INFLUENCE OF EDI APPROACH FOR COMPLEXITY OF INFORMATION FLOW IN GLOBAL SUPPLY CHAINS

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Abstract

The information flow in the supply chain is one of the key elements for logistics process efficiency. Supply chain information integration is a current issue in terms of both literature and business practice. This is often due to the use of different IT systems supporting management by business partners in the supply chain. One of the ways of integrating IT systems in the supply chain is the EDI implementation, which supports the exchange of electronic documents between business partners, while minimising the time of information flow as well as cooperation costs. The EDI implementation also influences the operational efficiency of logistic processes through minimising errors caused by faulty information flow. The article's objective is to show the complexity of information flow in global supply chains and how traditional EDI approach has changed through all these years to face new challenges. The authors try to explain, what are the different alternatives companies have and what is the future of data interchange in supply chains. The presented methodology takes into account both literature analysis and business practice research, based on research projects (domestic and international) carried out at the Institute of Logistics and Warehousing and experience with EDI implementations in companies carried out at Capgemini.

Key words: EDI, integrated supply chain, information flow efficiency

1. INTRODUCTION

Excellent communication and coordination are now increasingly necessary and transported goods cross more borders than ever before. In order to effectively support logistics areas, IT systems must enable easy communication with various contractors. An information system should therefore be required to be able to support not only its own data format but also the ability to communicate with all partners in the supply chain.

The flow of information between business partners in the supply chain is currently one of the key factors influencing the logistics process efficiency. The speed of information flow and focus on its detail and availability in the current time have resulted in the constant research and development of solutions to improve the integration process, both in scientific research and in business practice.

The use of EDI-based solutions is now more and more frequently used in business practice, as evidenced by research conducted by the authors within the framework of research projects carried out by the Institute of Logistics and Warehousing, as well as implementation works carried out by Capgemini. The article's objective is to show the complexity of information flow in global supply chains and how traditional EDI approach has changed through all these years to face new challenges. The authors decided to extend their research in order to identify the currently applied concepts of using EDI in logistic processes and to clarify the definition in scientific terms.

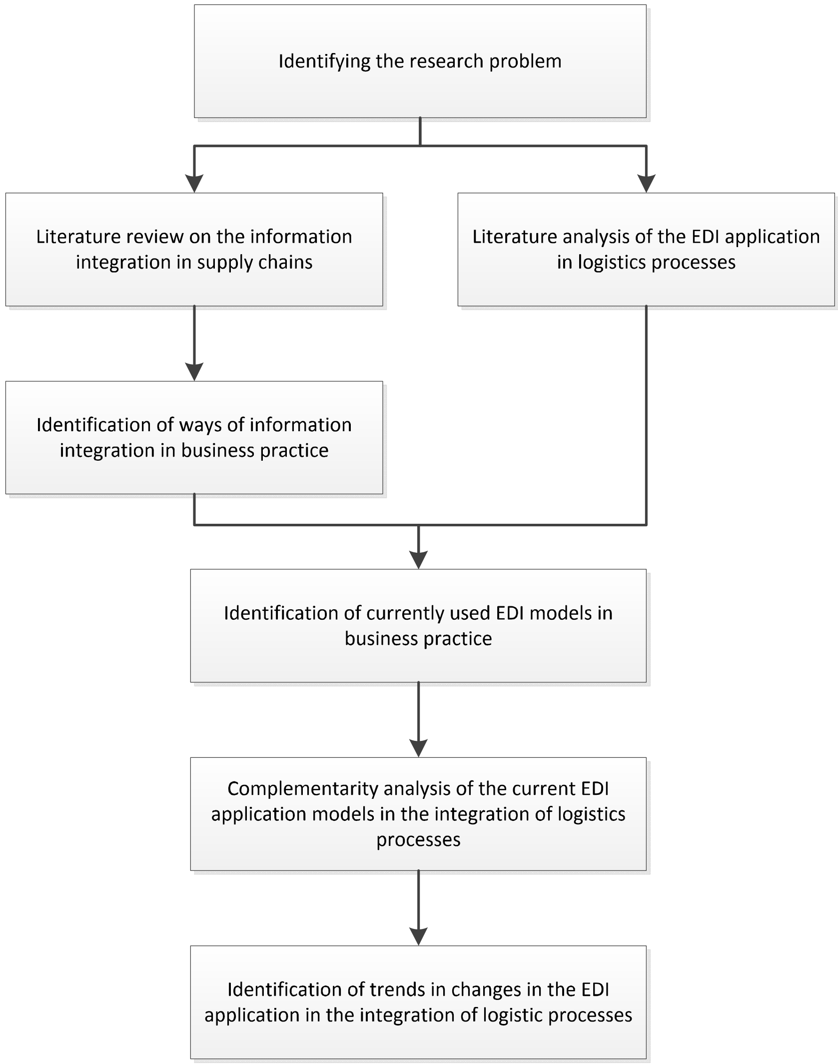
This paper discusses the efficiency of information flow in enterprises and supply chains, using IT support as an effective tool to support management decisions. The research carried out only confirms the need to standardize the use of IT tools of enterprises and suggests the development of comprehensive models (Stajniak & Guszczak, 2011) for monitoring the information flow in the logistics processes of enterprises in the supply chain. This paper presents the preliminary results of ongoing research on improving the models for using EDI in logistics processes implemented by various business partners in the supply chain.

