ANALYSIS OF THE INFORMATION FLOW EFFICIENCY IN THE INTERMODAL SUPPLY CHAIN - RESEARCH RESULTS

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Abstract

The decision-making process depends on up-to-date and accurate data. This makes the efficient information flow in both the enterprise and the supply chain a key aspect of decision making. The selection of IT tools supporting management and decision-making has a direct impact on the efficiency of information flow in the enterprise and supply chain. In this article Authors have focused on the subject of information flow efficiency by identifying basic integration problems in the supply chain. The presented research methodology takes into account both literature analysis and business practice research on the basis of research projects (national and international) carried out at the Institute of Logistics and Warehousing and Poznan School of Logistics in Poland.

The conducted research concerns a specific type of supply chain, which handles intermodal transport operations. The choice of the supply chain typology is based not only on the complexity of intermodal transport processes, but also on the timeliness of the problem, both in terms of research and business practice. The research also included an analysis of the possibility of using IT systems supporting information management in enterprises and supply chains.

Key words: information flow efficiency, intermodal transport, IT management systems

1. INTRODUCTION

The constantly changing market and competitive conditions of companies force the management staff to continuously search for new projects optimizing the process of end-customer service. Therefore, one of the most important factors determining the competitiveness of companies is an effective and responsive decision-making process, short-time and based on current data. The managerial decision-making process is directly dependent on the efficiency of information flow in the company. An

effectively prepared information flow is aimed at supporting the decision-making process, which will directly affect the quickness and accuracy of the decisions being made, both in economic (Sliwczynski & Kolinski, 2016) and ecological terms (Golinska, et. al., 2015). To this end, IT systems are developed in companies, which together with the development of IT and communication technologies, as well as globalization, are supported by IT tools and systems supporting company management.

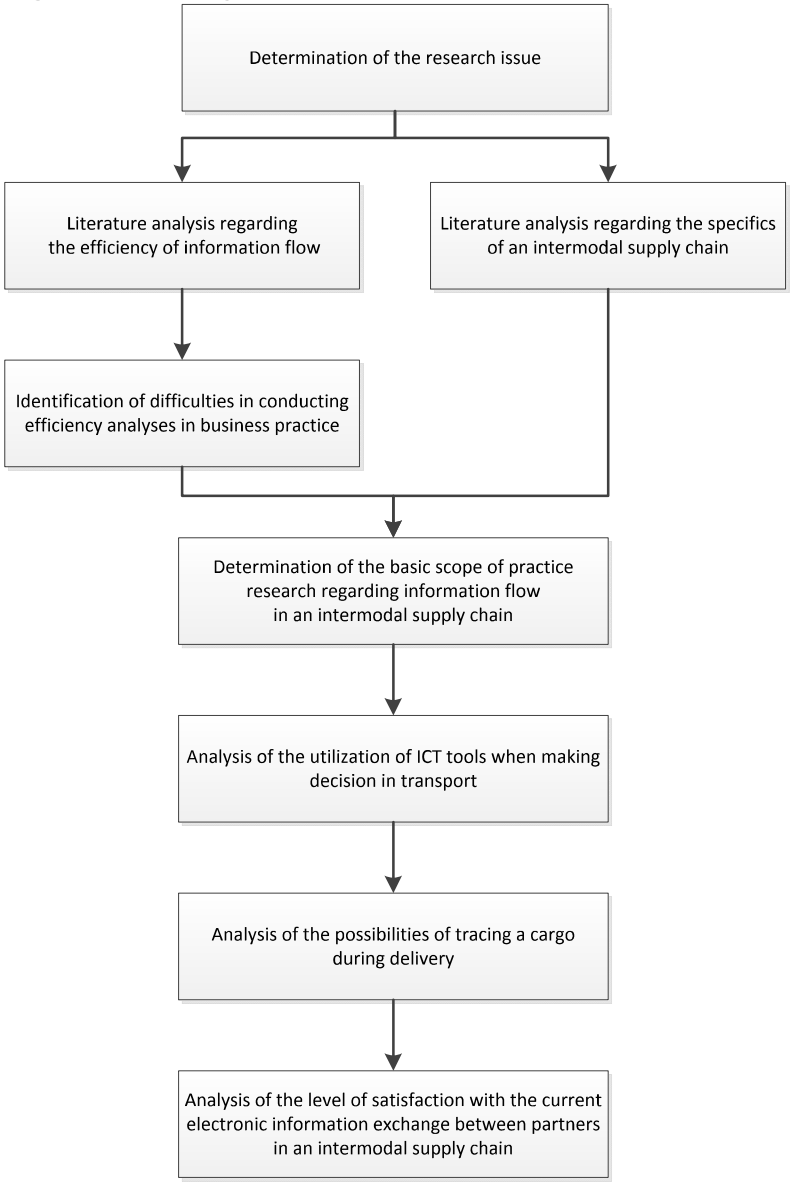
Analysis of the efficiency of information flow is not a simple matter, mainly due to the fact that definitions of the concept of efficiency are underdeveloped. This causes not only a scientific problem, but also a problem in economic practice. IT tools supporting company management and supply chain management are helpful, but the effectiveness of the application depends on the process approach when creating the company's information system. The issues of flow and integration of information in the supply chain are hampered by the specificity of logistic processes (Sliwczynski, Hajdul, Golinska, 2012) performed as well as by the new integration trends of the supply chain (Kärkkäinen, 2003; Hadas, et. al. 2015), in the form of the Internet of Things (Wortmann & Flüchter, 2015; Gubbi et. al. 2013), Blockchain (Dujak & Sajter, 2019) or industry 4.0 (Odwazny, Szymanska, Cyplik, 2018) and Physical Internet (Domanski, Adamczak, Cyplik, 2018). To summarize the above considerations it should be noted that the intermodal supply chain, taking into account the latest integration trends, generates complex problems related to the flow of information (Caris, Macharis, Janssens, 2013), mainly due to the complexity and network connections in the process relations of business partners, the application of various types of transport processes and the use of communication standards and formal procedures.

