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THE IMPACT OF TRANSPORT PROCESSES STANDARDIZATION ON SUPPLY CHAIN EFFICIENCY

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ABSTRACT. **Background:** During continuous market competition, focusing on the customer service level, lead times and supply flexibility is very important to analyze the efficiency of logistics processes. Analysis of supply chain efficiency is one of the fundamental elements of controlling analysis. Transport processes are a key process that provides physical material flow through the supply chain. Therefore, in this article Authors focus attention on the transport processes efficiency.
Methods: The research carried out in the second half of 2014 year, in 210 enterprises of the Wielkopolska Region. Observations and business practice studies conducted by the authors, demonstrate a significant impact of standardization processes on supply chain efficiency. Based on the research results, have been developed standard processes that have been assessed as being necessary to standardize in business practice.
Results: Based on these research results and observations, authors have developed standards for transport processes by BPMN notation. BPMN allows authors to conduct multivariate simulation of these processes in further stages of research.
Conclusions: Developed standards are the initial stage of research conducted by Authors in the assessment of transport processes efficiency. Further research direction is to analyze the use efficiency of transport processes standards in business practice and their impact on the effectiveness of the entire supply chain.

Key words: supply chain efficiency, transport efficiency, operational controlling.

INTRODUCTION

In the era of ongoing market competition, focusing on the level of customer service, order completion time and flexibility of deliveries, analysis of efficiency of logistic processes is gaining on significance. Transport processes are a key factor that ensures physical provision of materials to the entire supply chain. The article discusses issues concerning the analysis and evaluation of the efficiency of transport processes.

The analysis of efficiency in a supply chain is one of the fundamental elements of controlling analysis. Despite obligatory performance of extensive analyses in economic practice, the scope of their use is unsatisfactory. It results both from imprecise definition of problems related to the efficiency of logistic processes in reference books, and from the absence of comprehensive solutions supporting analyses in practice. Observations and studies on economic practice, carried out by the Authors, prove considerable impact of the standardisation of processes on supply chain efficiency.

The standardisation of transport processes is a continuous process directed towards constant improvement of activities related to logistic processes. All standards developed at a company should be balanced, i.e. strict and

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flexible at the same time. The term "strictness" refers to the procedures an employee who performs specified tasks must follow. Flexibility, on the other hand, allows employees to be creative and not to be limited by imposed standards [Liker 2004]. Liker defines the following types of standards [Kolinska and Cyplik 2010]:

- management standards - concerning internal purpose of employee management. They are essential in managing the workers. The standards describe guidelines for employees, job descriptions, cost settlement rules etc.
- operating standards - providing for technical and organisational aspects of logistic processes in a supply chain.

In the article, the Authors present studies on the application of the standards of transport processes and their impact on supply chain efficiency, and give suggestions regarding the standardisation of selected transport processes.

THE ROLE OF PROCESS STANDARDS IN TRANSPORT MANAGEMENT

Frequent modifications to processes in use may lead to various disruptions, but, considering frequent changes in economic reality, they are unavoidable, although intervals between modifications depend on a number of factors of external and internal nature. Abandoning any changes or introducing them not frequently enough may cause a company to take a step back [Kherbash and Mocan 2015]. Such treatment of changes to processes is defined as evolutionary or revolutionary. The first one assumes continuous improvement of the existing process, while the second one provides for the construction of a new process and is not of continuous nature. Both methods may complement each other, which allows their expansion due to constant improvement of processes. Another method consists in repetitive improvement of existing processes, which leads to their optimisation. Both methods have been presented in Table 1.

Table 1. Methods of transport process management
Tabela 1. Metody zarządzania procesem transportowym