2. RESEARCH METHODOLOGY

The presented analysis of the use of EDI in the integration of logistics processes in the supply chain is based on many years of research and development projects carried out by the Institute of Logistics and Warehousing as well as EDI implementation projects in companies carried out by Capgemini. Figure 1 illustrates the general methodological logic of the research work carried out in this area.

The research logic shown in the figure is consistent with the structure of this paper. The specificity of the subject discussed forced to take into account mainly practical knowledge, which has not been ordered in methodological and scientific terms so far. Literature support concerns various links of the subject matter, not necessarily directly connected with the use of EDI, but based on the analysis of information integration in the supply chains. In addition, it proves that there are few references to literature and that it is necessary to organize literature in this field.

Figure 1. Research methodology for the use of EDI in supply chains



Source: own study

3. COMPLEXITY AND GLOBALITY OF MODERN AND INTEGRATED SUPPLY CHAINS – LITERATURE AND BUSINESS REVIEW

The complexity of today transport and logistics chains needs a fast and reliable information exchange system to ensure an efficient and cost optimized logistics solutions. This is evidenced by the numerous literature references to electronic data exchange, both in technological (Bolisani & Scarso, 1999; Swatman & Swatman, 1992; Reekers & Smithson, 1996; Lu, Tsai & Chou, 2001) and economic terms (McLaren, Head & Yuan, 2002; Threlkel & Kavan, 1999; Nurmilaakso & Kotinurmi, 2004; Moberg, et al. 2002; Walton & Gupta, 1999). Research on the implementation of EDI has been carried out over many years (Collins, 1993; Riggins & Mukhopadhyay, 1999; Lee & Lim, 2005; and shows a diversified range of sectors and industries (Klein, 1995; Laage-Hellman & Gadde, 1996; Angeles, et al., 2001; Kim & Lee, 2008; Bernardes & Miyake, 2016; Bahija, Malika & Mostapha, 2016;

Okano et al., 2017) where it can be applied. It is also possible to find confirmation of EDI implementation efficiency in business practice (Rao, et al., 1995; Maltz & Srivastava, 1997; Lee, & Han, 2000; Lee, Lee & Kang, 2005; Zhou et al., 2018) The scientific literature focuses on the search for a solution that supports current technological trends in the integration of supply chains. Today's supply chains are far more complex due to globalization and also an integrated services offered by LSP's (Logistics Service Providers) and big logistics players including supply chain maintenance and coordination (Prajogo & Olhager, 2012; Kawa, 2012). It requires a full engagement of LSP into customer's businesses with full understanding of their processes and business objectives. As for information flows LSP which maintain the logistic part of business they're responsible for communication towards other LSP's like carriers, cross-docks, Sea and Air transportation, rail and in-land water carriers and warehouses. These are not all entities involved in such integrated model which is nothing else like fourth party logistics and even fifth party logistics taking into consideration all electronic integration aspects (Kawa & Zdrenka, 2016). On top of that we have to include communication towards suppliers to agree on logistics quantity and conditions of shipped goods, ship from and ship to places to agree pick-ups and drop-offs serving hours and conditions. If we take a look at geographical aspects the 4PL logistics providers have a role of control tower over the all transportation chains of their customers and seeks opportunities to provide a best in the class services wherever is needed (Kawa Pawlewski, Golinska & Hajdul, 2010). Like e.g. they cooperate with the very best carriers in different countries around the World, or they choose to cooperate with competitors e.g. for maritime transport instead to use own services if they are able to provide a better service for their customer. In generally the best in the class approach is the domain of the 4 PL logistic providers. It should be noted that in business practice it can be found a few reasons why customers are interested in 4PL services[1]:

– longer cycle from order till delivery (more deliveries are coming from far parts of the World). The same is about the cycle order – payment and longer periods have a negative impact on companies because of frozen funds. That's why companies prefer to outsource those to the professionals who are able to shorter those cycles,
– coordination of complex supply chains also requires funds for resources and IT technology. Lack of IT technology for growing and global supply chains will not allow companies to do the logistics by themselves that's they start to think to outsource this complex part and focus on their core businesses,
– globalization. More and more raw-materials or semi-products are imported from far-away places around the World. Companies have no knowledge about global supply chain management.

If we consider 4PL logistics providers leaders and their main customers you may see the following branches which ideally fits for 4PL logistics:

– High-Tech – Most often concerns the distribution of finished goods. Often from one or two manufactures deliveries to all parts in the World. This is a global

[1] Elaborated based on the results of research and implementation works.

distribution which requires short lead times and additional safety because of the high values of the goods,

- Automotive – In this case bigger supply chains are deliveries from suppliers to car's or car's parts manufactures. This branch is on the high level of globalization. Engine's manufactures, car's and engine parts manufactures produce parts which are used almost in all cars in the World. For example Mahle, Delphi Automotive, IAC and many others. Deliveries to manufactures requires a synchronization of many logistics services and operations from different side of the World from the other hand it also requires a full visibility and monitoring to prevent production stops,
- Aerospace - the supply chain looks similar to automotive branch. Here we have more quality requirements including of usage of special packages (e.g. for engines), certified carriers and suppliers. Marking and monitoring parts life-cycles and aftermarket services including the availability of different parts on the airports around the World,
- Pharma & Health Care – in this case we have a World distribution of finished goods. Very often medicines and medical products, diagnostic materials must be available each day in each hospital, clinic and doctor's private house. This chains is particularly demanding because of special necessity to ensure and provide required environmental conditions. LSP's, resources and IT system requires special certifications,
- FMCG branch has often more local character and is less oriented to services and their usage in 4PL market is very low.

4. ANALYSIS OF EDI USE

Electronic integration is widely interpreted as a 40 year technology for the exchange of standard electronic messages (mostly EDIFACT or X12) between business partners in the supply chain. Since, then a lot has changed and new technologies for data integration were developed. Conventionally architected ERP systems went as far as they could, resulting in a slow reaction if any changes are required. But let's start from the beginning. By American department of defense an Electronic Data Interchange is an information exchange between computers with use of commonly accepted standards (Hill & Ferguson, 1989). The other definition says: It is an Exchange of standard formatted messages between information systems (computers) of trade partners with minimal human intervention (Hill & Ferguson, 1989). Both definition focuses on standardized messages formats. The standardized body like UN/CEFACT, American National Standards or GS1 from the beginning started to shape different types of messages related to business transaction between trading partners. Since then a lot's of addition sector and branch related standard have appeared like Odette for automotive, Hippa for health and insurance, SWIFT for bank sector, SMDG for Maritime and container flow sector, VICS a voluntary organization for supporting X12 implementation in US and Canada. In worse situation are cross-industry and cross continental companies like for example logistics service providers. They are in a situation where often have to support a lots of different branches, they offer their services across sectors and across borders. It leads to the situation of nature flexibility of logistics services providers, where from one side they adjust to the IT solutions of their customers and from other (mostly for small customers) they impost own solutions. Besides all of these standardized zone we have plenty of non-standardized messages or the standard is limited to very narrow group of companies (use the same software for example). Here the need of data integration has appeared but there was no awareness of existing global standards like EDIFACT, X12, GS1 or UBL or a software producers have implemented different messages into their solutions. But sooner or later those companies have business relationships with bigger, where standards are met and they start use standardized solutions keeping old way of communications. In the following papers Authors going to help users to orient between different standards and solutions for data integration those from the past and those for the future.

