

# IMPROVING THE VALUE OF THE INFORMATION SERVICE FLOW IN LOGISTICS PROCESS INTEGRATION

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## 1. Introduction

Companies have started to integrate internal business processes in global organizations by establishing enterprise applications integration (EAI). The main motivations have been the need to have better real-time information to manage business and build better competitiveness. In many cases, multinational organizations have had various applications in different locations without a real possibility to establish cost effective interoperability between services. Huge enterprise resource planning (ERP) system implementations have been carried out over the last decade.

Electronic payment has been the biggest success story to start external integration over the internet by using a common information model. The financing sector really understood the value of using a standardized information model for process integration of payments. This business process model changed the entire financial sector's business model with private customers, business and the public sector. The benefits of this integration of payment have been obvious to the entire business ecosystem.

The financing sector is now offering an interoperable eInvoicing service and a bank network to all customers. These are the key processes used in any business-to-business (B2B) or business-to-consumer (B2C) and business-to-government (B2G). It has been estimated that the volume of invoices in the world in 2012 was at minimum about 350 billion, whereof 150 billion was between (B2B) and (B2G). The penetration level (the estimated electronic invoicing proportion of the total volume of invoices) in the world is about 5%, and in Europe the volume is about 18% (Koch, Billites 2012). In our case study, we have estimated the volumes of orders and shipping's compared to invoicing volumes in percentages. This explains why there are 246% more orders and 138% more shipping's than invoices.

Table 1 will summarize the volumes of invoicing in the whole world and in Europe and also the penetration level (the estimated electronic invoicing proportion of the total volume of invoices in 2012, Koch, Billites (2012)). In this same table we present the invoicing volumes in our case study and we also show the volumes of orders and shipping's compared to invoicing volumes in percentages.

*Table 1: Process transaction volumes and penetrations*

|   | Orders | Shipping's | Invoices           | e-invoices * |
|---|--------|------------|--------------------|--------------|
| World                                       |        |            |                    |              |
| Consumer (B2C)                              |        |            | 200 billion        | 5 %          |
| Business (B2B) & Government (G2B)           |        |            | <u>150 billion</u> | 5 %          |
| Total                                       |        |            | 350 billion        |              |
| Europe                                      |        |            |                    |              |
| Consumer (B2C)                              |        |            | 17 billion         | 12 %         |
| Business (B2B) & Government (G2B)           |        |            | <u>16 billion</u>  | 18 %         |
| Total                                       |        |            | 33 billion         |              |
| Case study business (B2B)                   |        |            |                    |              |
| Tier 0 (18 companies)                       |        |            | 861 632            | 70 %         |
| Tier -1 (22 companies)                      |        |            | <u>1 632 750</u>   | 40 %         |
| Total (40 companies)                        |        |            | 2 494 382          |              |
| Volume of transactions compared to invoices | 246 %  | 138 %      | 100 %              |              |

\* Estimation of electronic invoicing penetration

All those users, business networks, ecosystems and even countries which have implemented ePayment and invoicing have realized the benefits and they are seeking the next step to expand business process integration by expanding the integration to ordering, shipping processes. Companies have understood the importance of B2B integration as a whole, but there exists quite little understanding of how much savings could be done in different processes. In this paper, we show how better integration and automation of information flows enhance the speed of processes and thus provide cost savings and other benefits for the organization.

This paper will contribute special knowledge to this academic field by establishing a well conducted case study and methods to collect data, analyze and simulate the results. For business partners, this paper will establish an organizational and business network level understanding of potential savings. Competitive advantages will be established by joint efforts. At the end of the day, the actions taken will also have an impact on environmental aspects of sustainability.

The empirical part of the paper is structured as follows. In the first part of the empirical section, we will structure the information model needed for logistics integration. Then we will design the structure of organizations and stakeholders for the study in order to collect data. Finally we will analyze the value of information flows by using the Monte Carlo simulation method.

## **2. Theoretical background: Related literature**

An accurate and real-time information flow in logistics processes is essential for functions to proceed smoothly, e.g. transportation and related activities, such as ordering, shipping, forwarding and invoicing.

Even though effective information exchange is widely identified and acknowledged as a significant element of process integration which has shown to improve cost-effectiveness and overall supply chain performance (Croom, 2005; Closs et al., 1997), there are still obstacles for deeply automated activities between stakeholders in supply chains. High investment costs, incompatibility of software/hardware and lack of awareness about automation benefits are the main obstacles to deploying advanced technologies (Evangelista and Kilpala, 2007; Murphy and Daley, 1999; Ferguson et al., 1990).