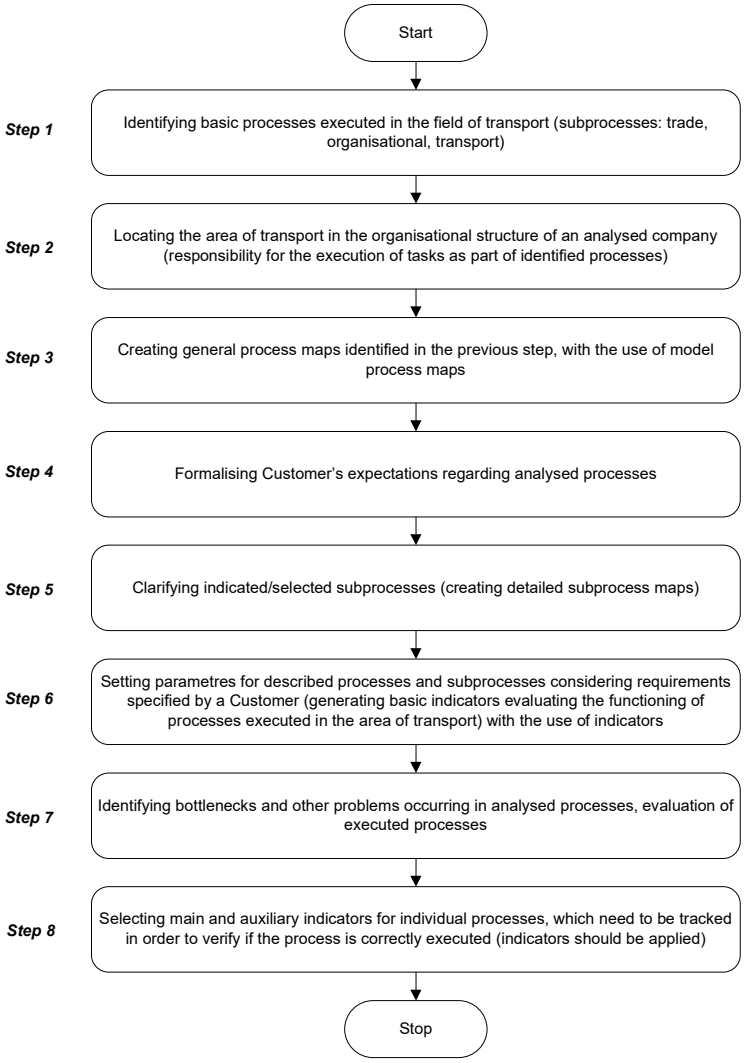
Approach	Subject	Basic methods	Auxiliary methods
Revolutionary (renewal, re-engineering, restructuring of processes)	economic processes	*business process re-engineering* (BPR)	benchmarking outsourcing, insourcing
Evolutionary (incremental, continuous improvement of processes, optimisation of processes)	economic processes	*total cycle time* (TCT)	benchmarking
	subprocesses, actions	*kaizen* KVP *six sigma*	benchmarking

Source: Nowosielski 2008

Analysing the structure of transport processes, the following factors should be taken into account:

- operations which comprise the process,
- order in which individual operations are carried out,
- which operation cannot start until other operations are finished,
- duration of each operation,
- occurrence of idle moments between operations.

The analysis of these factors gives an image of a process, which makes it possible to modify and improve it [Nikfarjam, et al. 2015], with a purpose of developing a repetitive standard. A diagram depicting approaches to the analysis of transport processes directed towards developing standards has been presented in Figure 1.



Source: own study

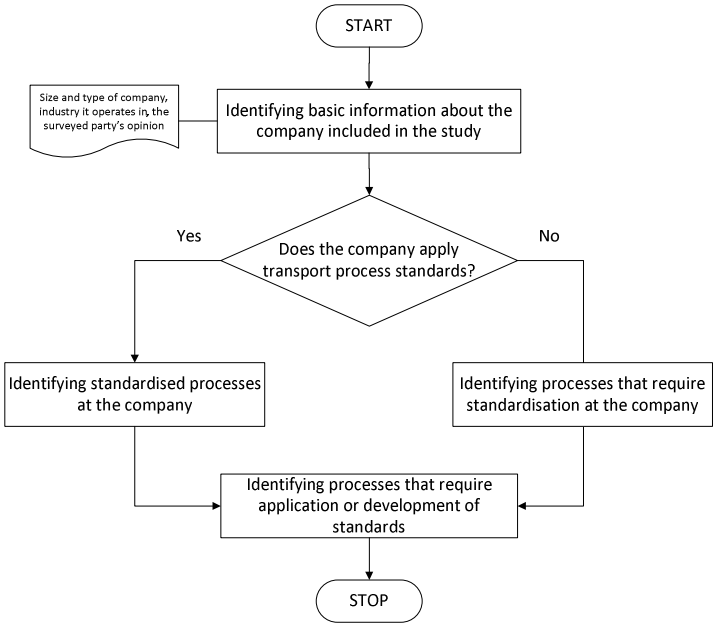
Fig. 1. Diagram depicting the standard of methodological approach to the analysis of transport processes in a company
Rys. 1. Standardowe podejscie metodyczne analizy rpocesów transportowych w przedsiębiorstwie