5. IDENTIFICATION OF THE EDI APPLICATION IN THE SUPPLY CHAIN

From the above EDI introduction we can assume the EDI itself is the old technology and without additional organizations model it will not fit easily into complex supply chains with many actors involved. However EDI's foundations are clean Master Data and usage of standards in identifiers and electronic messages and these have to be foundations for any integration models in logistics. It's hard to image that in global supply chain a 4PL logistics provider will have to use different messages standards to all suppliers and carriers around the World which numbers could be even few hundreds. If we don't use global identifiers how would be possible track and trace a single logistics unit and to monitor environmental conditions when it's being passed from supplier via road carrier, rail terminal, rail carrier, Sea terminal, Sea carrier and so on? That's why based on this foundation standards for identifiers and messages there models of interoperability with LSP,m where one of them is LIM (logistics interoperability model) by GS1 and the second is Common framework based on eFreight UBL messages standards (Pedersen, 2012). Although both of them are very well and detailed described, they have some shortages regarding interoperability with 4PL logistics providers. The below figures (fig. 2 and fig. 3) shows the scope of both models.

Figure 2. Business process in LIM model by GS1

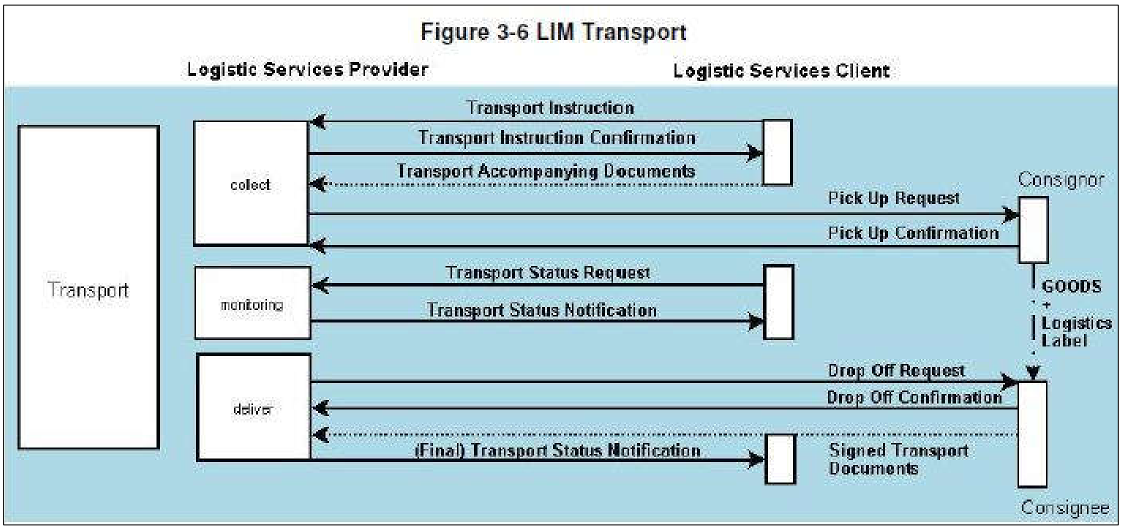
Scope

Interoperation Agreement	Master Data Alignment	Logistic Services Conditions	Planning	Warehousing	Transport	Financial Settlement

Source: own study

The above figure shows the business processes identified in GS1 LIM model. It assumes the full cooperation between customer and LSP from agreements of cooperation via master data synchronization, logistics conditions, transport planning, warehousing, transportation and billing and settlements.

