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Метод оценки эффективности транспортных процессов в цепях поставок

The evaluation method of transport processes efficiency in supply chains

(Статья публикуется в авторской редакции)

Аннотация

Статья посвящена вопросам анализа и оценки эффективности транспортных процессов в цепях поставок. Сделан акцент на экологических угрозах от деятельности транспортной отрасли, которые появляются в условиях погони за наибольшей эффективностью. Выполнен литературный обзор и отмечено, что, несмотря на имеющиеся научные труды по этой теме, проблема оценки эффективности транспорта остается и является весьма актуальной. Авторами предложен метод оценки транспортной эффективности и изучены варианты ее повышения. Для каждого варианта повышения эффективности рекомендовано выбирать свою концепцию управления. Проведена классификация финансовых показателей с точки зрения различных участников логистических цепей поставок.

Ключевые слова: транспортная эффективность, цепь поставок, операционный контроль.

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Summary

The article discusses issues concerning the analysis and evaluation of the efficiency of transport processes. Emphasis is placed on environmental threats from the activities of the transport industry, which appear under the conditions of the pursuit of maximum efficiency. Completed literature review, and noted that despite the existing scientific papers on this topic, the problem of assessing the effectiveness of transport is still very relevant. The authors proposed a method for evaluation the efficiency of transport processes and to explore options to improve it. To improve the effectiveness of each option is recommended to choose their operating concept. The classification of financial performance was completed from the various points of view: various participants of the logistics supply chain.

Keywords: transport efficiency, supply chains, operational controlling.

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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.

International organizations and individual countries propose the criteria and indicators of sustainable development, often containing quite complicated system of indicators. Working out indicators of sustainable development is often quite complex and expensive procedure that requires a large amount of information, which is difficult or sometimes just impossible to obtain [1].

In the paper [2] as indicators when assessing the cost-effectiveness of environmental projects by reference to time characteristics, the algorithm of calculation based on net present value, profitability index is proposed as the indicator.

Environmental efficiency of production in the paper [3] is evaluated by six indicators of man's impact on the environment. To get integral value E_3 the procedure of regulation of each type of impact on revenues or staff is used. Then for the whole complex of enterprises they were determined the average values of each impact out of the normalized ones, which are assumed as the norm of 100 %.

Accordingly, each of six types of impacts of any company can be expressed as a percentage to the level taken as 100, these six evaluations can be summarized and divided by six. The obtained ratio of environmental impact and economic potential (E_3/E_2) is essentially the inverse value of the eco-efficiency, which is calculated by the relevant conversion.

In the paper [4] there is an attempt to use together with the existing synthetic indicators the integral ones, which are calculated as geometric mean values in order to assess the effectiveness of innovative processes in rail transport.

Efficiency of transport process

Transport efficiency is a very important issue from the point of view of processes organised in a company and in a supply chain. Improving the efficiency of a transport pro-

cess is therefore a very important factor in controlling actions. Nevertheless, it needs to be remembered that aiming at maximising transport efficiency can entail numerous threats. The most dangerous traps of maximising efficiency are: lack of coordination in realisation of operational aims of individual departments with strategic aims of a company or a supply chain, discrepancy between strategic aims formulated by individual companies which are elements of a supply chain, discrepancy between operational aims of different departments of a company and, finally, threat of a negative influence on the surrounding environment [5].

Transport efficiency is a concept which is quite difficult to define. Generally efficiency can be defined as a measurement (usually expressed as a percentage) of the actual output to the standard output expected. Efficiency measures how well something is performing relative to existing standards; in contrast, productivity measures output relative to a specific input, e. g., tons/labor hour [6].

In the economic aspect, efficiency is the result of company's business activity, which is the ratio of the effect achieved to the spending incurred:

$$E = \frac{e}{s}, \quad (1)$$

where: E — efficiency; e — effects; s — spending

The resulting efficiency improvement can be achieved through a deliberate development of value-oriented processes, thus establishing the proper (standard) allocation of resources. The method for evaluating the resource allocation efficiency presented in this paper is consistent with the concept of Kaldor-Hicks efficiency, according to which the solution leads to increased efficiency when the proper allocation of resources enables improvement of efficiency ratio described by formula (1). In a situation where any change of a specific allocation of resources causes a decrease of efficiency ratio — the current allocation is the most effective [7–8].

