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TABLE OF CONTENTS

PREFACE

The process of development and the possibility of the increase of contemporary enterprises competitiveness, mainly depends on the logistics processes efficiency. The issue of logistics is a particularly important factor in enterprise management in terms of both operational and strategic management, but also in terms of economic and organizational aspects. In the literature one may find the statement that customer service should be considered as the most important element of the modern logistics efficiency. The concentration at the customer service level is determined mainly by globalization and the implementation of new strategies of customer service. All procedures contrasting the way of customer service by an enterprise, are a factor influencing the competitive position on the market. These reasons of business practice make it necessary to concentrate the enterprise executives on the aspect of logistics management.

Logistics management based on strategy formulation, planning, material flow control, warehousing, inventory, work in progress, finished goods and adequate information - from the point of obtaining to the point of consumption - in order to adjust to the needs of customers and their satisfaction. Tasks of logistics management can be divided into supply logistics, production and distribution. Therefore, in this monograph it was decided to take into account the basic material flow phases in terms of enterprise and supply chain management.

The first part of the monograph applies to the practical aspects of logistics management in enterprises. The first chapter raised the issue of the impact of the supply process on the efficiency of enterprise management, including purchasing strategies. The following chapters present the logic of the material flow and the problem of inventory optimization, production management by using tools of Lean Manufacturing, transport management in terms of planning and transport processes organization, warehouse management, taking into account the latest trends affecting the warehouse process efficiency, and logistics controlling as a support tool making operational decisions in the enterprise.

The second part of the monograph has been concentrated on logistics management in the supply chain. A key element of supply chain efficiency is the selection of risk management strategy, which is dedicated to the first chapter. The

next chapter presents the use of IT tools supporting enterprise and supply chain management. Another element to the detailed analysis is to discuss the problems of the application of SOP plan in enterprises and supply chains, analysis of warehouse space, the role of transport operators in the supply chain and the problem of distribution center location.

This monograph is the result of cooperation between researchers from Poznan School of Logistics and Poznan University of Technology, specialists from Institute of Logistics and Warehousing and practitioners of the leading Polish logistics enterprises. The principal aim of the monograph is a comprehensive approach of logistics management, including best practices. The results of the research presented in this monograph are the result of a detailed analysis of not only the Polish economy, but also of international scientific cooperation by the authors of individual chapters, which obtained also thanks to the Erasmus+ Programme. Therefore, another important aim of this monograph is to promote the knowledge and best practices regarding the logistics management and their confrontation with other research institutions in the European Union.

The Editor of this monograph would like to thank all the authors for their commitment, creativity and scientific discussions, without which it cannot be able to discuss the complex issues of logistics management in the enterprise and supply chain.

Adam Koliński

PART 1.
LOGISTICS MANAGEMENT IN ENTERPRISES

CHAPTER 1
INFLUENCE OF SUPPLY PROCESS ON THE BUSINESS MANAGEMENT EFFICIENCY

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Abstract

Making decisions concerning the choice of suppliers and procurement contract conditions, material safety and supplies reliability, allocation of material stock and its recovery, connecting supplies with production processes as well as stock and capital limitations cause multidimensional reliance of a 'trade off' type between procurement and purchasing processes.
This chapter presents the issues of material requirements planning and the proposed system of indicators for evaluation of supply process efficiency.
Keywords: supply efficiency, purchasing, material requirements planning

1.1. Introduction

Procurement can be defined as the entire system, including the supply of its own, external suppliers and their relationships (logistics system approach) or as a delivery, or set of activities leading to the delivery of goods to the place at the right time, quantity and condition. The definition of supply is often considered as synonymous concept of purchasing (table 1.1). In this context, supply is the process of acquiring the business of goods and services (intake process, purchasing) or a range of supply operations, including the step acquisition - aspect of the transaction and the physical flow of products - transportation, receipt and

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storage of intermediate materials, as well as other actions essential to execute everyday business functions in the area of goods and services acquisition. The subject of procurement logistics is goods (raw materials, auxiliary materials and consumables, purchase and goods acquired in trade) that should be made available to an enterprise in accordance with its needs. Strategic decisions in the supply logistics include:

- make or buy,
- rules for the selection and evaluation of suppliers,
- selection of control rules of material supplies,
- the area of computerization of supply processes.