These considerations inspire the Authors to conduct in-depth research in order to identify the application of IT tools to improve the efficiency of information flow in relation with business partners in the intermodal supply chain.

2. RESEARCH METHODOLOGY

The methodology provided for conducting parallel literary and business practice studies. The studies were carried out both as part of research works carried out by the Institute of Logistics and Warehousing in the years 2016-2017. Figure 1 presents the methodology of the research works carried out.

Figure 1. The logic of the conducted research works



Source: own study

Due to the issues in question, two theoretical scopes have been distinguished, related to:

– the efficiency of information flow and information integration of partners in the supply chain,

– the specificity of an intermodal supply chain.

Theoretical research were supported by the identification of the needs of business practice, which has been carried out under the research and development project NSB Core - North Sea Baltic Connector of Regions. The structure of this chapter corresponds to the logic of the research works, compliant with the developed methodology.

3. THE PROBLEM OF CONDUCTING THE ASSESSMENT OF EFFICIENCY OF INFORMATION FLOW IN THE SUPPLY CHAIN

Efficient information flow in a company directly influences the accuracy of decisions made by management staff (Trojanowska, Varela, Machado, 2017). However, it should be remembered that not all decisions are optimal or effective, which may be caused by the following factors (Kisielnicki & Sroka, 2005, p. 18):

– making decisions by employees who do not have the appropriate information and gathering information by people who do not make decisions on the basis of it. In the first case, the risk of making a non-optimal decision increases. In the second one, the cost of information is incurred, which does not translate into the return on the decision,

– decision-makers' uncertainty as to the estimation of the return on decisions made on the basis of information acquired. This problem can be reversed and it can be said that decision makers lack information about the money and time that needs to be spent to obtain the information of a certain value. This means that decision makers often make non-optimal decisions due to the lack of data. This also means that decision makers often devote resources of the organization to obtain inappropriate information,

– excessive focus on easily accessible information, although sometimes of low value. Decision makers stop searching for information if they do not expect the additional effort to be compensated by a corresponding increase in the value of the information,

– the difficulty of controlling the cost and time spent by employees on acquiring information of a certain value. It is often difficult for the organization to determine whether an employee is an efficient or inefficient decision maker, i.e. whether a given employee could make a decision of a specific return faster and cheaper. For example, people sometimes assume that the more time and the higher the cost of information, the more certain or the more valuable is the decision made on the basis of it, but such a rule is not always true. This is because the phenomenon of fine tuning appears, i.e. increasing the quality above the expected level,

– multitasking nature of employees, as a result of which employees most often focus on making the decisions they are made accountable for, rather than those that bring real value to the company. Moreover, making multiple decisions in a short period of time requires employees to spend time for "switching" between decisions,

– devoting excess time and money to multiple transfers of the same information within a group of people and agreeing on the decisions to be made when at the same time the probability of estimated return on the decision is not increased and no new decision with a higher return is found. This is particularly the case when

a group of employees is not integrated and has no established decision-making path, e.g. when an emergency situation appears. In such a case, the same information is being repeatedly analyzed and the same options of actions are being considered.

The specificity of the information flow process hinders the already complex efficiency issue. The concept of efficiency has not been clearly defined so far. The literature on the subject provides various interpretations and approaches to the efficiency of processes taking place both in the company (Rummler & Brache, 2000; Zheng, Liu, Bigsten, 2003; Prabowo, et. al 2014; Doumeingts & Ducq, 2001; Nikoomaram, Mohammadi, Mahmoodi, 2010; Yiu, Wing, Hong, 1999; Golik, Khasheva, Petrovich, 2015; Perroni, et. al 2017; Fraccascia, Albino, Garavelli, 2017) and in the supply chains (Mishra 2012; Lichocik & Sadowski 2013; Geunes et al. 2016; Brandenburg 2016; Sohrabpour et al. 2016; Nikfarjam, Rostamy-Malkhalifeh, Mamizadeh-Chatghayeh, 2015; Yoo, et. al. 2017; Liang, et al. 2006; Gunasekaran, Patel, McGaughey, 2004; Stephens, 2001; Beamon, 1999). The presented definitions and concepts of efficiency do not usually exclude one another, but constitute a complementary whole or inclusion of another analytical aspect. Table 1 shows the differences in definitions between efficiency and productivity, effectiveness, profitability and reliability.

Table 1. Substantial differences between efficiency, productivity, effectiveness and profitability

efficiency	The ratio of the utility effect and the expenditures incurred to obtain it.
productivity	The ratio of total production (of goods or services), achieved by a subject (employee or group of employees, technical equipment, plant, etc.) to total time of its work. Productivity is a feature of the subject involved in the production process (e.g. employee, machine, etc.) and is not affected by whether the manufactured products are sold or not.
effectiveness	The degree to which the system has achieved its objective. Effectiveness is measured by the ratio of the result achieved (e.g. output achieved) to the result assumed (e.g. planned production output).
profitability	The ratio of the profit achieved by the enterprise to the value of sales, value of assets or value of the capital. It is then referred to as the profit rate (profitability on sales), profitability on assets held or profitability on capital involved, respectively. The analyzed profitability ratios may include various types of profit: gross profit, net profit and operating profit. Since the main purpose of conducting business activity is to generate profits, profitability ratios play a very important role in the assessment of the functioning of a company.
reliability	Ability to perform supporting task under set conditions for a specified period of time, without any failures.