Complexity of transport management is supported by a number of managing concepts which are implemented in order to improve efficiency. According to model (1) we can distinguish few methods of improving efficiency of actions:

- lowering spendings and keeping the level of effects at the same time,
- lowering spendings and raising the level of effects at the same time,
- keeping the level of spendings and raising the level of effects at the same time,
- raising the level of spendings and raising drastically the level of effects at the same time.

Figure 1 shows basic methods of improving transport efficiency and attributing them to chosen concepts of managing.

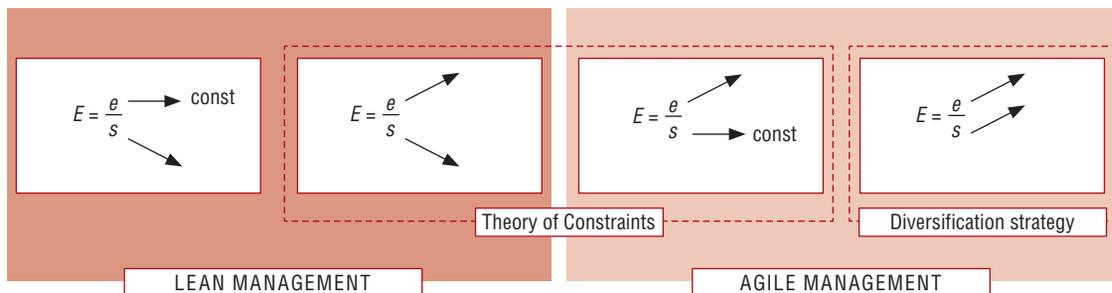


Fig. 1. Attributing methods of improving efficiency to chosen concepts of managing. Source: Own study

The basis of the above picture is conviction that Lean Management concept concentrates on lowering spendings by, among others, lowering the level of expenses. Agile Management concept, on the other hand, does not focus on expenses optimisation. Therefore, the methods of improving efficiency which did not concern lowering spendings were recognised as characteristic of Agile Management concept. Theory of Constraints concentrates on two methods of improving efficiency: improving effects and keeping spendings as well as improving process and lowering spendings (e. g. reducing the supply of work in progress). According to the definition of diversification strategy [9–10], raising effects is possible thanks to increasing spendings (e. g. introducing new services or entering new markets).

Evaluation of transport proces efficiency

An analysis of transport efficiency should be based not only on operational indicators, which are directly connected with transport process, but also on financial indicators. Aims and indicators used in an analysis of transport efficiency should result from a company’s vision and strategy. An analysis of transport efficiency can be named complete when it does not only refer to indicators which apply to past results but also when it allows to monitor what affects future results. The problem of complete transport efficiency assessment has still not been polished in the matter subject literature. The problem of transport efficiency assessment can be based on the assumptions of Balanced Scorecard developed by R. Kaplan and D. Norton. The authors proposed the analysis of efficiency from four perspectives: financial, customer, internal business process, and learning and growth. Many companies already have performance measurement systems that incorporate financial and nonfinancial measures. What is new about a call for a “balanced” set of measures? While virtually all organizations do indeed have financial and nonfinancial measures, many use their nonfinancial measures for local improvements, at their front-line and customer facing operations. Aggregate financial measures are used by senior managers as if these measures could summarize adequately the results of oper-

ations performed by their lower and mid-level employees. These organizations are using their financial and nonfinancial performance measures only for tactical feedback and control of logistics process in short-term [11].

Carrying out an analysis of transport efficiency in discussed four perspectives, we have developed a set of indicators [12–16; 1]; which take into account the basic characteristics of efficiency defined by model (1). Table 1 presents selected indicators of assessing transport efficiency in a financial perspective.

Table 1

Selected indicators of assessing transport efficiency in a financial perspective

No	name of indicator	formula	characteristic	unit
1.	Return on investment (ROI)		a — net profit	%
			b — investment*	
2.	Return on equity (ROE)		a — net income after tax	%
			b — shareholder equity	
3.	Return on assets (ROA)		a — net income	%
			b — mode of total assets	
4.	Return on sales (ROS)	$\frac{a}{b}$	a — net profit	%
			b — sales revenue	
5.	Indicator of complaints and returns		a — value/cost of complaints and returns	%
			b — value/cost of all deliveries	
6.	Indicator of the cost-transport fleet		a — mileage costs	PLN/vehicle
			b — number of vehicles	

*Investment, means the money which were spend for buying things which will be sold [17].

Source: Own study

The table shows only chosen financial indicators which, in author's opinion, are most often used when assessing transport efficiency in ecological aspect. There are many more indicators which can be useful in economic practice but it needs to be borne in mind that the more indicators, the bigger the threat of missing the main aim of carrying out an analysis.