Figure 3. Transactions and messages identified in transport process - LIM model by GS1

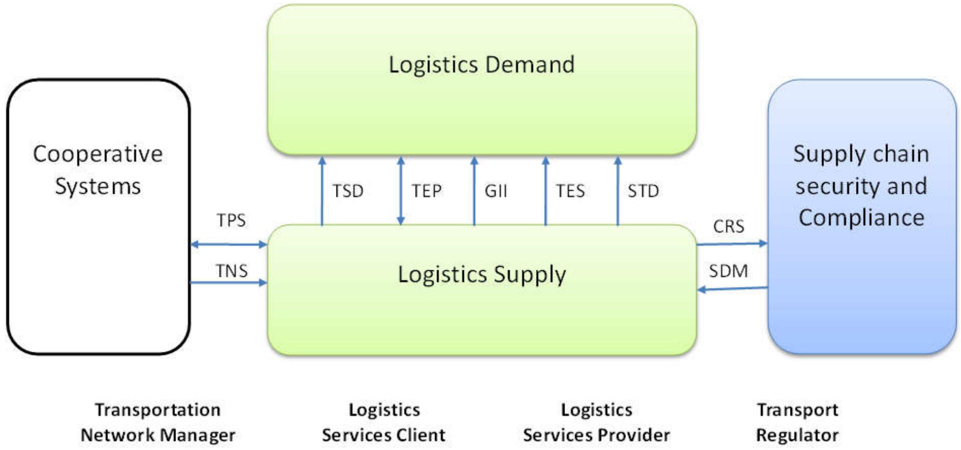


Source: own study

The above figure shows the set of transactions identified in transportation process in GS1 LIM model. It starts when transport provider received transport instructions, which are confirmed with transport instruction response. The transport carrier can negotiate pick-up with consignor with pick-up request and pick-confirmation. Then carrier negotiate drop off with consignee with drop-off request and drop-off confirmation messages. Finally after delivery of goods final status is being sent from carrier to customer. Transport statuses can be exchange whenever it is required during the transportation. In most cases it depends from individual agreements between carrier and customer.

In Authors opinion the LIM model can be very well applied into typical 3PL or 4PL logistics interoperability model with more focus on road transportation for FMCG sector.

Figure 4. Scope and transactions of Common framework reference model



Source: own study

The above shows the scope and transactions of common framework reference model. The difference to GS1 model here is that there is an extension towards the external system and e-administration. Transactions descriptions:

- Transport Execution Plan (TEP) – This contains all the information needed for a Logistics Service Client and a Logistics Services Provider related to the execution of a transport service. A Transport Instruction can be developed through several steps, or it can be created in one step only,
- Transport Execution Status (TES) – The Transport Execution Status information package gives the status for a Transport Instruction. The identifier of the Transport Instruction is needed. The status is marked as Boolean, either there is a deviation, or not,
- Transport Service Description (TSD) – This is the information that any Logistics Services Provider needs to communicate to Logistics Services Clients (potential clients) such that they may use the information about the service provided when the need for transport has been established,
- Goods Item Itinerary (GII) – All door-to-door transport operations using more than one mode of transport, and many of those that use only one mode, are not direct services being provided without transhipment. Hence, it is necessary to be able to describe the complete itinerary for a given goods item,
- The Single Transport Document (STD) - This document may also be called the multimodal eWaybill. A Waybill is issued by the Logistics Services Provider to the Logistics Services Client. It states the details of the transportation, charges, and terms and conditions under which the transportation service is provided.

In Authors opinion the common framework reference model has a bigger potential for Intermodal transportation and container's transport due to the fact it has been developed within the project focused on intermodal transport the e-waybill is the confirmation for this.