Tab. 1.1 The differences between supply logistics and procurement

Supply logistics	**Procurement (purchasing)**
optimal quality of products assurance	the type of purchase specification
minimizing the total cost	determination of the necessary level of investment
acquisition and maintenance of reliable and competitive suppliers	implementation of the procurement process
minimum inventory level and smooth flow of raw materials	evaluation of procurement process efficiency
cooperation and integration with other areas of enterprise	

Source: (Domański, Adamczak, Cyplik, 2012, p. 12)

A key aspect of the sphere of supply decisions in purchasing and delivery of materials and raw materials. These instruments of procurement policy include: product policy, contracting policy, communication policy and purchasing policies.

Carrying out a detailed analysis it needs to look at the process of material management using the refference methodology of the SCOR[1] process approach and take into consideration components (Śliwczyński, Koliński, 2012, p. 300):

- S&OP planning - makes it possible to plan operations in a supply chain including transposing the needs of sales into the level of planning the stream of goods from production process,

[1] SCOR – Eng. *Supply-Chain Operations Reference Model – Model Overview Version 9.0.* – a referential model of supply chain operations integrating five basic processes– planning, supplies, realisation, distribution and service of the turning streams, developed by managers and academics associated in a global organisation *Supply-Chain Council.* The model consists of representative methods of describing supply chain processes, a set of standards for the assessment of processes and their results as well as the best practical actions of managing processes in a supply chain.

- material requirements planning – including material structure of a product, which is necessary for material count, technologies and production itineraries, necessary for scheduling material needs, and store states; simulation is carried out with the nett values of material needs,
- the procedure of commission- makes simulation of individual variants possible according to estimated nett material needs,
- the generator of real consumption and the algorithm of updating prognoses, which should be treated as auxiliary simulation models of real consumption for examined material indices; they are necessary for simulating the real environment of material supplies realization, transport processes and supplies availability at the stage of verifying the commission models
- commission procedure verification - facilitating a multi-criteria analysis and the choice of satisfactory models according to set criteria values,
- the transport system and the verification model of that system including the model solution for a multi-criteria load and routes planning as well as means straining and transit scheduling,
- the warehouse process, which is also an auxiliary model necessary for defining the capability of receiving and servicing transport processes and maintaining supplies.

The efficiency of supply process depends on several factors. The research of business practice shows that enterprises have the biggest problems with the appropriate planning and monitoring process. Table 1.2 summarizes the key factors influencing of supply process efficiency.

Tab. 1.2 Key factors influencing of supply process efficiency

Element of supply process	**Percentage of answers ***
Material Requirements Planning (MRP)	24%
The process of supply monitoring in enterprise	27%
The process of suppliers qualification	23%
Scheduling of materials supply	21%
The choice of method of replenishing the individual product groups	20%
Analysis of supplies completeness	22%
* The surveyed enterprises were able to choose more than one answer.	

Source: own study in a group of 174 enterprises from the manufacturing industry, TSL and trade

The specificity of production and service enterprises also indicates an interest in operational activities of the supply process. In this chapter, the author decided to focus on the tactical level of supply process management in the enterprise. Therefore, the detailed discussion on the impact of the supply process on the efficiency of the enterprise includes:

- material requirements planning,
- developing a system of evaluation measures of the supply process efficiency.

