. This tendency was also at the root of the growth of 3PL operators, originally, and 4PL operators, in the longer time perspective. Therefore, when identifying the need to work with a 3PL/4PL operator, the analysis should begin with the identification of the most commonly outsourced logistics process.

The research on the identification of outsourced processes was carried out independently from the realization of this research, but it can be treated as a basis for further analysis of the application of GS1 standards when collaborating with 3PL/4PL operators.

This is a long-term research, a continuation of the research conducted in 2010 and 2014. The current research was conducted in the first half of 2017, in 107 companies, regardless of their size, operating in various sectors and active in Poland. The objective of the research was to determine the demand and supply for outsourcing logistics services.

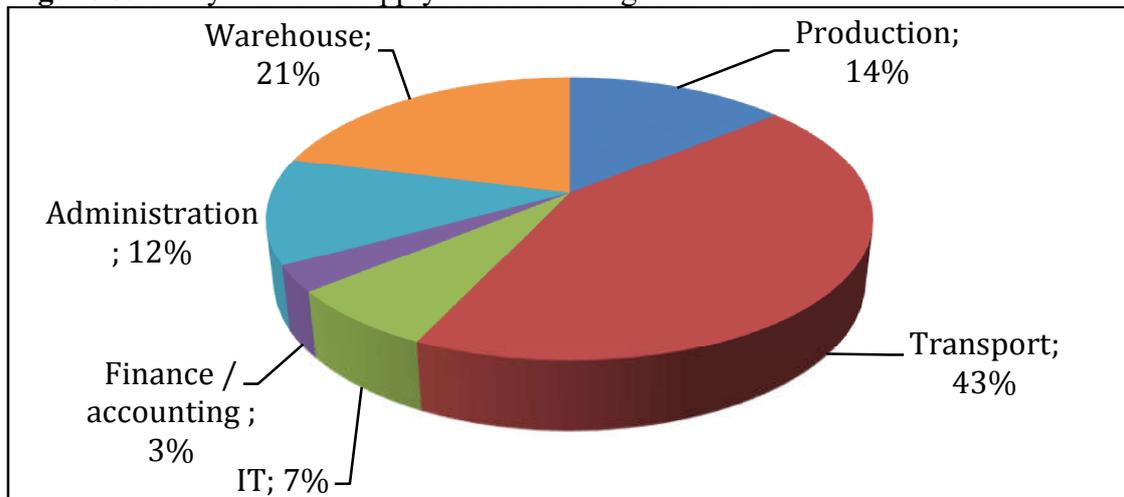
Figure 4 shows the demand for outsourcing services, while Figure 5 shows the specifics of the supply of outsourcing services.

Figure 4. Analysis of the demand for outsourcing services



Source: own research

Figure 5. Analysis of the supply of outsourcing services



Source: own research

One can also note that both in the demand and supply perspective, transport resources are dominant (respectively, 41% and 43%). This should not be surprising, mainly due to the cost intensity of the transport infrastructure and the subsidiarity of transport resources, which greatly affects the range of the possible uses.

A similar array of demand & supply forces is present with regard to warehousing (19% vs 21%). In the light of the entirety of the resources considered in the research, the suppliers and buyers of logistics services mainly focus on the transport and warehousing categories. This is very understandable and stems from the natural evolution of logistics. The second line of interest is made up of production (11% vs 14%) and administration (10% vs 12%). These categories of resources are both more

difficult to contract (the customer is eligible to decide about cancelling them) and to accept for execution (the logistics operator is eligible to decide whether to accept the service). The logistics written resources and practice show plenty of facts for and against commissioning processes, mainly production processes, but also administration processes. It should be highlighted that the supply exceeds the demand in the case of these four services, leading to a comfortable situation for the customer when choosing a logistics operator in a specific category. IT services, finances and accounting enjoy a much lower interest - respectively, 12% vs 7% and 7% vs 3%. Of note in this case is the reversed relation - the demand exceeds the supply. This is a significant gap in the offer of logistics suppliers within the context of the article's topic, namely managing the information, both hard information (finances, accounting) and soft information (general, publicly available). The supply offer should be expected to grow in this regard. Table 2 shows the detailed data on the use of outsourcing of specific processes.