To manage transport processes efficiently, one needs to determine logical and temporal relations between individual elements of each process, and relations between different process within a company, starting from transactions, through accompanying events and ending with process management, which, in turn, allows reducing time, costs and consumption of human resources [Whipple and Russell 2007]. The way transport processes are organised in a company has direct impact on partnerships with other parties. The awareness of interactions between company departments allows comprehending interactions between links in a supply chain. The better companies cooperate with each other as part of business partnership, the more efficient a supply chain is [Demir et al. 2001; Forza, Salvador and Rungtusanatham 2005].

THE PROBLEM OF TRANSPORT PROCESS STANDARDISATION - STUDY RESULTS

The chief purpose of the standardisation of processes, developed in the form of process maps, is describing business processes

with a view to simplify, eliminate and improve them so that products and services are cheaper, better and more available [Hunt 1996]. For this reason, the Authors decided to run a study of economic practice, whose aim was to identify processes which required standardisation. Figure 2 presents the methodology applied to perform a study of the scope in which transport process standardisation is used.



Source: Own study

Fig. 2. Methodology applied to perform a study of the scope in which transport process standardisation is used
Rys. 2. Metodologia zastosowania do analizy przypadku, w których użyto standaryzacji procesu transportowego

The study carried out by the Authors had the form of questionnaires (part of companies allowed the Authors to run observations and direct interviews on their premises). The study was carried out in the second half of 2014 at 210 production, trade, service, service and production, production and trade, trade and service, and production, trade and service companies seated in the Wielkopolska region. The questionnaire included seven open or multiple choice questions. The purpose of the study was to identify the degree of standardisation of transport processes in economic practice. Table 2 presents basic information concerning the companies included in the study.

The first part of the questionnaire included questions classifying companies in terms of employment rate and company type. The central part of the survey focused on issues concerning the analysis of the use of transport process standards and the necessity to develop additional transport processes.

Table 2. Basic information concerning the companies included in the study
Tabela 2. Podstawowe dane dotyczące przedsiębiorstw poddanych badaniom

Characteristics	Answers (%)
1. Number of employees:	
· less than 10 employees	18%
· from 10 to 49 employees	24%
· from 50 to 250 employees	27%
· more than 250 employees	31%
2. Company type:	
- production company	27%
- trade company	12%
- service company	21%
- production and trade company	6%
- production and service company	12%
- trade and service company	14%
- production, trade and service company	8%

Source: own study

The results of the study have shown that 25% of companies covered by the study does not follow transport process standards or is not aware of it. Such a result should come as no surprise, considering the strategy of unifying transport-related orders in the entire logistic chain of supplies. However, the results also prove increased awareness of the need to apply process standardisation in order to improve the efficiency of actions and competitive position in the market.

Further research concerned the identification of transport process standards used in practice and processes which required standardisation. Table 3 includes collective results showing the scope of transport process standardisation, whereas Table 4 presents results regarding processes that need to be standardised.

Table 3. Scope of transport process standardisation in economic practice
Tabela 3. Zakres standaryzacji procesów transportowych w praktyce ekonomicznej

The element of transport process	Per cent of indications*
Transport order acceptance	22%
Consignment collection	16%
Consignment execution (transport)	20%
Load delivery	26%
Execution of transport orders (transport services)	16%

* The companies had the possibility to select more than one answer.

Source: own study

Table 4. The need to standardise transport processes in economic practice
Tabela 4. Potrzeba standaryzacji procesów tranportowych w praktyce ekonomicznej

The element of transport process	Per cent of indications*
Transport order acceptance	20%
Consignment collection	21%
Consignment execution (transport)	18%
Load delivery	28%
Execution of transport orders (transport services)	13%

* The companies had the possibility to select more than one answer.

Source: own study

Analysing the above results, the highest degree of applying standards for the following transport processes must be determined:
- load delivery
- transport order acceptance
- consignment execution.

The results may also denote that identified transport processes have the greatest impact on supply chain efficiency in terms of customer service level.