1.2. Material Requirements Planning in enterprise

One of the most often used tool supporting a enterprise's management is the function of material requirements planning (MRP). Material requirements planning can be defined as a set of techniques that uses bill of material data, inventory data, and the master production schedule to calculate requirements for materials. It makes recommendations to release replenishment orders for material. Further, because it is time-phased, it makes recommendations to reschedule open orders when due dates and need dates are not in phase. Time-phased MRP begins with the items listed on the MPS and determines the quantity of all components and materials required to fabricate those items and the date that the components and material are required. Time-phased MRP is accomplished by exploding the bill of material, adjusting for inventory quantities on hand or on order, and offsetting the net requirements by the appropriate lead times (APICS, 2004).

The main aims of using material requirements planning are as follows (Fajfer, Koliński, Krajewski, 2014, p. 20):

- supply reduction,
- delivery times of products and intermediate products determination,
- accurate allocation of production costs,
- better use of available infrastructure (warehouses, production capabilities),
- quicker reactions to changes taking place in the surrounding environment,
- control of realisation of individual production stages.

MRP Closed Loop is an decisions option which supports material supply including feedback in making management decisions. Closed Loop MRP (Fig. 1.1) is a system built around material requirements planning that includes the additional planning processes of production planning (sales and operations planning), master production scheduling, and capacity requirements planning. Once this planning phase is complete and the plans have been accepted as realistic and attainable, the execution processes come into play. These processes include the manufacturing

control processes of input-output (capacity) measurement, detailed scheduling and dispatching, as well as anticipated delay reports from both the plant and suppliers, supplier scheduling, and so on. The term closed loop implies not only that each of these processes is included in the overall system, but also that feedback is provided by the execution processes so that the planning can be kept valid at all times (APICS, 2004).

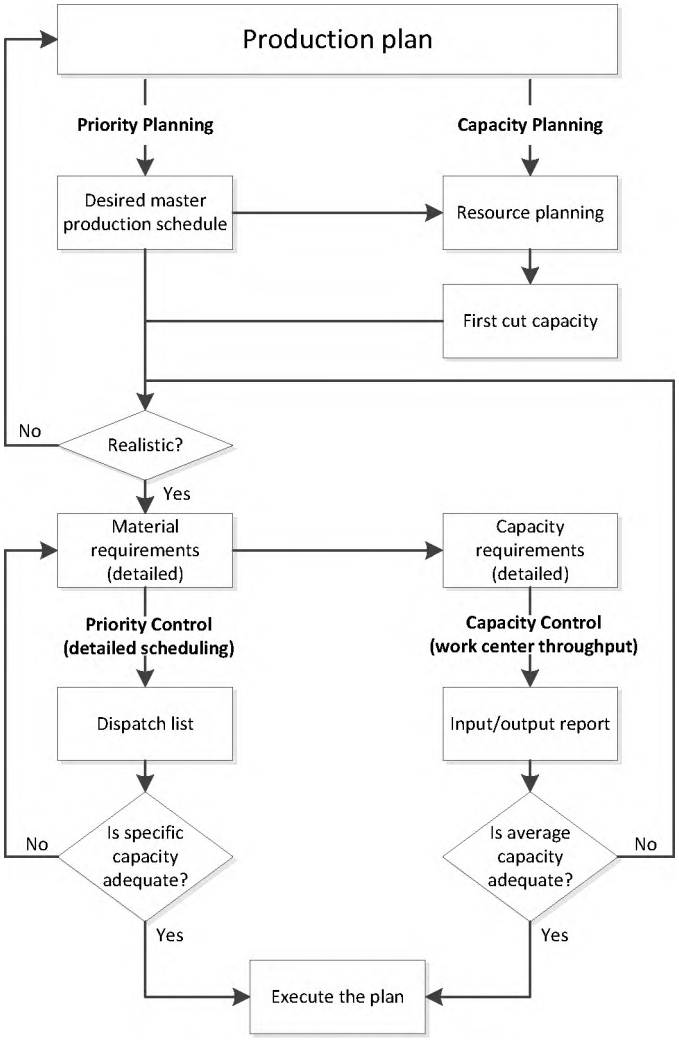

Fig. 1.1. Closed-Loop MRP
Source: own study based on (Heizer, Render, 2008, p. 579)