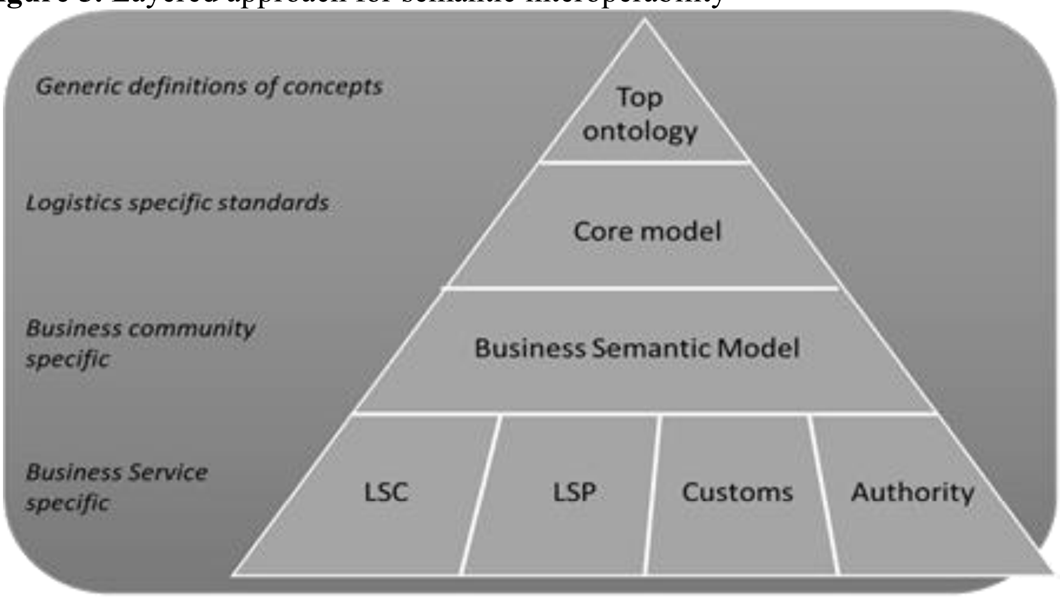
Both models require some changes - extensions to follow the modern integrated 4PL logistics. For example in automotive and aerospace industry LSP and customer needs to confirm the quantity of materials before plan the delivery so it requires additional integration from LSP towards supplier and customer to confirm and commit the quantities of materials. For global distributions and supply chains it requires a process for interoperability with other LSP's in bigger scope than we have in existing models. What is also not mentioned in both models are the cooperation to parcel carriers which requires additional standardization in transport statuses and labels for example and to Sea terminals where there is a bunch of messages going through between Sea carriers, rail carriers, carriers and terminal.

These shortages requires additional research and are not in the scope of this article. The article task is to show how demanding are complex and global supply chains for electronic integration with logistics.

6. FUTURE TRENDS

Today's approach is changing in direction of using more sophisticated solutions of information exchange like semantic solutions for interoperability between companies and organizations. With help of semantic different companies or group of companies having their own standards for electronic messages can exchange the documents. Thanks to today's level and accessibility of tools for semantic interoperability this idea becomes more and more popular it has its application not only in transport and logistics sector but everywhere where different standards and also different languages meet specially in transnational data exchange. This solutions is also promoted in European projects related with transport and logistics and e-administration. Figure 5 shows a layered approach for semantic interoperability in which the layers reflects the various company layers.

Figure 5. Layered approach for semantic interoperability



Source: own study based on i-Cargo[2] project

[2] i-Cargo – Intelligent Cargo in Efficient and Sustainable Global Logistics Operations European funded Project.

Different organization requires different information in their business process. Some organizations can be interested in concerns related to the transport of dangerous cargo, while customs organizations may want to look into details of import/export declarations. Within the logistics domain, several global standardization bodies for information exchange in logistics supply chains exist, including UN/Cefact, the World Customs Organisation (WCO) and GS1[2]. Individual services of different business actors requires a specific information or delivers specific information which are described in business community specific layer where also are the rules for logistics messages standards.

7. CONCLUSION

In big companies where there is large IT department, which is prepared for handling customers with different technologies and standards, they often intend to build an inhouse information model which could call canonic data model or semantic data model. In this case it means that all other formats received from outside are converted to the in-house format. The important thing is that external formats have comparable data elements which can be matched with internal one. In the logistics companies which are in the global market, often services which element of the main business process for these companies, are ordered at other logistics companies, carriers, rail, air or ocean carriers. From customer point of view for him there is still one service which he wants to monitor. But from the point of view of main logistic service provider there are many services of different companies which have to be integrated in standardized way. This is a common for lead logistics (4PL) providers where they establish such integration and services around so called control towers (Dębicki & Hałas, 2015). Integration of information systems of logistics service providers and applying standardized solutions in electronic messages bring the logistics World to the idea of physical internet, where the main assumption is optimization of transportation in the existing logistics networks and to offer best of the class services for customer.

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