During the analysis of the need to standardise process, the following processes have been identified:
- load delivery
- consignment collection
- transport order acceptance.

Considering both results obtained from companies applying transport process standards and results from companies planning the standardisation of processes, low need to standardise the process of transport order (transport service) execution has been identified. It may be the consequence of the fact that the process depends on the size of a transport company and specific nature of the industry which it operates in.

STANDARDISATION OF TRANSPORT PROCESSES WITH THE USE OF REFERENTIAL MODELS

A company functioning in a highly competitive environment must make sure that it operates under conditions favouring fast generation of data and its efficient collection. That is why it needs to continuously improve and streamline its operations. An effective solution which positively influences a company's image and the quality of goods and services without generating extra costs is a reconstruction of its process management strategy, It consists in conducting regular analyses, streamlining and controlling actions in order to improve the efficiency of company operations. A prerequisite of process-based approach is seeing a company as a whole and improving actions from different functional areas. These requirements can be met, among

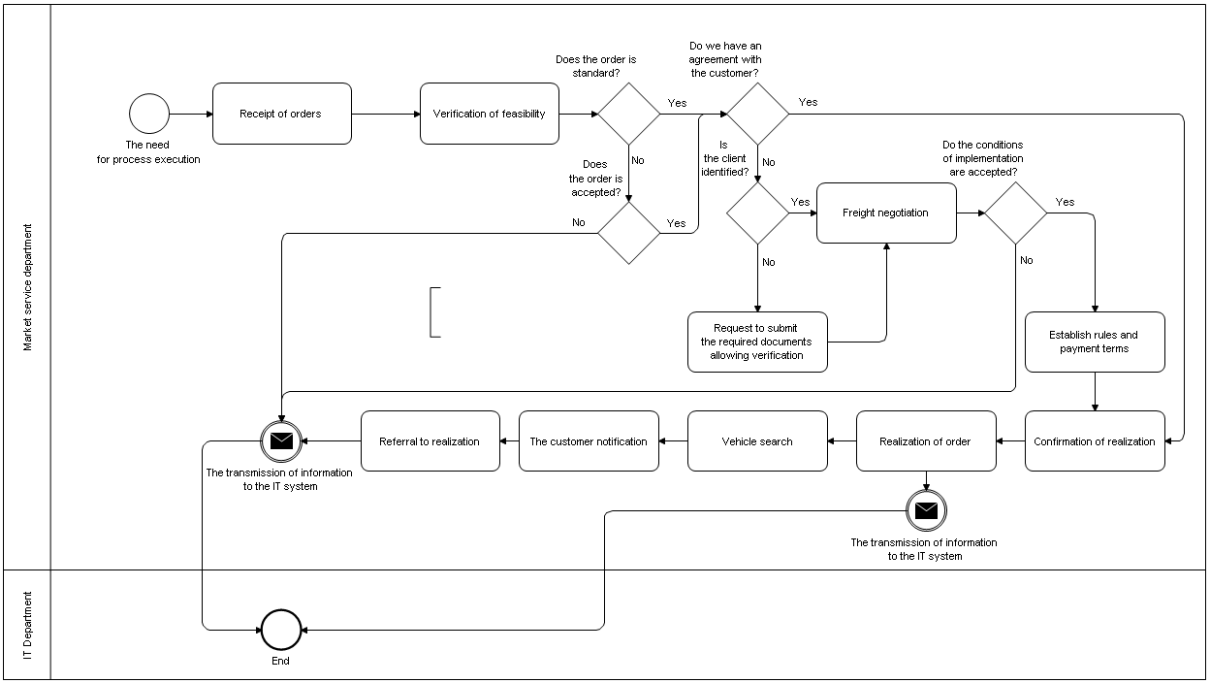
others, by applying process standardisation by means of referential modelling.

When developing a referential model, one must specify proper tools for defining, analysing and designing processes, and, consequently, develop suitable models of procedures, which will indicate what type of data is required to build a referential model [Long and Zhang 2014]. They need to be developed in the same language as process models are suggested to be formulated.