### *2.1 Logistics*

*Logistics as a common notion relates to the movement of physical goods. The evolution of the concept derives from big historical actions, such as the construction of the great pyramids, the emigration from Europe to the Americas, and both World War I and II, which have all been enormous logistical challenges. The exact term of logistics has its roots in the military, and later in the 1980s it expanded to the terminology of business. In business practice, the concept of logistics is often used interchangeably, e.g., with material management and physical distribution (Lummus et al., 2001, Daugherty et al., 1996).*

*Commonly logistics is seen as a function of one company even though it manages material, service and information flows between its suppliers and customers. In other words, as the logistics function is carried out at multiple locations in a given supply chain, it is an integrative factor across a supply chain. Logistics activities cover a company's inbound and outbound, internal and external raw material and products' movements as well as return streams back to the company. The information flow is an essential part of the function as it is a basis for decision making in the logistics chain (Lummus et al., 2001).*

*Council of Supply Chain Management Professionals have defined logistics as "the process of planning, implementing, and controlling procedures for the efficient and effective transportation and storage of goods including services, and related information from the point of origin to the point of*

*consumption for the purpose of conforming to customer requirements. This definition includes inbound, outbound, internal, and external movements". CSCMP (2010). The survey study by Lummus et al. (2001) showed that logistics is seen more as a tactical and operational action, like an executive function of more strategic supply chain management.*

## 2.2 Information logistics

Information within the supply chain has become a vital element for B2B integration, performance and successful management implementation. To enable dynamic actions and decision-making, the information exchange and information quality are very important issues for coordination operations within the supply chain (Li and Lin, 2006; Fiala, 2004). Most approaches to network information focus on certain user groups or processes without discussing the integrated, network-wide information logistics (Dinter et al., 2010).

According to Dinter et al. (2010), information logistics can be defined as “the planning, implementation, and control of the entirety of cross unit data flows as well as the storage and provisioning of such data”. Information logistics should provide value to the whole supply chain not only by benefits but by cost reduction and eliminating risks as well (Dinter et al., 2010; DeLone., 2004). ICT is typically considered an enabler to (re)design, manage, execute, improve and control business processes both within and between organizations (Melao, 2009). B2B integration can be understood as collaborations between supply chain partners using ICT in business interactions, which are exchanges of business documents over the internet in a business process as part of information logistics (Dinter et al., 2010).

Visibility in supply chains and an accurate and real-time information flow among partners are essential for smoothly proceeding functions and logistics activities. In integrated processes, information gathering, sharing and exchanging among the participants is essential (Gunasekaran and Ngai, 2003; La Londe and Masters, 1994). Even though B2B integration is widely identified and acknowledged to build efficiency to the supply chain (Croom, 2005; Wu et al., 2005; Closs et al., 1997) the interoperability of systems still remains on a low level and the real benefits have not been realised (Evangelista and Kilpala, 2007; Murphy and Daley, 1999).

*Collaboration and information exchange within logistic chain operations and processes has to be organized in an effective and reliable manner that requires changing from managing individual functions to integrating activities into key logistic chain processes. E-logistics and the outsourcing of logistics business processes can be seen as subsets of a wider external logistics market. E-logistics can be defined by Wiengarten (2012) as the transfer of goods and services using internet-based information exchange.*

In our empirical study, we are interested in benefits that are potentially achievable through efficient information exchange primarily in logistics processes. Based on the literature review, more effective information exchange would have a significant effect, not only on logistics processes but on the broader, systematically functioning supply chain as a whole.

## 3. Empirical Study

*In order to make an in-depth investigation into the nature and information value of logistics processes, we have built a research framework that covers both the information model design elements of the logistics processes and the measurement and analysis of the monetary value of the B2B integration. The logistics processes were selected as the focal area of the empirical study since we made an initial hypothesis that information plays a key role in the process improvements and since there is still lot of potential for further process integration.*

3.1 Research approach

The empirical part is based on an empirical study on 40 companies operating in the biorefinery business. We firstly selected focal companies (tier 0), which represented the focal supply chain actors. Then we asked the focal companies to select the most suitable suppliers (tiers 1 and 2) to be included in the study. It can be said that the selected group of companies corresponds with the company structure in the industry sector. The biorefinery industry is an interesting area for the empirical study because the economic value of the business is high and the business covers various types of business-to-business service and product transactions in a global scale.