Table 2 presents selected indicators of assessing transport efficiency in a customer's perspective.

Table 2

Selected indicators of assessing transport efficiency in a customer's perspective

No	name of indicator	formula	characteristic	unit
1.	Indicator of transportation timeliness	$\frac{a}{b}$	a — number of forward transportation	%
			b — total number of transportation	
2.	Indicator of cargo damage during transport		a — number of damaged transport units	%
			b — total number of transport units	
3.	Delivery reactivity	a — number of items delivered ahead of schedule	%	
		b — total number of elements		
4.	The share of incomplete deliveries to the customer	a — number of incomplete deliveries	%	
		b — total number of deliveries		

Source: Own study

Some of the aforementioned indicators very often come down to one indicator-OTIF (On Time and In Full delivery). This indicator should be seen as the level of customer's service from customer's perspective (commercial network) — "on-time, in-full" — full orders, delivered on time. In practice we can meet the term OTIF developed by "error-free" element. This element allows for mistakes in completion (quantity is ok but a different variant than ordered has been delivered). OTIF has become the key driver for process improvement initiatives across the organization. Planning orientation and organizational integration resulted in process optimization across the supply chain resulting in a higher service level with reduction in inventories [18]. Table 3 presents selected indicators of transport efficiency in the internal process perspective.

The aspect of transport process efficiency is most evident in the compilation of indicators in the company's internal business process perspective. This should not be surprising, as the operational processes that enable transportation of products have the greatest impact on the evaluation of the transport process efficiency. Table 4 shows the selected indicators of transport process efficiency in the learning and growth perspective.

Table 3

Selected indicators of assessing transport efficiency in the internal process perspective

No	name of indicator	formula	characteristic	unit
1.	Rate of transport fleet use	$\frac{a}{b}$	a — number of driven kilometers	km/vehicle
			b — number of vehicles	
2.	Indicator of vehicles utilization capacity		a — weight of transported cargo	kg/vehicle
			b — number of vehicles	
3.	Cargo predictability	a — transported cargo (weight or volume)	%	
		b — transport fleet capacity		
4.	Indicator of transport intensity	a — transportation time	h/delivery	
		b — total number of deliveries		

Source: Own study

Table 4

Selected indicators of assessing transport efficiency in the learning and growth perspective

No	name of indicator	formula	characteristic	unit
1.	The share of defective deliveries	$\frac{a}{b}$	a — number of defective deliveries	%
			b — total number of deliveries	
2.	Delivery flexibility		a — number of special deliveries	%
			b — total number of deliveries	
3.	Transport reliability	a — number of operations on time	%	
		b — total number of operations		
4.	Indicator of cargo damage during transport	a — number of damaged transport units	%	
		b — total number of transport units		

Source: Own study

The indicators of transport process efficiency evaluation in the learning and growth perspective are the most desirable form of evaluation, but are also the most difficult indicators to develop. The risks posed by learning and growth indicators may not only be contrary to the transport management objective, but also to the basic strategic objectives of the company or supply chain [19]. Analysis and development of measures for efficiency evaluation separately for each perspective can lead to effect opposite to the one expected — a set of indicators that are mutually exclusive or show divergence of objectives can be obtained.

Based on the analysis of literature analysis and taking into account the importance of each indicator in economic practice, an evaluation model was developed for the trans-

port process economic efficiency. Figure 2 shows an overall evaluation model for the transport process efficiency.

The algorithm for evaluation of the transport process efficiency shown in Figure 2 is based on the assumption that individual perspectives of the analysis are equivalents in terms of decision-making. Therefore, in the absence of a positive result of any of the perspectives, the analysed transport process state is deemed economically inefficient. It should be noted, however, that the efficiency analysis in individual perspectives does not have to generate all the results within the normative values. It is possible to use the analysis of economic benefits to establish that despite the presence of deviations the process situation can be considered effective or economically acceptable.