A referential model for procedures may be documented by means of description of processes, functions and organisations suitable for such concepts as BPMN, and adjusted to specific requirements of a project. The role of referential models becomes visible during process construction. The models not only provide process maps, but also allow experimenting on processes before their implementation. As systems are subject to evolution, their models do not have to faithfully reflect reality. In the case of referential models of business processes, the models should include suggestions concerning process improvement. To achieve this goal, changes and evolutions are most frequently introduced based on best practices. Referential models form a methodological framework for modelled, complex reality of a company. They represent its organisational knowledge, set certain modelling standards and define information structures.

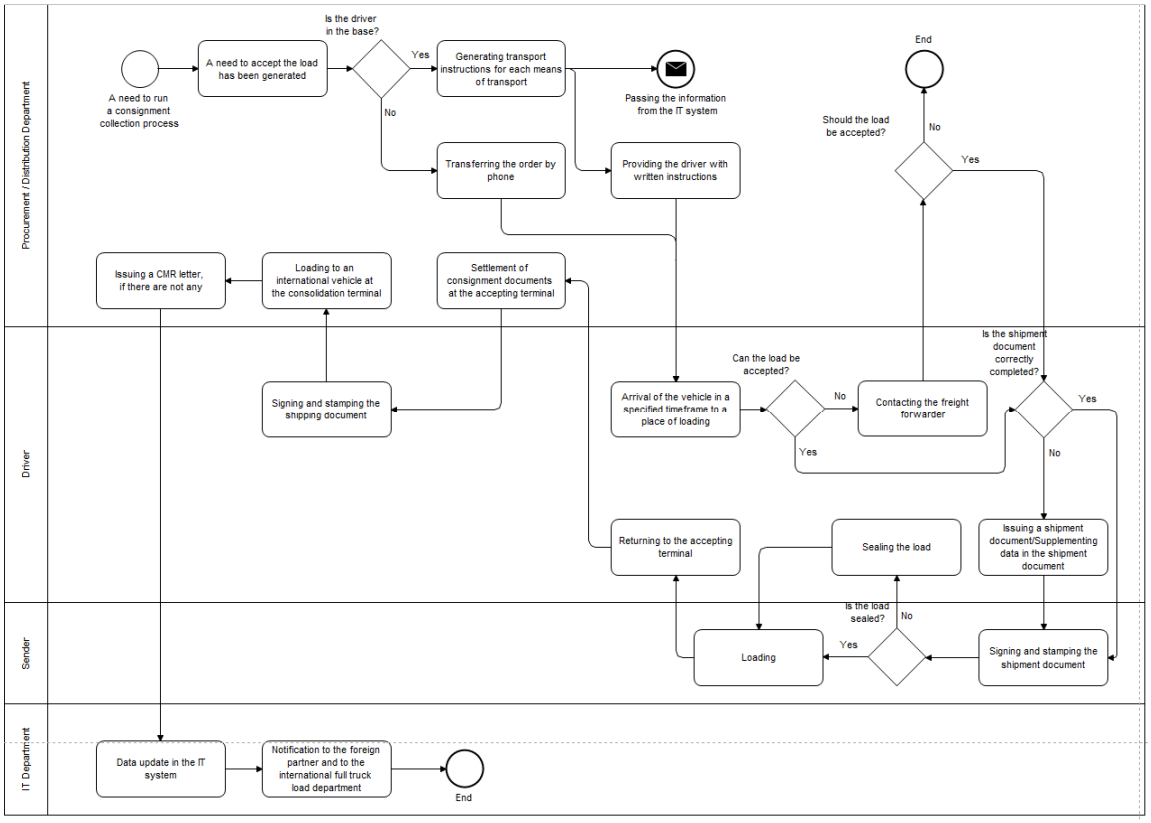
General category of processes in supply chains should be considered to include specific, busi-ness sequence of actions in time and space, with clear-cut beginning and ending of actions, and clearly defined outlays and results [Lambert 2004]. Flexibility of processes facilitates modelling and application of referential models [Sanchez and Perez 2005].

The theoretical premises and studies presented above accompanied the development of referential models used for load handling. Figures 3-6 present diagrams of referential models of processes, which were the object of studies at companies (developed as part of a research project titled "Information tools supporting the optimisation of transport processes in supply chains", Project of the Poznań School of Logistics: KPL1/2013).