Table 2. Classification of demand and supply for outsourcing from 2010 to 2017

Resource type	Demand			Supply		
	2010	2014	2017	2010	2014	2017
Production	15%	13%	11%	31%	19%	14%
Transport	33%	38%	41%	36%	41%	43%
IT	12%	11%	12%	6%	5%	7%
Finance / accounting	10%	9%	7%	2%	3%	3%
Administration	25%	14%	10%	19%	15%	12%
Warehouse	5%	15%	19%	6%	17%	21%

Source: own research

The three most often outsourced and accepted for outsourcing logistics process in the last research, namely transport, warehousing and production processes, were subject to tendency analysis. When performing the change tendency analysis, the continuous increase of cooperation needs with regard to transport and warehousing should be noted, along with the simultaneous reduction of outsourcing of production processes. This situation is caused by the focus of production processes on the phenomenon of outsourcing which consists in re-accepting the previously commissioned processes which mainly means, in practice, the taking-over of the execution of all production sub-processes.

When analysing the dynamics of changes in services from 2010 to 2017, it can be observed that with regard to the key categories - transport and warehousing, the demand and supply show a rising trend, both year to year and generally, throughout the years. The situation is reversed in case of services such as production and administration - the demand and supply have a reducing trend, both year to year and in general. The most interesting situation has a place within the remaining categories of service. In case of IT, we can talk about an initial drop in demand and supply, followed by the return (demand) and increase (supply) of their respective levels along the years (a parabolic curve). In this case we can claim the demand and supply of IT

services have stabilized to a certain degree. Speaking of the finances and accounting services, the demand is showing a decreasing tendency (both year to year and in total), while the supply is exhibiting a growing tendency (up to 2014 and in total) that stabilized throughout the latter period (2017). A conclusion can be made that the diminished demand was noticed by the supply, which caused a deceleration and stabilization of offers in this category.

Taking into account the market conditions, shown in the research presented above, we must conclude that further analysis and identification of the possibilities of the use of communication standards in collaboration with 3PL/4PL operators should be based, firstly, on the identification of the possible applications in transport and warehousing processes. The Authors' further research work has been aligned to this assumption.

5. SPECIFICATION OF COMMUNICATION STANDARDS IN SUPPLY CHAINS

The full and optimal use of global supply chains in the current reality is only possible thanks to reliable communication, identification and coordination of logistics processes.

The key factor improving the functioning of businesses is transparency in the supply chain, understood as complete and trustworthy information provided in real time, about products in move within the supply chain. The increase in transparency in the supply chain is the main element of the strategy of businesses aiming to reduce the costs and improve efficiency. Better transparency translates into a more efficient control of logistics processes, along with maximized profits and reduced risk.

The GS1 system offers a series of standards, services and solutions designed to improve the efficiency and transparency of supply chains. These solutions provide a standard way of identification of goods, cargo, resources or locations, thus allowing to accurately specify where, at any point in time, the shipment is, and to share this information with other participants of the supply chain. The collaborating elements of GS1 system create a tool that allows the execution of the following functions:

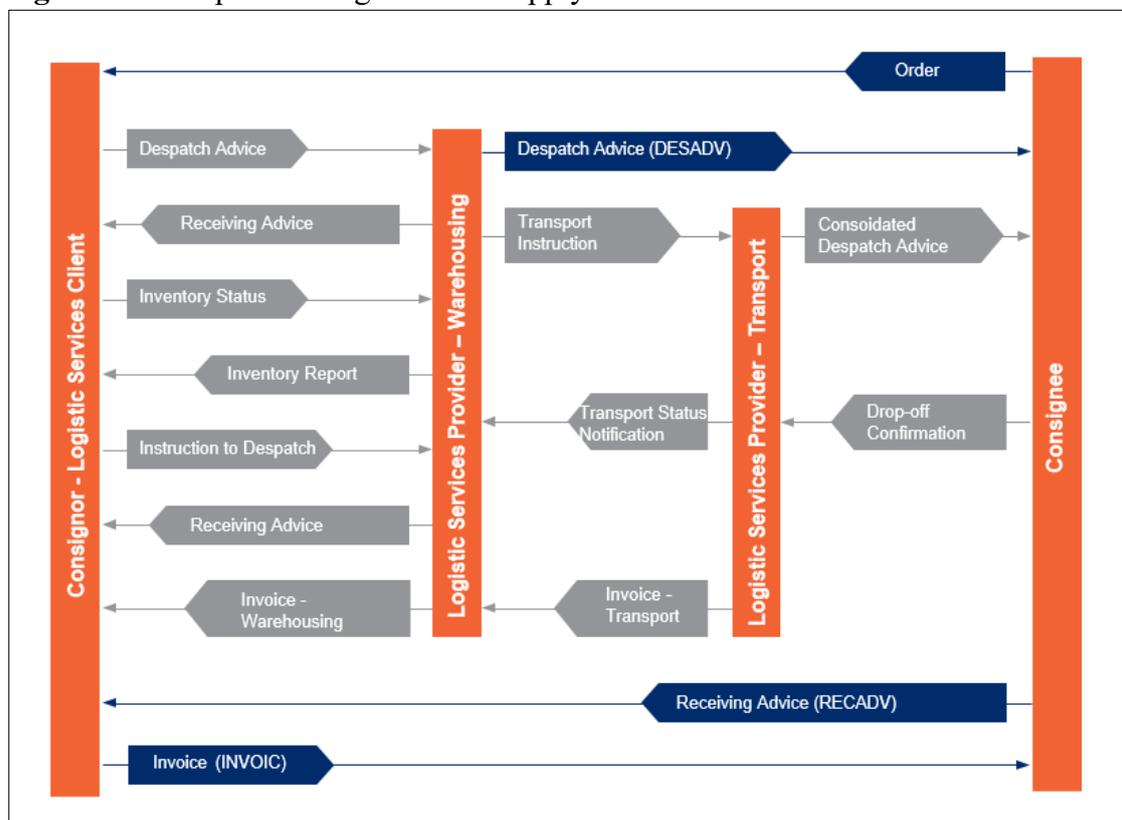
- unambiguous identification of objects moving within a supply chain,
- automatic capture and identification of data about the moving goods and cargo,
- sharing information about goods and cargo, and also about all events related to them, with other participants of the supply chain.

Currently, most businesses use various IT systems for managing business operations such as purchasing systems or finance and accounting systems. The data for these systems come from various documents, e.g. from a purchase order or from an invoice, and they must be uploaded and processed without any errors. The GS1 system's communication standards allow the automation of such transactions between business partners. Thanks to the use of GS1 global identifiers, the developed Electronic Data Interchange standards allow direct integration of the data collected, for example, when scanning the bar code from a pallet when accepting the goods into

a warehouse or when releasing them. They are the basis for generating electronic sales documents.

Electronic Data Interchange (EDI) is a way of transferring data between business partners, with the use of standard messages. (Fig. 6). The standard was created to systematize and align the way of sending information between businesses and institutions who exchange with each other hundreds, or maybe even thousands of documents, daily. These mechanisms are mostly used in trade relations (order documents, electronic invoices), but also for transport purposes (e.g. delivery notifications, transport status updates) and for finance purposes (wire transfers, accounting notes or correction invoices). Using EDI reduces the costs and streamlines the cooperation between trade partners within the entire supply chain. Orders can be processed with higher efficiency, invoices can be delivered more quickly and using electronic documents eliminates mistakes made when filling in data manually.

Figure 6. Example of using EDI in a supply chain



Source: own study on the basis of GS1 internal sources

Identification and communication standards play a special role in supply chains because they provide a codified base for transferring information, consequently streamlining transactions, facilitating coordination and ensuring efficient use of resources in the supply chain. Billions of times a day, the GS1 system connects physical objects, such as products, logistics units and locations with information on them supplied with the use of communication standards, thus ensuring transparency throughout the entire supply chain.

The specifics of the application of communication standards in the chain's distribution processes directly affects the flow of information with 4PL operators.