Source: own study based on: (Ostroff & Schmitt, 1993; Foster, et. al., 2008; Nowakowski, 2008; Trojanowska, Kolinski, Varela, Machado, 2017)

The studies of commercial practice also confirm the conclusions of the literature analysis. The decision-making ambiguity in the field of analysis and assessment of efficiency hinders its comprehensive application in practice. The study was conducted in the first half of 2016 and was attended by 152 logistics companies from Wielkopolskie Voivodeship, the enterprises represented both the sector of SME and large enterprises. Periodically conducted studies concerning the degree of use of efficiency analyses in companies indicate that about 50% of Polish companies use the efficiency analyses, of which only about 30% of companies perform an efficiency analysis of the processes taking place throughout the company. This proves not only the insufficient use of the efficiency analyses in practice, but also the low level of integration of the information flow in the company.

The identification of difficulties in comprehensive utilization of efficiency analysis of logistic processes in business practice also indicates the significance of the problem of information flow in the company and supply chains. Table 2 shows the identified difficulties in the utilization of logistic processes efficiency analyses in practice. The companies surveyed had the opportunity to identify more than one difficulty in conducting efficiency analyses.

Table 2. Difficulties resulting from a reliable analysis of the efficiency of logistics processes

No.	Problem	Share %
1	**Problems with flow of current information between company departments and in the supply chain**	**29%**
2	Problems related to implementation of the strategy chosen by the company or supply chain	7%
3	Problems with a reliable identification of actual needs and efficiency of logistics processes	11%
4	**Difficulties in collecting appropriate data for the conducting of efficiency analysis**	**9%**
5	**Lack of IT tools supporting the analysis and assessment of process efficiency**	**10%**
6	**Difficulties in correct interpretation of the implemented management tools (confusion of concepts)**	**7%**
7	**Problems with translating the strategic goals into operation plans and current plans**	**11%**
8	Problems associated with planning of an even load for the resources used in the logistics process	7%
9	**Lack of a person/department responsible for making such analyses**	**9%**
Total		100%

Source: own study

These studies only confirm the predominant opinion that efficiency analysis is a complicated process and one that is difficult to apply in practice. One should also turn attention to the fact, that approx. 75% of the identified problems are related to the flow of information within a company. This is mainly caused by difficulties in the flow of up-to-date information within the company, as well as within the supply chain.

The above studies allow us to state that the analysis of efficiency requires a comprehensive approach, both from the point of view of the concept of its performance, as well as IT solutions supporting the decision-making process (Trojanowska, Varela, Machado, 2017; Hadas, Cyplik, Adamczak, Domanski, 2015). There is a need for comprehensive tools and methods in the literature of the subject and in business practice, which facilitate quick response to changes in the market environment, while ensuring the efficiency of the logistics process in the supply chain.

These premises, theoretical as well as current studies of business practice, have led the Authors to deepen the research on the use of IT tools to improve the efficiency of information flow.

4. SPECIFICITY OF AN INTERMODAL SUPPLY CHAIN

There are many definitions of intermodal transport, and this type of transport involves moving loads using more than one mode of transport. The main part of the route is carried out by rail, inland or maritime (Fransoo & Lee, 2013) and the initial and/or final section is carried out through as short as possible section by road transport (Woxenius, Bärthel, 2008) and the whole process is carried out in an integrated transport unit.

A similar definition has been developed jointly by the European Conference of Ministers of Transport (ECMT), European Commission and the Economic Commission for Europe at the UN, which consider intermodal transport as the carriage of goods in one and the same transport unit or road vehicle, sequentially using two or more modes of transport without reloading of the goods, using the changing modes of transport (Wagener, 2014).

The intensification of transport implemented with the use of intermodal transport is connected with development of container transport. This process of a large, international scale began between the 1960s and 1970s, which was mainly due to the existence of so-called "bottlenecks" when the cargo was changing the means of transport (Golinska & Hajdul, 2012). This problem resulted in the need to handle too many cargo batches at the same time, which needed a place for storage, which consumed a lot of space and generated a number of additional costs for the carriers. The number of these parties continued to increase, which was related to the intensification of the global economy and the constant development of international transport (Martínez-López et al. 2018). For these reasons, problems have started to arise within the scope of efficient handling of loads transported by different modes of transport (Wang, et al. 2018; de Miranda Pinto et al. 2018).

The solution to the above mentioned problems was the introduction of containers with high load-carrying capacity into service and the standardization of parameters relating to the dimensions or load capacities. Thanks to this, the process of cargo

transport has been completely changed, it has been accelerated, the costs (Hanssen, Mathisen, Jørgensen, 2012) as well as the risk of damage to goods has been reduced. Container transport has also led to an intensive development of intermodal transport, which has been mainly influenced by the incorporation of rail containers to the transport system.

Currently, the most common intermodal supply chain is intercontinental transport of cargo by container ships, where the transport of containers to the port of loading and transport of containers from the port of destination to the recipient is carried out on railway platforms. In the case of such deliveries, the mode of transport is changed twice; in sea ports (ship - wagon) and in the final intermodal terminal (wagon - vehicle) (Zhang, Ioannou, Chassiakos, 2006; Monios & Wilmsmeier, 2013; Šakalys & Batarlienė, 2017).