Source: Own study

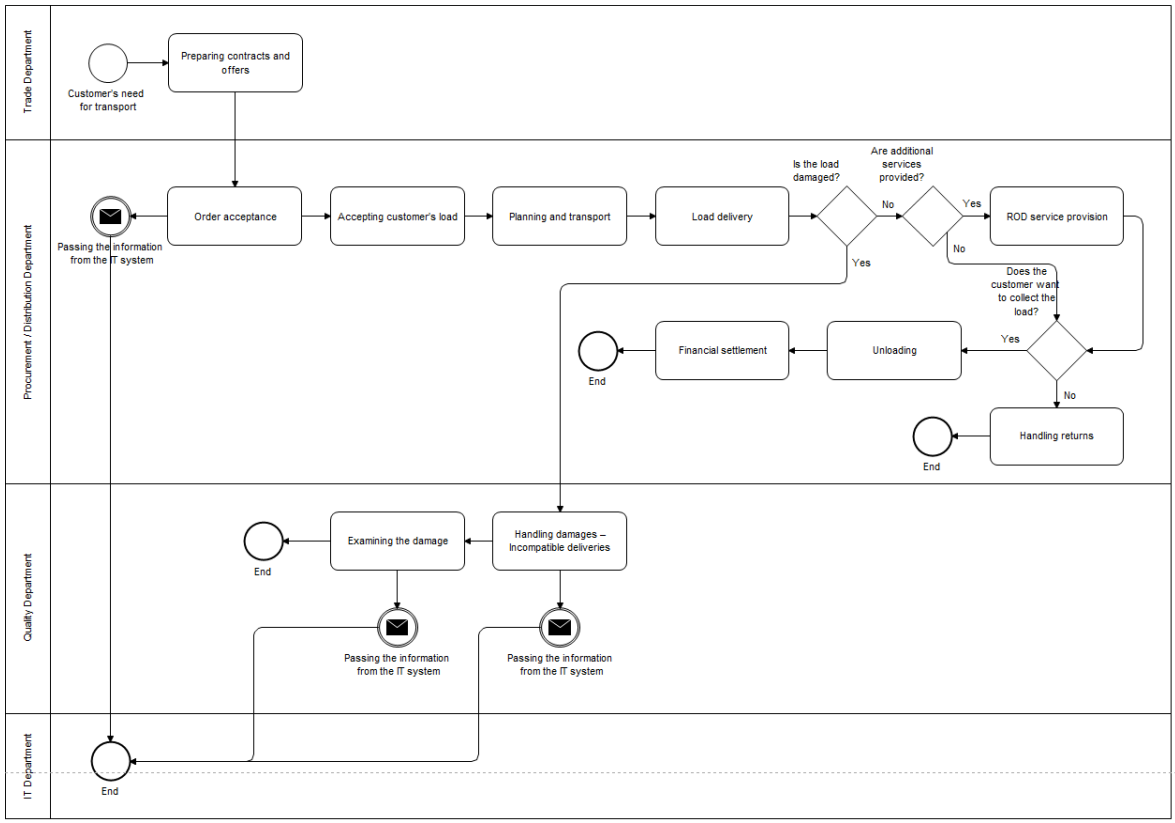
Fig. 3. Process standard - transport order acceptance
Rys. 3. Standard procesu – przyjęcie zlecenia transportowego