6. ANALYSIS OF THE IDENTIFIED INFORMATION AND INTEGRATION NEEDS IN RELATIONS WITH 3PL/4PL OPERATORS

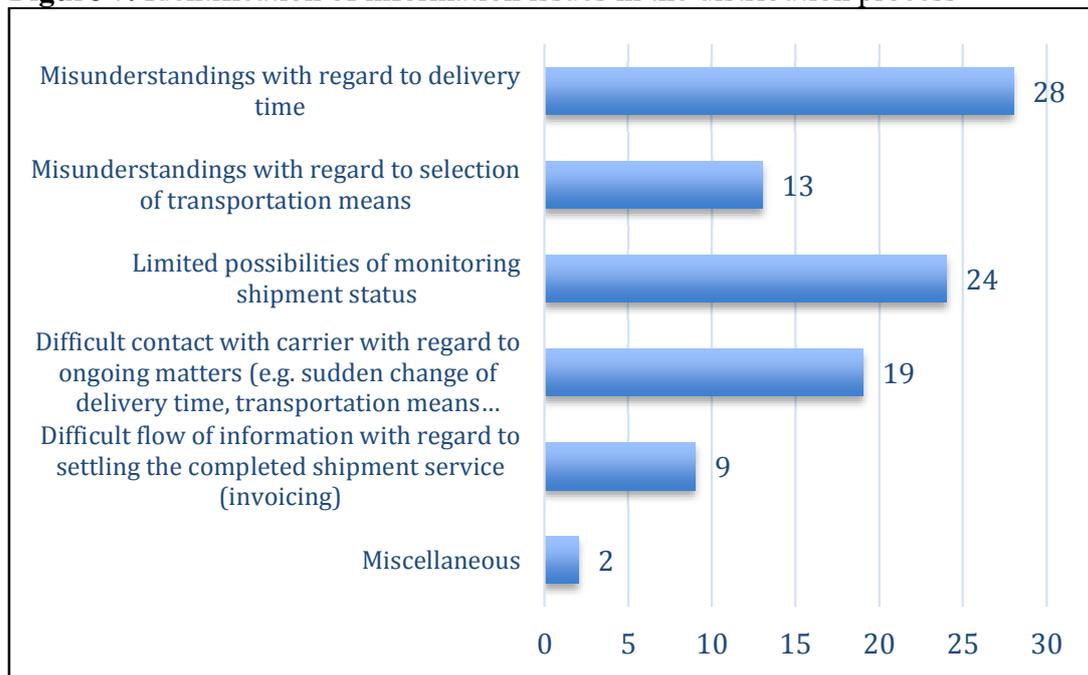
Regardless of the conducted research discussed in the paper's previous sub-chapters, the analysis of information and integration needs in the supply chain is a very important aspect, necessary to consider when identifying the possible uses of communication standards in collaboration with 3PL/4PL operators. This is a very important factor influencing both the efficiency of logistic processes and conflict situations (Turkalj, Fosić, Dujak, 2008) in the company and supply chain.

The research was conducted in Q3 and Q4 2017, in 76 businesses operating in the TSL sector. The research assumes that the concept of significance (importance) expresses the level or strength of conviction / certainty of the respondent with regard to the validity of the application of a given function in the efficient flow of information in the supply chain. A uniform mechanism of evolution has been established - based on a five-level Likert scale (Likert, 1932), supplemented with a zero level. The position of numerous research teams presented in the related literature shows that analyses based on Likert's scale assumptions are of quantitative nature (Elliott, Woodward, 2007; Gamst, Meyers, Guarino, 2008; Gatignon, 2013). The specific score meant:

- 0 – no significance of the problem,
- 5 – very high significance of the problem.

When analysing the conducted research, a conclusion should be made that 40 businesses declared that they are using shipping companies to distribute their goods to customers, constituting 52.6% of the examined sample. Figure 7 presents a detailed analysis of IT issues with the carrier in the distribution process. The results present the number of times specific issues were pointed out by the responders, given that multiple answers could be selected.