The use of different means of transport causes additional costs generated by intermodal transport, connected with the logistical handling of the process as well as the physical movement of the loading unit related with reloading (Caris, Macharis, Janssens, 2008). For this reason, intermodal logistics is more complicated than simple transport from point A to point B. The container requires additional operations, for example, it may remain without use for some time. Intermodal transport, however, makes it possible to exploit the best characteristics of the various modes of transport. Also due to transport units. It also makes it possible to transfer cargo from road to rail and inland waterway type of transport. The use of this mode of transport depends on the distance between the place of loading and the place of delivery, and the use of intermodal transport makes sense only when a certain transport distance is exceeded (Caris, Limbourg, Macharis, van Lier, Cools, 2014).

Intermodal transport has a number of features that make it very different from other modes of transport, in particular multimodal and combined transport, such as:

- the use of means of transport of at least two modes of transport, for example trucks and railways or trucks and ships,
- concluding a single contract (document) between the carrier and the service purchaser, which concerns the intermodal transport,
- transport of goods using this type of transport from one country or customs territory to another,
- the involvement of only one carrier in the transport, who shall carry out the transport from the place of receipt of the goods to the place of their delivery,
- the necessity of creating cargo units, which concerns the fact that the transported cargo is subject to various types of manipulations, including, for example reloading, together with the entire unit, i.e. the means of transport.

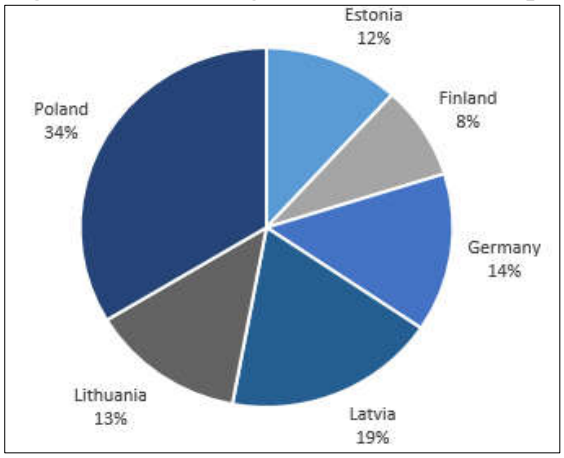
Current environmental trends and the activities of the European Union are contributing to the growing importance of intermodal transport among other modes of transport. Communication between actors in the supply chain is an important element in the development of intermodal transport. Actors in the supply chain have operating systems at their disposal to support internal processes, however the integrated circulation of information between partners is becoming increasingly important.

5. STUDIES ON THE POSSIBILITY OF USE OF IT SYSTEMS IN INTERMODAL SUPPLY CHAIN

5.1. Characteristic of responders and Research scop

The study has been carried out as part of the NSB Core - North Sea Baltic Connector of Regions research and development project, on a deliberately selected sample representing the logistics services sector, in six countries. The largest number of questionnaires have been carried out in Poland 34% and Latvia 19%, the percentage share is distributed fairly evenly across the rest of the countries and amounts to 14% Germany, 14% Lithuania, 12% Estonia, 8% Finland. The data are shown in Figure 2.

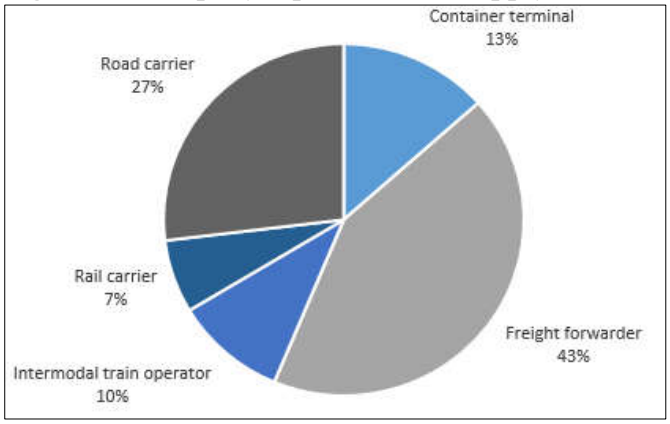
Figure 2. Percentage share of countries participating in the survey - total



Source: NSB Core survey

The research sample consisted of 119 service providers of diversified nature of the business activity. Most of them were forwarding agents representing almost 43% of the surveyed population, road hauliers were represented by 27% of the survey participants and container terminal operators by 13.4% of the respondents. 10% of the respondents were intermodal operators. The least numerous were the railway operators, whose share in the sample amounted to 6.7%. The data are shown in Figure 3.

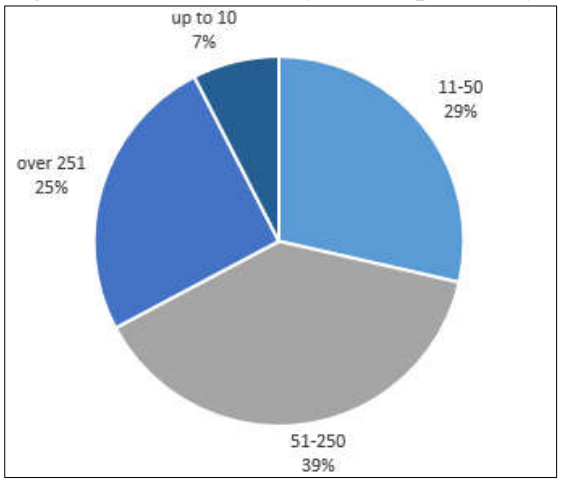
Figure 3. Company's position in a supply chain - total



Source: NSB Core survey

When analyzing the employment, it should be stated that the largest segment were medium enterprises, employing from 51 to 250 employees. The share of large enterprises was 25.2%, and of micro and small enterprises – 36.1%. This ratio is similar in terms of the size of the company taking into account the annual turnover. The companies participating in the survey were represented by senior and middle managers, most often employees employed at the level of managers responsible for operational activities. The characteristics of research sample is presented in Figure 4.