Source: Own study

Fig. 4. Process standard - consignment collection

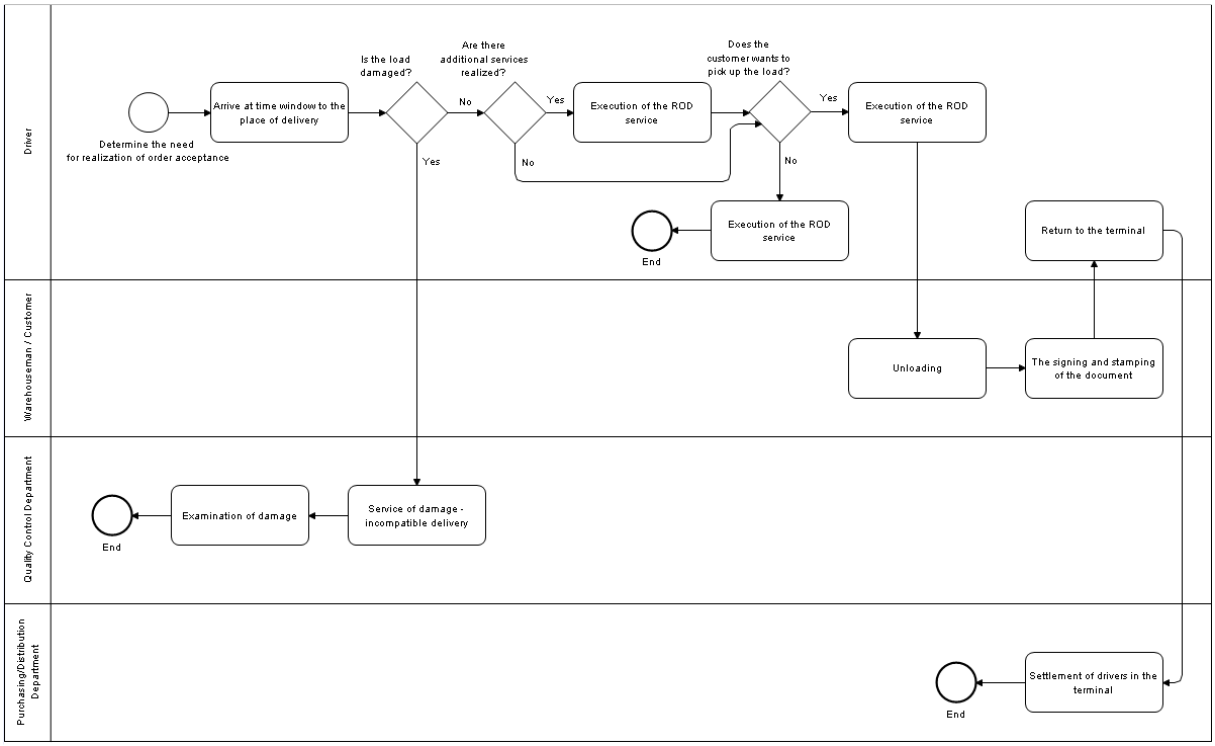
Rys. 4. Standard procesu – konsygnacja wysyłek



Source: Own study

Fig. 5. Process standard - consignment execution on the example of domestic full track load transport

Rys. 5. Standard procesu – realizacja wysyłki na przykładdzie transport krajowego pełnosamochodowego



Source: Own study

Fig. 6. Process standard - load delivery
Rys. 6. Standard procesu – dostawa ładunku

Two fundamental issues are important in practical implementation of referential models: one focuses on construction i.e. searching the methodology, building a model and aiming at defining referential requirements of description methods, while the second one treats models as material to be used in practice.

Advantages of referential models described above include:

- standardisation of process structures,
- possibility to develop process maps,
- easier reading of process maps by creating appropriate diagrams,
- possibility to run process analyses,
- allowing verification of process completeness,
- assistance in selecting key processes,
- recording data and generating information about processes,
- possibility to use verified models with ready process maps.

Presented referential models are the result of the co-Author's long-standing studies in terms of process analysis. They were developed as part of consulting works and transport audits for companies.

One of such tools is undoubtedly BPMN (Business Process Modelling Notation), which, on the one hand, facilitates the development of models and makes them more understandable to users, which makes it suitable for use even in cooperation with people with very low awareness of process modelling (communicating the functioning of a process to users), and, from the other hand, whose simulation functionalities (e.g. iGrafx) add an extra value to graphs developed in BPMN, as they allow evaluating the efficiency of suggested workflow methods and/or assess resources necessary to achieve previously set goals.

CONCLUSIONS

The analysis of effects of referential process applications in logistics has shown that the best

results are achieved following the determination of weaknesses, study of deviations and improvement of current status of transport processes by way of models. Satisfactory effects on parametres of models referring to delivery time and costs of processes have been observed. Furthermore, referential models may be created to support the selection of software, management of chosen processes, certification and knowledge management.

Even if a company does not apply referential models in transport management, acceptance of process-based orientation forces the standardisation of processes which is analogical to the one offered by referential models.

The article presents preliminary studies carried out as part of standardisation of processes occurring in logistic supply chains. Further research will be aimed at analysing the use of transport process standards in economic practice and the impact of transport processes on the effectiveness of the entire supply chain.

All stages of the flow of materials (procurement, production and distribution) and accompanying warehouse processes require similar analyses.