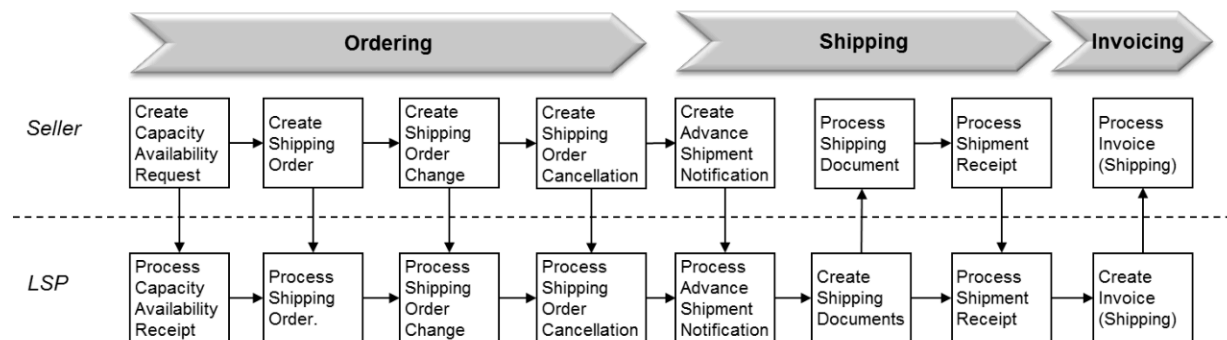


Figure 1. Information logistic process model in the Seller-Logistic Service Provider case study

The process activity mapping framework for logistics information flows illustrated in Figure 1 provides a useful method for identifying the sequence of activities under study. Lead time was used as a primary measure for the quantification of process flow efficiency in the simulation. The assigned expert measures were used as input values for the simulation.

The selected research design covers the expert data collection methods related to the logistics processes and a simulation-based application for investigating process value by using the process lead times as a measure. Simulation analysis was selected as the method for the data analysis because of its suitability for creating a sophisticated analysis based on the expert judgments in a case where no historical data was available about process scenarios.

Table 2. Data collection

| Step | Method                  | Purpose  | Number of sources  |
|------|-------------------------|--|--|
| 1    | Survey instrument       | - To collect the data about the transaction volumes and frequencies  | 40   |
| 2    | Expert group interviews | - To identify and validate the structure of the business process activities for the information model for the industry | 5 interviews, key experts from standardization organizations |
| 3    | Focus group interviews  | - To assess the lead time distributions and automation rate of business processes                                      | 2 workshops, 14 experts from the seller and LSP side         |

The research process covers different data collection methods. We developed a survey instrument for collecting the data about the transaction frequencies and volumes of logistics activities. For the purpose of the process selection and mapping of the business process activities, several expert group interviews were organized. We also used the manuals and expert knowledge from the leading standardization organizations (GS1/RosettaNet, Oasis/UBL, UN/CEFACT) in this process mapping and information model development stage. Measures of process lead time variations and automation were also collected during the expert group interviews.

### 3.2 Simulation model of logistics processes

We used Monte Carlo -based simulation software for calculating the lead time flows with variation. In the analysis, the activity lead-times are modelled as triangular distributions, which are commonly used when the expert is able to evaluate the minimum, maximum and most likely value for a variable. We restricted the usage of extreme cases by applying the general rule of taking away 10 per cent of the upper and lower bounds cases. In the analysis, the Monte Carlo simulation method was applied, which randomly selects values from the distribution and uses several iteration rounds to complete an analysis. The number of iterations in the model was selected as 1000. Table 3 summarizes the main data variables used in the study. Median values of lead times were used as the most likely values on the simulation input worksheet.