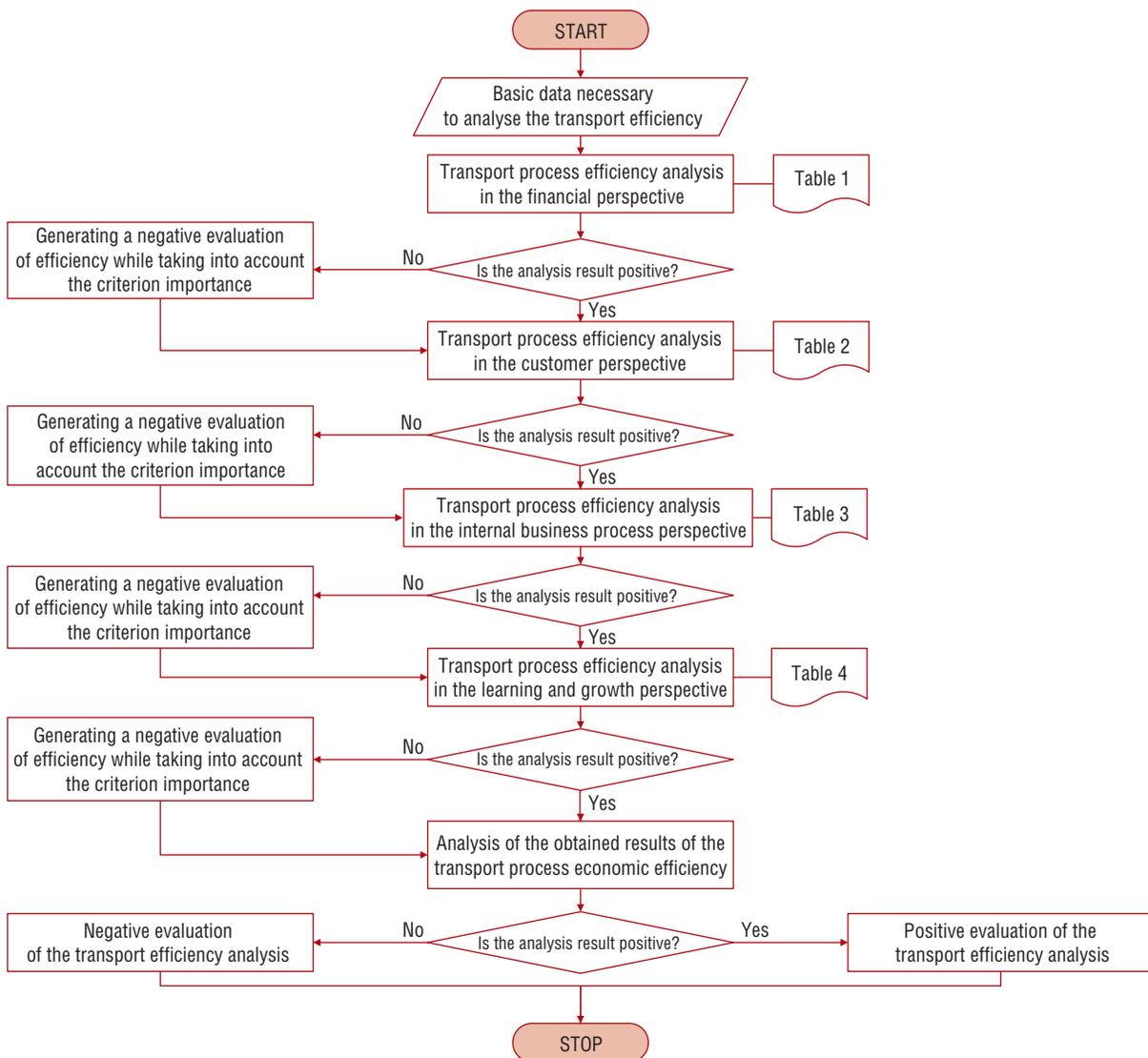


Fig. 2. Overall evaluation model for the transport process efficiency
Source: Own study

Conclusions and further research

So the basis of the assessment of transport environmental efficiency is the definition of its role in building a sustainable society. In order to determine the environmental efforts, it is necessary to accurately measure and evaluate the impact of the activities of the transport sector on the environment and the results of environmental activities. The task of improving the eco-efficiency of transport, is transformed into the problem of integrating different modes in a single system. And the creation of an economic platform GreenS, which will manage a transport complex not only by penalties (Green Straffes) but also by the awarding of every transport modes (Green Starts) for their contribution to saving the environment [1, 20].

The direction of future research and continuation of this work should be an analysis of conditions and system connections as part of evaluation of the logistics process efficiency in companies and supply chains. The efficiency analysis should compare the key indicators in companies within specific industries. Observations on benchmarking of analysis and evaluation of logistics process efficiency prove the need for managerial evaluation models and algorithms in business practice [21, 22]. Joint development of a set of indicators within the supply chain would enable a mutual comparison of the results obtained, which could have a direct impact on improving the efficiency of decisions — not only those affecting individual processes carried out within the company, but also throughout the supply chain. **ИТ**

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