Figure 4. Size of surveyed companies by number of employees



Source: NSB Core survey

The survey questionnaire consisted of 4 closed-ended questions which were answered by the respondents by choosing one of the available answers. The first three questions were designed to examine to what extent and for what purpose the actors in the intermodal supply chain use ICT tools. The last question identified the level of satisfaction with the current exchange of information between respondents.

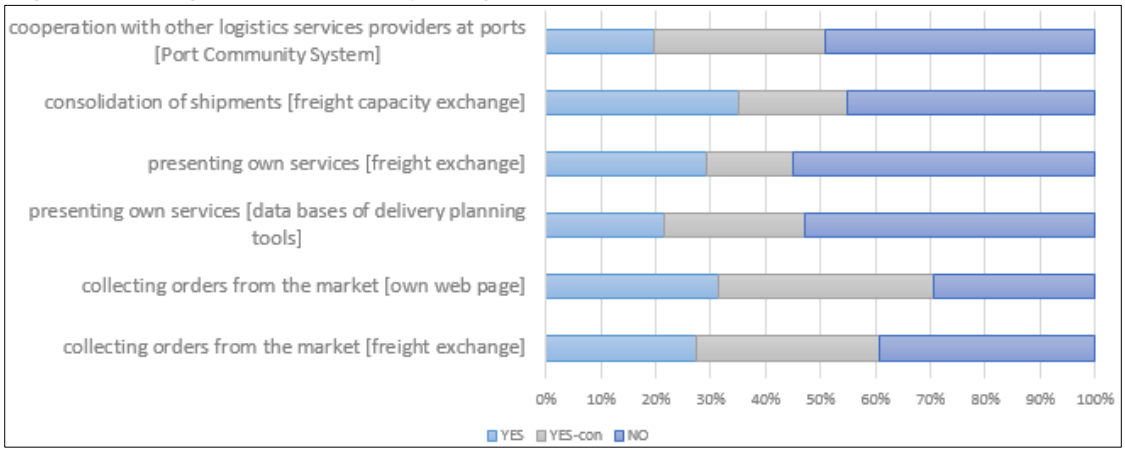
– does your company use ICT tools to assist decision-makers in the following fields related to transport? (all respondents)
– do you offer your clients track and trace services on each segment of journey? (freight forwarder)
– do you offer your clients track & trace services? (intermodal operator)
– please evaluate the quality of existing system for exchanging electronic messages and documents between your company and the following categories of logistics service providers? (all respondents).

5.2. Use of ICT tools to support decision making in transport

When responding to a question related to the use of ICT tools supporting the process of making decisions connected with transport, the respondents could choose one of three answers: YES, YES-con (applicable in case of container transports), NO. The questions answered by the respondents depended on the nature of their business activity.

The figure below shows the questions which were answered by the forwarders together with the percentage share of each of the selected answers. The results of the study are characterized by a low degree of differentiation. About half of respondents confirmed that they use ICT tools for cooperation with other LSP at ports (Port Community System), consolidation of shipments, presenting own services (data bases of delivery planning tools; freight exchange). Most often, ICT tools are used by a forwarder to collect orders form the market (own page) - more than 70% and by freight exchange - more than 60% (Figure 5).

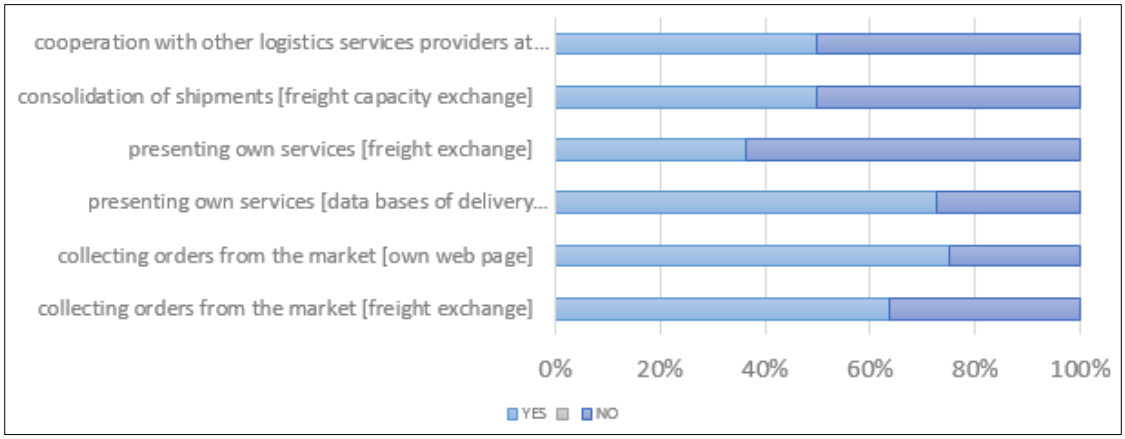
Figure 5. Usage of ICT tools by freight forwarder



Source: NSB Core survey

The next figure shows the questions which were answered by the intermodal operators together with the percentage share of each of the selected answers. The results of the study are characterized by a medium degree of differentiation. About half of the respondents confirmed that they use ICT tools for cooperation with other LSP at ports (PCS), consolidation of shipments. Most often, ICT tools are used for presenting own services (data bases of delivery planning tools) - more than 70%, collecting orders form the market (own page) - also more than 70% and by freight exchange - more than 60%. The least frequently, however, for presenting own services (freight exchange), about 35% of the respondents have chosen this answer (Figure 6).