Figure 7. Identification of information issues in the distribution process



Source: own research

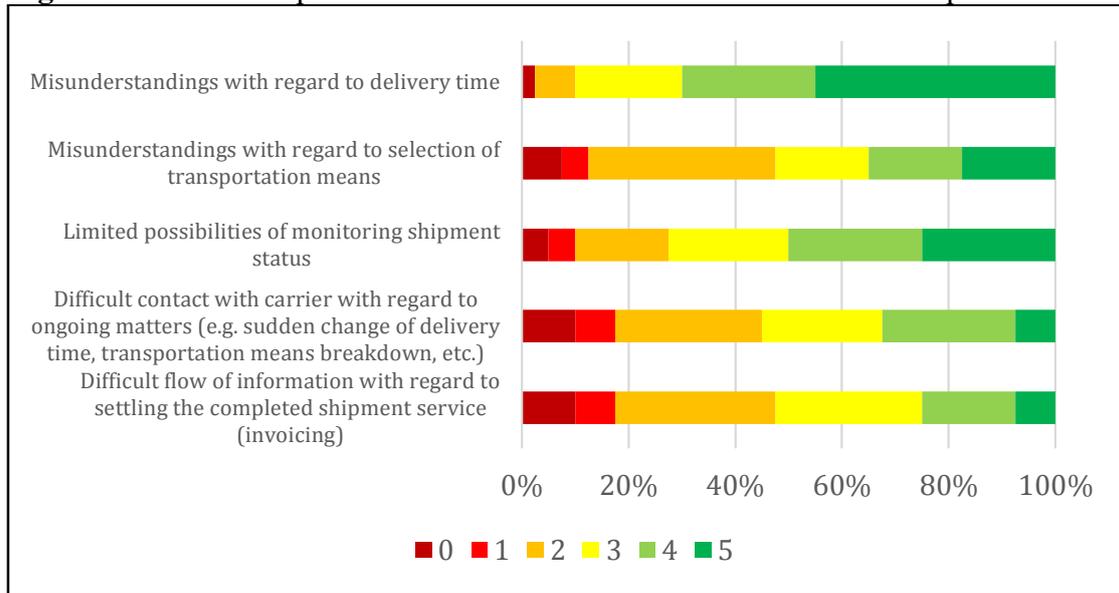
A conclusion should be made, following the analysis, that businesses identify two basic information issues with carriers with regard to their distribution process:

- misunderstandings with regard to delivery time (70% of businesses declaring that they use carrier services in their shipment process),
- limited possibilities of monitoring the shipment status (60%).

The conducted research allowed to identify the level of importance of specific issues in the flow of information. Figure 8 presents the analysis of the level of importance of the identified issues related to the flow of information in the distribution process.

When analysing the level of significance of information issues in distribution processes, it should be concluded that only two identified issues are highly significant from the perspective of economic practice (score of over 3.0 - average significance). Pursuant to the conducted analysis a conclusion should be made that businesses identify two basic information issues in the distribution process as significant ones:

- misunderstandings with regard to delivery time (70% of businesses declaring that they use carrier services in their shipment process) - high significance (4.00),
- limited possibilities of monitoring the shipment status (60%) - average significance (3.33).

Figure 8. Level of importance of information issues in the distribution process

Source: own research

Table 3 presents the detailed results of the significance level for the specific, analysed problems of efficient flow of information in the distribution process.

Table 3. Detailed analysis of the level of importance of information issues in the distribution process

Identified problem	Importance						Average value
	0	1	2	3	4	5	
Misunderstandings with regard to delivery time	1	0	3	8	10	18	4.00
Misunderstandings with regard to selection of transportation means	3	2	14	7	7	7	2.85
Limited possibilities of monitoring shipment status	2	2	7	9	10	10	3.33
Difficult contact with carrier with regard to ongoing matters (e.g. sudden change of delivery time, transportation means breakdown, etc.)	4	3	11	9	10	3	2.68
Difficult flow of information with regard to settling the completed shipment service (invoicing)	4	3	12	11	7	3	2.58

Source: own research

Summarizing the analysis of integration with a supply chain, a conclusion should be drawn that the identified information issues in distribution processes apply both to transportation and warehousing, which confirms the necessity to differentiate, in this way, the basic scope of evaluation of the efficiency of the distribution process and to develop a reference model of application of information standards in distribution processes realized by 4PL operators.

7. CONCLUSION

The application of communication standards in distribution processes is a phenomenon enjoying a growing popularity in the economic practice, both in Europe and globally. This is forced by the specifics of execution of distribution processes, where the end customer's requirements, directly impacting the level of service of the customer of the entire supply chain, play a key role.

The need for information integration within the realization of distribution processes between business partners seems necessary and this is the very reason for which the use of information standards positively affects the efficiency of logistics processes. Despite the current use of different information standards by different business partners, the information integration of the supply chain cannot be viewed from the perspective of the achieved goals, but rather the future-oriented direction of improvement of one's competitive position in the dynamically changing market. The conducted research shows that transport and warehousing processes, being the key aspects behind the efficiency of distribution processes, should be the main focus of further analysis.

In this chapter the authors focused on analysing the integration needs of business partners in the distribution process, based on relevant research projects carried out in the Poznań School of Logistics, the Institute of Logistics and Warehousing in Poznań and in GS1 Poland. Still, we should remember about trade-off connections existing with the supply process, which is also a part of cooperation between the businesses and 4PL operators. The next stage of research conducted by our research team is the development of a reference model of the possible applications of communication standards in logistics processes organized by 4PL operators.

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