1.3. Analysis of supply efficiency

It is difficult to clearly define the concept of efficiency. In the economic aspect, efficiency is the result of enterprise'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

Efficiency is defined ambiguously, particularly in the literature, which causes major decision-making problems, both on the strategic and operational level. In the literature there are numerous notions wrongly treated as synonymous, such as efficiency, productivity and profitability. Table 1.3 shows the essential differences among these notions.

Tab. 1.3 Essential differences between efficiency, productivity, effectiveness, profitability, and reliability

Efficiency	The quotient of effect and expenditures incurred to acquire the effect.
Productivity	The ratio of total production (goods or services), achieved by an object (an employee or group of employees, technical equipment, plant, etc.) to the total time of his work. Productivity is a feature of an object participating in the production process (e.g. employee, machine) regardless of whether the manufactured products will be sold or not.
Effectiveness	The degree to which the system has reached the intended objective. Effectiveness is measured by the ratio of the achieved result (e.g. completed production) to the intended result (e.g. planned production volume).
Profitability	The ratio of profits earned by the enterprise to the value of sales, value of assets, or the value of equity. We can then talk about the profit rate (profitability of sales), profitability of employed capital, and the profitability of own capital. We can distinguish various types of profit in the analysed profitability ratios: gross profit, net profit, and operating profit. Since the main purpose of any business activity is to generate profit, profitability ratios play a very important role in the evaluation of the health of a enterprise.
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)

Due to the complex nature of the efficiency of supply processes, the ambiguity of definitions, and the wide range of tools both used in business practice and presented in the literature, it is very difficult to successfully use efficiency analyses in enterprises.

Measuring results is the basis of management incorporating efficiency activities in a enterprise. Developing suitable measures and techniques is though troublesome. In order to create a coherent indicators system one needs to connect individual levels of enterprise's management in a 'cause and effect' way. A close connection between strategic and operational levels rationalises the process of analysing anomalies of individual values from the plan on tactical and operational levels. Compliance of current actions is assessed on the basis of defined strategic aims which should be transposed to an operational level. Transposing enterprise's strategic aims to tactical and operational levels depends on, from the controlling point of view, modifying criteria and measures for assessing efficiency of the aims realisation. Criteria and measures for analysis of anomalies of the real state of things from the one that has been planned, on an operational level, are not only long-term but also very general when it comes to the obtained data, e.g. market share. However, it needs to be remembered that it is already on an operational level where it is necessary to monitor gradually the aims realisation and alternatively correct current actions so as to increase the probability of gaining the result that has been planned (Śliwczyński, Koliński, 2012, p. 300).

Transposing a strategic aim in an expense aspect is possible due to a detailed analysis of a S&OP plan which includes programming the choice and the size of sales on individual markets and operations securing the sales in a complete supply chain. The S&OP plan is a decisional process thanks to which all tactical plans are coordinated with each other. However, an effective analysis should be supported by input data that is not financial.

It is just a multi-criteria analysis of the S&OP plan that can be a reliable basis for transposing enterprise's aims to the operational level of the sourcing process. Therefore, the developed system of indicators requires a detailed role of expenses analysis that sourcing expenses play in a logistic process. Accepting the basic dependence of logistic expenses and transposing them to sourcing expenses, other expenses should be treated as permanent, or known, to the decision maker of the controlling system. Transposing enterprise's result to sourcing expenses is shown in fig. 1.2.