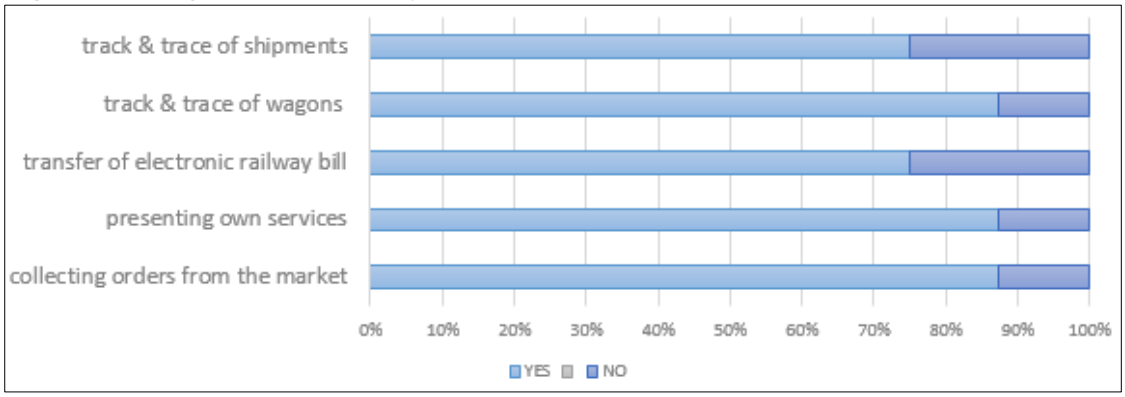
Figure 6. Usage of ICT tools by intermodal operator



Source: NSB Core survey

The figure below presents the analysis of questions which were answered by rail carriers together with the percentage share of each of the selected answers. The results of the study are characterized by a small degree of differentiation. It is worth noting a very high percentage of ICT tools used to support decisions related to the implementation of the transport process. Approx. 75-88% of the respondents replied in affirmative to all questions. (Figure 7).

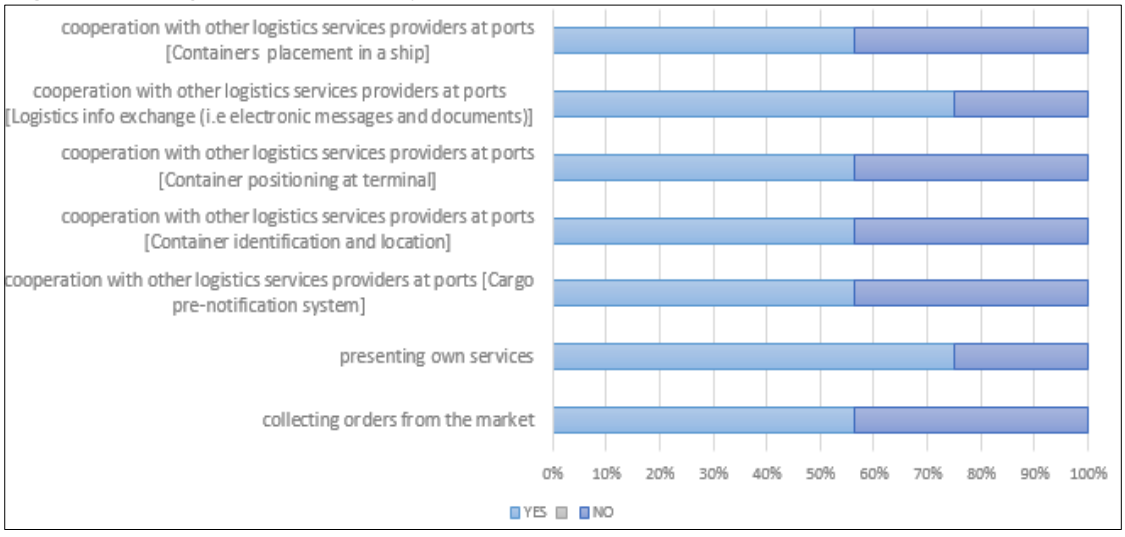
Figure 7. Usage of ICT tools by rail carrier



Source: NSB Core survey

The figure below presents the analysis of questions which were answered by container terminals representatives together with the percentage share of each of the selected answers. The results of the study are characterized by a small degree of differentiation. Approx. 75% of respondents indicated that they use ICT tool for support of cooperation with other logistics services providers at ports [Logistics info exchange (i.e electronic messages and documents)] and presenting own services. The remaining questions have been answered in the affirmative by about 55% of respondents (Figure 8).