Table 3. Simplified example of the data sheet for the simulation model

| Actor    | Process                               | Median lead-time [min] | Automation rate % | Frequency | Cost [EUR/min] | Cost Potentia [EUR] |
|----------|---------------------------------------|------------------------|-------------------|-----------|----------------|---------------------|
| Seller   | Create Capacity Availability Request  | 25                     | 0,3               | 3444250   | 10,5           | 36164625            |
| Logistic | Process Capacity Availability Reseipt | 20                     | 0,3               | 3444250   | 6,5625         | 22602890,63         |
| Seller   | Create Shipping Order                 | 15                     | 0,3               | 3444250   | 4,375          | 15068593,75         |
| Logistic | Process Shipping Order                | 20                     | 0,3               | 3444250   | 6,5625         | 22602890,63         |
| Seller   | Create Shipping Order Change          | 15                     | 0,05              | 344425    | 7,71875        | 2658530,469         |
| Logistic | Process Shipping Order Change         | 20                     | 0,3               | 344425    | 6,125          | 2109603,125         |
| Seller   | Create Shipping Order Cancellation    | 10                     | 0,05              | 344425    | 5,34375        | 1840521,094         |
| Logistic | Process Shipping Order Cancellation   | 15                     | 0,3               | 344425    | 4,375          | 1506859,375         |
| Logistic | Greate Shipping Documents             | 15                     | 0,3               | 3444250   | 4,375          | 15068593,75         |
| Seller   | Process Shipment Delivery Report      | 6                      | 0,01              | 3444250   | 3,34125        | 11508100,31         |
| Logistic | Process Shipment Delivery Report      | 6                      | 0,01              | 3444250   | 3,34125        | 11508100,31         |
| Logistic | Create Invoice (Shipment)             | 10                     | 0,3               | 3444250   | 3,9375         | 13561734,38         |
| Seller   | Process Invoice (Shipment)            | 30                     | 0,003             | 3444250   | 18,070625      | 62239750,16         |

The outcome of the simulation analysis when the lead time was used as a measure is illustrated in Figure 2. The analysis shows the logistics process improvement potential in the monetary values. It is based on the calculation of lead time improvement potential when transferring from manual to automated information flows by taking into account the assessed automation rate %. Time saving potential is transferred into monetary values (EUR) by multiplying the working time with the average salary. The simulation analysis shows that the lead time impact in EUR could vary between 136 533 250 EUR and 287 989 190 EUR with the mean value of 216 776 312 EUR.

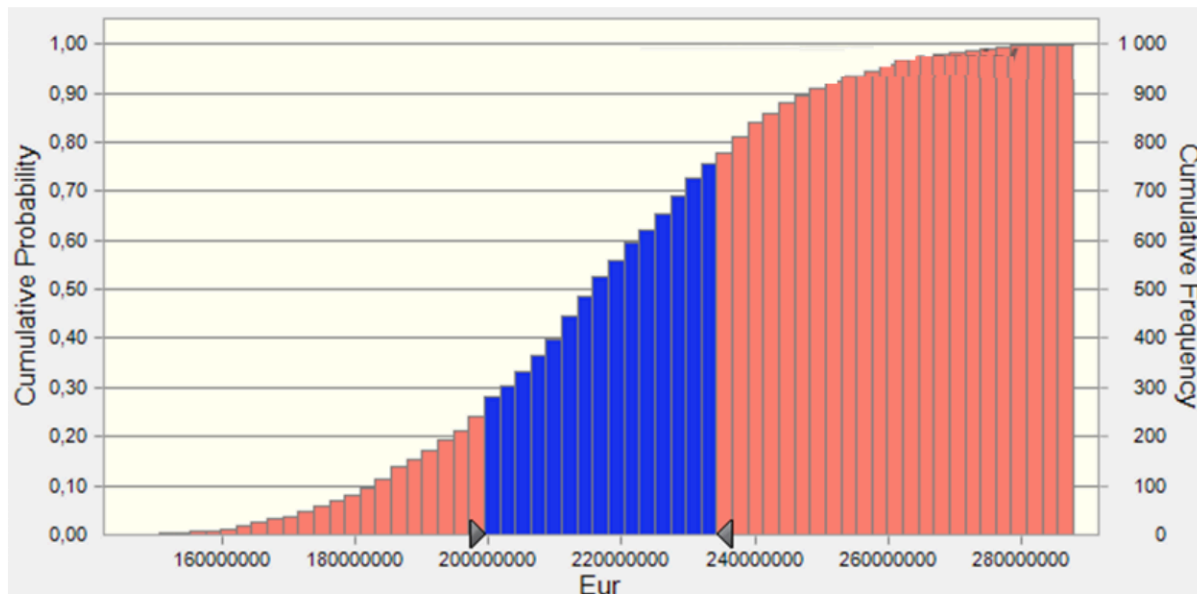


Figure 2. Simulated distribution of value provided by the logistics process (n=40 firms)

The sensitivity chart in Figure 4 illustrates the potential of most essential process activities for creating cost savings in the logistics. Based on the simulation analysis, Process Invoice - Shipment (59.5%), Process Shipping Order (9.3%), Fire (10.5%), Process Capacity Availability Receipt (6.7%) and Create Shipping Order (6.2%) are the most potential process activities in the case logistics supply chain. The sensitivity chart provides a valuable analysis of the importance of the process activities and allows organizations to put priority on process steps that have the highest impact on the results. The advantage compared to traditional methods is that it takes into account both actual lead times and the lead time variation of the processes.