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WPŁYW STANDARYZACJI PROCESÓW TRANSPORTOWYCH NA EFEKTYWNOŚĆ ŁAŃCUCHA DOSTAW

STRESZCZENIE. **Wstęp:** W dobie ciągłej konkurencji rynkowej, koncentrującej się na poziomie obsługi klienta, czasu realizacji zamówień oraz elastyczności dostaw coraz większą rolę odgrywa analiza efektywności procesów logistycznych. Analiza efektywności w łańcuchu dostaw jest jednym z podstawowych elementów analizy controllingowej. Procesy transportowe są kluczowym procesem zapewniającym fizyczne zasilanie przepływu materiałowego w całym łańcuchu dostaw. Z tego względu w niniejszym artykule Autorzy skupili uwagę na efektywności procesów transportowych.
Metody: Prace badawcze prowadzono w drugim półroczu 2014 roku w 210 przedsiębiorstwach z terenów województwa wielkopolskiego. Obserwacje i badania praktyki gospodarczej przeprowadzone przez Autorów świadczą o znacznym wpływie standaryzacji procesów na efektywność łańcucha dostaw. Opierając się na wynikach badań zostały opracowane standardy tych procesów, które zostały ocenione jako konieczne do ustandaryzowania w praktyce gospodarczej.
Wyniki: Na podstawie uzyskanych wyników i obserwacji, Autorzy opracowali standardy procesów transportowych wg notacji BPMN, która umożliwi Autorom przeprowadzenie wielowariantowych symulacji tych procesów w dalszych etapach prowadzonych badań naukowych.
Wnioski: Opracowane standardy stanowią wstępny etap badań naukowych realizowanych przez Autorów w ramach oceny efektywności procesów transportowych. Kierunkiem dalszych badań jest analiza efektywności zastosowania standardów procesów transportowych w praktyce gospodarczej oraz ich wpływ na skuteczność całego łańcucha dostaw.

Słowa kluczowe: efektywność łańcucha dostaw, efektywność transportu, controlling operacyjny

EINFLUSS DER STANDARDISIERUNG VON TRANSPORTPROZESSEN AUF DIE EFFEKTIVITÄT EINER LIEFERKETTE

ZUSAMMENFASSUNG. Einleitung: In der Zeit des andauernden Markt-Wettbewerbs, der sich auf den Kundenservice, auf die Zeit der Ausführung von Kundenaufträgen und auf die Flexibilität von Lieferungen konzentriert, spielt die Analyse der Effektivität von logistischen Prozessen eine immer grö?ere Rolle. Die Analyse der Effektivität in der Lieferkette ist einer der grundlegenden Bestandteile der Controlling-Analyse. Die Transportprozesse stellen einen schlüsselhaften Prozess, der den Materialfluss in der ganzen Lieferkette effektiv gewährleistet, dar. Aus diesem Grunde haben die Autoren der Effektivität von Transportprozessen ihre besondere Achtung geschenkt.
Methoden: Die Forschungsarbeiten führte man im zweiten Halbjahr 2014 in 210 in Gro?polen lokalisierten Unternehmen durch. Die gezielte Wahrnehmung und die von den Autoren durchgeführte Erforschung der Wirtschaftspraxis zeugen von einem bedeutenden Einfluss der Prozess-Standardisierung auf die Effektivität der Lieferkette. Gestützt auf die Forschungsergebnisse wurden die Standards für diejenigen Prozesse, die einer Standardisierung in der Wirtschaftspraxis unbedingt bedürfen, augearbeitet.
Ergebnisse: Aufgrund der erzielten Ergebnisse und Beobachtungen haben die Autoren die Standards für die Transportprozesse nach der BPMN-Notation erarbeitet, die ihnen es erlaubt, in den weiteren Etappen der fortgesetzten wissenschaftlichen Forschungen Mehrvarianten-Simulationen solcher Prozesse durchzuführen.
Fazit: Die ausgearbeiteten Standards gelten als eine einleitende Etappe für die Forschungen, die von den Autoren im Rahmen der Bewertung der Effektivität der Transportprozesse weiterhin in Angriff genommen werden. Die Ausrichtung der weiteren Erforschung zielt auf die Analyse der Effektivität der Anwendung der betreffenden Standards in der Wirtschaftspraxis und auf die Bewertung des auf die Effizienz der ganzen Lieferkette ausgeübten Einflusses hin.

Codewörter: Effektivität der Lieferkette, Effektivität des Transportes, operatives Controlling.

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