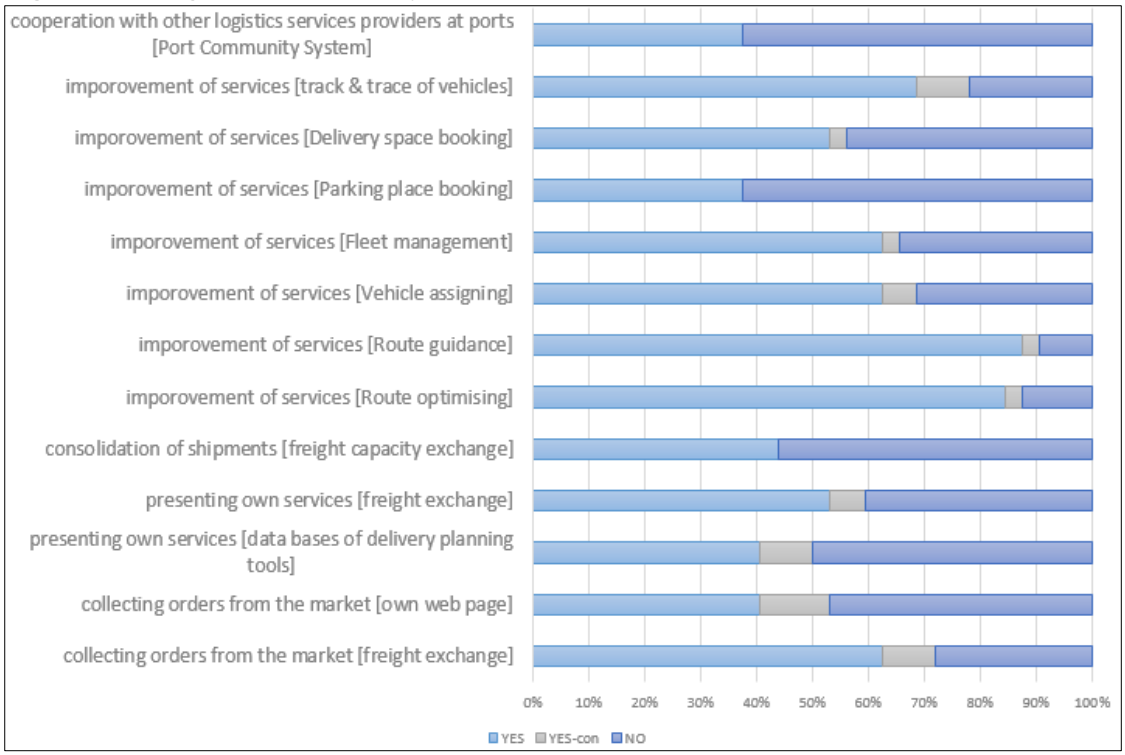
Figure 8. Usage of ICT tools by container terminal



Source: NSB Core survey

At the next stage of the study, questions were answered by the road carriers, presented together with the percentage share of each of the selected answers. The results of the study are characterized by a significant degree of differentiation. The least frequently, ICT tools are used by respondents to support improvement of service (parking lace booking) - approx. 37% and consolidation of shipments (freight capacity exchange) - approx. 43%. On the other hand, the largest number of respondents have selected two answers, the improvement of services (route guidance) - more than 90% and the improvement of services (route optimizing) - approx. 88% (Figure 9).

Figure 9. Usage of ICT tools by road carrier



Source: NSB Core survey

In the conducted studies, it can be noted that the respondents show frequent use of ICT tools for supporting decision-making processes related to transport. To the greatest extent - as much as around 80% on average - in the case of a railway carrier, while the responses given by the remaining respondents are characterized by diversification ranging from approx. 35% -90% with a majority of responses above 50%.

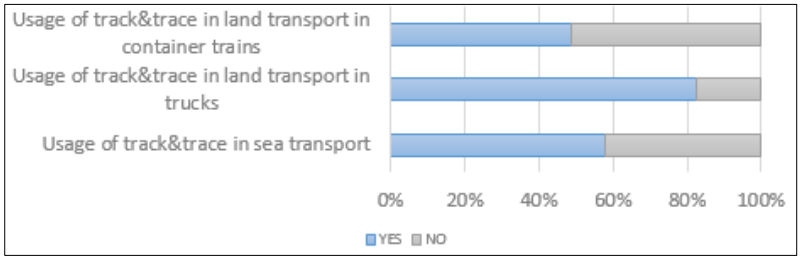
5.3. Frequency of offering truck & trace services

The scope of research related to offering cargo tracking services during delivery was carried out among respondents representing freight forwarders and intermodal operators. Freight forwarders answered three questions and intermodal operators answered one of them, choosing one of the two answers: YES, NO.

Most often, the service of shipment tracking is offered by a forwarder on a section executed by means of road transport - more than 80% of cases, the least

frequently on a section executed by means of rail transport - less than 50%. Figure 10 provides a complete summary.

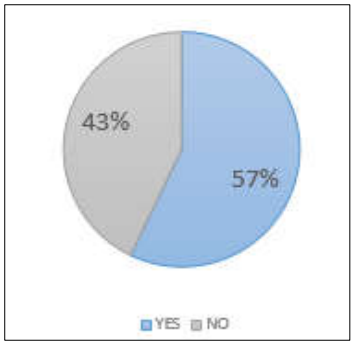
Figure 10. Frequency of offering truck & trace services by freight forwarder



Source: NSB Core survey

The graph below shows the frequency with which an intermodal operator offers cargo tracking to its customers, the availability of this service was confirmed by 57% of the respondents (Figure 11).

Figure 11. Frequency of offering truck & trace services by intermodal operator



Source: NSB Core survey

Based on the survey results, it can be concluded that for an average of 60% of the transports, logistics operators offer the possibility of tracking the cargo. However, the tracking service is best developed for road transport, in more than 80% of cases respondents confirmed the availability of this service.

5.4. Level of satisfaction with the existing electronic exchange of information between actors in the intermodal supply chain

At the last stage of the study, the respondents have evaluated the quality of the existing system of exchange of electronic messages and documents between their company and the indicated categories of logistic service providers, using one of the three possible answers:

– satisfactory - if the level of information exchange is satisfactory,

– not satisfactory - if the level of information exchange is not satisfactory,

– not existing - no electronic exchange of information between partners.