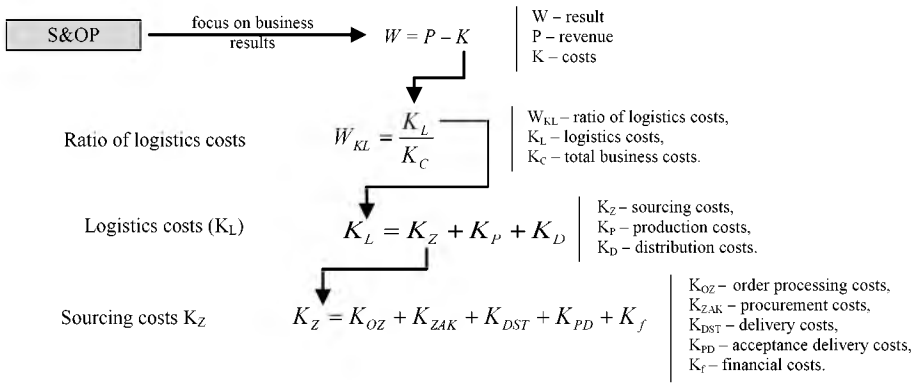

Fig. 1.2. Transposing enterprise's result to sourcing expenses
Source: own study (Śliwczyński, Koliński, 2012, p. 302)

The idea shown in fig. 1.2 is based on the assumption of expenses optimisation as a more efficient tool of improving enterprise's result. Expenses optimisation is about rationalising factors which can be steered by a enterprise and for this reason it has a tremendous effect on the possibility to generate higher profits. However, it needs to be remembered that the optimum concentration on the analysis of sourcing expenses is advisable only in a situation when the value of logistic expenses rate, meaning the share of logistic expenses in enterprise's total expenses, is significant.

Efficiency analysis supports planning and organization of the supply process, control of results and correcting deviations, by (Śliwczyński, Koliński, 2016):

- mapping client's needs regarding materials in the final product to the requirements of the supply process (e.g. scope and methods of material quality control),
- current ABC/XYZ classification of materials, suppliers, supply channels and the selection of methods and algorithms for supply management in classification groups,
- support in determining the methods and procedures of steering and operational norms - for purchasing, orders, deliveries and inventories,
- support in developing effective and safe methods of qualifying suppliers and coordinating periodic control of suppliers (technological, financial, trade, logistics, qualitative),
- support and coordination to conclude purchase contracts, negotiate terms of cooperation, payment and execution of deliveries,

- controlling and steering the process of ordering, monitoring deliveries, integration with the warehousing process for efficient support of delivery acceptance, exchange of information and support of complaints and returns,
- support of planning material needs and controlling the conversion formulas and scheduling of the MRP system (Material Requirement Planning),
- analysis of working capital - commitments cycle and inventory cycle,
- control of delivery parameters - timeliness, completeness, quality compliance of materials,
- developing the map of material safety covering rational scenarios and variants of deliveries, and analysis of supply risk, downtime and changes in production plans, sales shortages
- integration of plans of supply, production, transportation, warehousing, sales,
- account of supply costs and materials management,
- setting and controlling value limits of purchases,
- developing and controlling the budget of purchases and supply, analysis of deviations and implementing corrections and budgets conversions,
- reporting of the supply and materials management process.

1.4. Indicators system of supply efficiency

The supply process efficiency analysis should be based not only on operational indicators directly related to the supply process, but also on financial indicators. The objectives and measures of the supply process efficiency analysis should be a result of the enterprise's vision and strategy. The supply process efficiency analysis should be considered complete when it relates not only to the measures concerning the past results, but also to the measures that allow anticipating the impact on the results in the future. The issue of the supply process efficiency evaluation may be based on assumptions of Balanced Scorecard (Michalska, 2005) developed by R. Kaplan and D. Norton. The authors proposed a balanced performance evaluation according to the relation between the objectives and the value of their measures in the following perspectives: financial, customer, internal business processes, learning and growth (Kaplan, Norton, 1996, p. 8). Economic efficiency should, therefore, be understood as analysis and evaluation using financial and non-financial indicators that have a direct impact on the supply process economics.