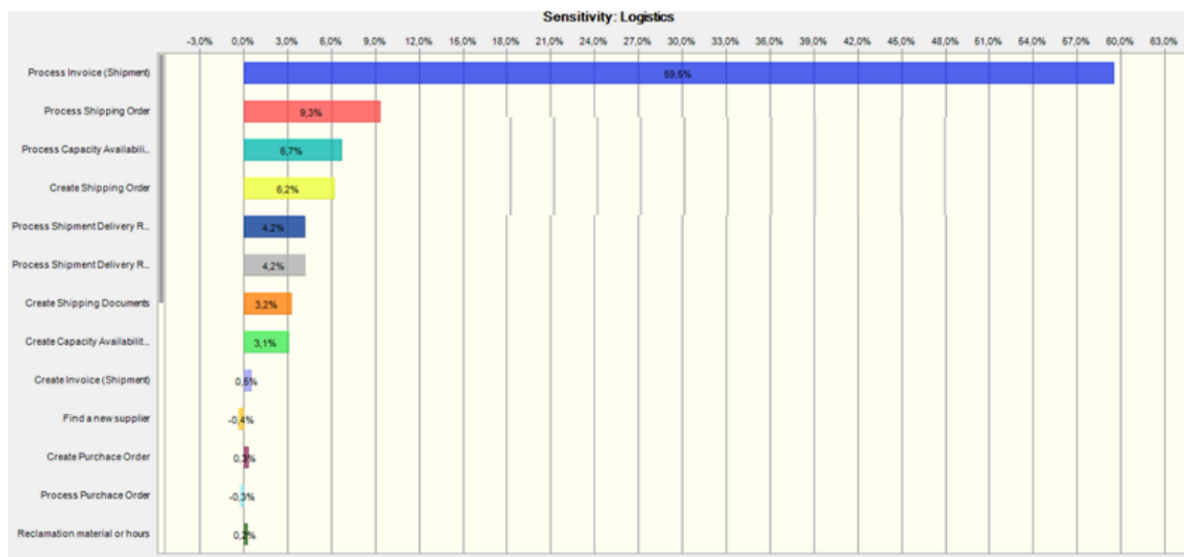


Figure 3. Sensitivity chart of the value of different processes

The simulation approach seems to provide many advantages for the analysis value potential of B2B integration and information flows in logistics. From the decision-making perspective, it allows to connect the variability of process lead times to the measuring of the flow efficiency.

The potential is shown as a probability distribution, which provides opportunities to take risk and uncertainty into account in the decision making. An outcome of the simulation method is the sensitivity analysis, which shows the contribution of the process activities for the resulting value potential outcome. For investment calculations, it illustrates the value potential of process improvements.

#### 4. Discussion and conclusions

The aim of this study was to define a general logistics process used in manual and electronic business transactions between a buyer, supplier and logistic partner. The mutual understanding was built by an expert group, consisting of key global experts in different major standardization organizations. The common business processes formed an information model for logistics. The data collection and valuation was done by a focus group, formed from executives and managers involved in global B2B integration as a buyer, seller or logistic partner. The analysis was done by using the Monte Carlo method.

This study was able to define the economic value in the form of cost savings in logistic B2B integration. The results give a broad understanding of B2B integration as discussed in the following. B2B integration has a great impact on independent firms, strategic business partners and value adding services. The results explain the importance of logistic and information interoperability. The current literature expresses the importance of business process integration in logistics (see e.g. Hazen and Byrd, 2012 and Jeffers et al., 2008) and businesses have started to design and implement the common standards, but there exists little evidence in the literature of its economic impact. This study was able to report the cost savings in one supply network case. This method can be used in other industries and even further developed for other business sectors and processes. These results can be scaled to other networks and explain the overall understanding of cost savings in logistics process integration. This information is needed in decision making when outsourcing logistic and information services.

The key findings and recommendations for academic and business networks are to seek for a common interoperable information model for B2B integrations. This will help to design data collection in a heterogeneous business environment. The result will offer a better business-level understanding of economic value of logistics process integration. The establishment of a common information model will support the design of interoperable solutions and systems. The common information model was designed by using literature and interviews of standardization experts. The data collection was executed by high-level business partners and managers responsible for global logistic integration. The volume of the data represents a rather good sample size. However, the research was dominated by one industry domain and rather large firms, and therefore future studies should be extended to cover a large population of business sectors. Small and medium size companies and other industries should be covered in further research.

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