A forwarder was the most satisfied with the electronic communication with the road carrier - as many as 63% of the respondents have chosen this answer, then with the container terminal - 43%. The least satisfactory (18%) or specified as non-existent

(47%) was the electronic data exchange between a forwarder and an intermodal operator. The total results of the questionnaire are shown in table 3.

Table 3. Freight Forwarder's level of satisfaction with electronic data exchange with others supply chain participants

level of satisfaction	intermodal train operator	rail carrier	container terminal	road carrier
Satisfactory	18%	24%	43%	63%
NOT satisfactory	35%	37%	29%	27%
NOT existing	47%	39%	27%	10%

Source: NSB Core survey

In the group of respondents representing container terminals, the degree of satisfaction with electronic exchange of information with other participants of the supply chain was at the highest level of 50% in case of cooperation with intermodal train operator. The cooperation with the rail carrier and the container terminal was equally highly rated and chosen by 44% of the respondents. The total results of the questionnaire are shown in table 4.

Table 4. Container terminal's level of satisfaction with electronic data exchange with others supply chain participants

level of satisfaction	intermodal train operator	rail carrier	container terminal	road carrier
Satisfactory	50%	44%	44%	38%
NOT satisfactory	31%	25%	31%	38%
NOT existing	19%	31%	25%	25%

Source: NSB Core survey

The table below shows the level of satisfaction with the electronic data exchange between the intermodal operator and the other actors in the supply chain. The highest level of satisfaction has been identified in cooperation with the road carrier 50%, slightly lower but still high 42% in the case of the intermodal rail operator and the road guide. As the least satisfactory, the exchange of information with the container terminal has been indicated - 33%. The total results of the questionnaire are shown in table 5.

Table 5. Intermodal operator's level of satisfaction with electronic data exchange with others supply chain participants

level of satisfaction	intermodal train operator	rail carrier	container terminal	road carrier
Satisfactory	42%	50%	33%	42%
NOT satisfactory	33%	25%	50%	33%
NOT existing	25%	25%	17%	25%

Source: NSB Core survey

Among all respondents, the road carrier proved the highest level of satisfaction connected with the electronic exchange of information, 63% of respondents have chosen the communication with an intermodal operator as the most satisfactory, while in the case of the rail carrier and the container terminal it was 50%. The total results of the questionnaire are shown in table 6.

Table 6. Rail carrier's level of satisfaction with electronic data exchange with others supply chain participants

level of satisfaction	intermodal train operator	rail carrier	container terminal
Satisfactory	63%	50%	50%
NOT satisfactory	13%	13%	0%
NOT existing	25%	38%	50%

Source: NSB Core survey

In the group of respondents representing road carriers, the degree of satisfaction with electronic exchange of information with other participants of the supply chain was at the highest level of 66% in the case of cooperation with an intermodal operator, cooperation with a railway carrier was assessed positively by 31% of the respondents. Cooperation with the container terminal, on the other hand, was assessed as unsatisfactory 19% or non-existent 53%. The total results of the questionnaire are shown in table 7.

Table 7. Road carrier's level of satisfaction with electronic data exchange with others supply chain participants

level of satisfaction	intermodal train operator	rail carrier	container terminal
Satisfactory	66%	31%	22%
NOT satisfactory	22%	19%	25%
NOT existing	13%	50%	53%

Source: NSB Core survey

Over the next several years, in accordance with the assumptions of the EU development policy, the main modernization effort will be directed at removing the development barriers of intermodal transport, which in practice will require undertaking numerous infrastructural investments aimed primarily at modernization of all transport branches and increase of mobility and spatial integration of regions. Among the many projects planned for implementation, the urgent need to expand the existing network of reloading terminals should be singled out. Investments in the development of maritime nodal infrastructure and road-rail terminals in the TEN-T network are particularly important.

Turning to the results of the survey, it should be stressed that the respondents, regardless of the nature of their activity, classified the following as the main barriers hindering (although not as strongly as initially assumed) the development of intermodal transport: high operating costs (related, among others, to the use of railway infrastructure) and too long delivery times. Only in the case of the assessment of the

importance of the underdeveloped inland container terminal network was it noted that the opinions of the respondents varied quite strongly depending on the type of business conducted. It turns out that the above factor is a much more important development barrier for road carriers and forwarders than for managers of container terminals. It can be assumed that in the case of terminals, there is a concern that further development of nodal infrastructure (adding new locations) will lead to the emergence of alternative cooperation offers on the market, which will significantly intensify the current fight for customers.

6. CONCLUSION

Analysis of the efficiency of information flow in supply chains is a current problem both in terms of theoretical work and the needs identified in business practice on an international scale. This research confirms the need for support with IT tools supporting decision making, which has a direct impact on the efficiency of implemented logistic processes in supply chains.

In the course of their research, the authors focused on the specifics of the intermodal supply chain as a representative of this type of supply chains, which requires comprehensive IT and information support, additionally taking into account the international range of the chain's impact. An intermodal supply chain requires both process and information integration, which makes the research carried out useful in the development of research works on other types of supply chains and networks.

The direction for further research carried out by the Authors and the research team is the information integration in an intermodal supply chain, both through the integration of operational activities in logistic processes, as well as the information integration of IT systems supporting the management of a company and the supply chain. The expected effect of operational and information integration of the supply chain is the increase in the efficiency of logistic processes also in the financial perspective, therefore this aspect is also an important direction of further research.

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