A set of measures was developed according to the production process efficiency analysis in these four perspectives (Śliwczyński 2011; Twaróg 2005)

while taking into account the basic efficiency feature described by formula (1). Table 1.4 shows the selected measures of economic evaluation of the supply process efficiency in the financial perspective.

Tab. 1.4 Indicators of assessing supply efficiency in the financial perspective

No.	Name of indicator	Data relation	Data	UoM
1.	Index of complaints and returns	$\frac{a}{b}$	a – value/cost of complaints and returns	%
			b - value/cost of all supplies of materials and raw materials	
2.	Index of valuable incompleteness of deliveries		a – value of incomplete deliveries	%
			b - total value of deliveries	
3.	Material inventory turnover index		a - costs of materials consumption	%
			b - average inventory of materials	
4.	Average value/ cost of delivery		a – value/cost of completed orders	PLN
			b – number of completed orders	

Source: own study

The table shows chosen financial indicators which, in the author's opinion, are most often used when assessing supply efficiency. 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 the analysis. Table 1.5 presents selected indicators of assessing supply efficiency in a customer's perspective.

Tab. 1.5 Indicators of assessing supply efficiency in the customer perspective

No.	Name of indicator	Data relation	Data	UoM
1.	Efficiency of order realization	$\frac{a}{b}$	a - number of completed orders	%
			b - general number of orders	
2.	Quantitative and value market share		a - size of the target group of clients	%
			b - total size of the market	
3.	Average duration of delivery		a - total delivery time	h
			b - number of deliveries	
4.	Share of incomplete deliveries to the client		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 (Sehgal et al., 2006). Table 1.6 presents selected indicators of supply efficiency in a perspective of an internal business process.

Tab. 1.6 Indicators of assessing supply efficiency in the internal business process perspective

No.	Name of indicator	Data relation	Data	UoM
1.	Efficiency of acceptance of materials	$\frac{a}{b}$	a – average time of acceptance of materials	h/em.
			b – number of employees	
2.	Reliability of delivery		a – number of deliveries compatible with the order	%
			b - total number of deliveries	
3.	Share of faulty raw materials deliveries		a - number of faulty raw materials deliveries	%
			b - total number of raw materials deliveries	
4.	Untimeliness of deliveries		a – number of untimely deliveries	%
			b- total number of deliveries	

Source: own study

The aspect of production process economic efficiency is most evident in the compilation of indicators in the enterprise's internal business process perspective. This state of affairs should not be surprising as these are processes which take place on an operational level that have the biggest contribution in assessing supply efficiency. Table 1.7 presents selected indicators of supply efficiency in the learning and growth perspective.

The indicators of supply 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 supply process management objective, but also to

the basic strategic objectives of the enterprise or supply chain (Lichocik, Sadowski, 2013).

Tab. 1.7 Indicators of assessing supply efficiency in the learning and growth perspective

No.	Name of indicator	Data relation	Data	UoM
1.	Share of faulty raw materials deliveries	$\frac{a}{b}$	a - number of faulty raw materials deliveries	%
			b - total number of raw materials deliveries	
2.	Flexibility of delivery		a – number of deliveries that meet the special requirements	%
			b – total number of deliveries	
3.	Reliability of delivery		a – number of deliveries compatible with the order	%
			b - total number of deliveries	
4.	Load standardization		a – the number of items included in the unified loads	%
			b- the number of items included on general loads	

Source: own study

While preparing the compilation of indicators of supply efficiency evaluation it should be taken into account that there are close links between the various perspectives according to the balancing of perspectives in the BSC. 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.

The set of indicators developed above was confronted by the authors with the business practice expectations. The research involved the importance analysis of the developed indicators in individual perspectives.

The authors assumed that the concept of significance (importance) expresses the respondent's strength of belief/confidence as to the validity, effectiveness and the ability to use the indicator in various perspectives. The same mechanism was established for evaluation of each criterion - based on a five-level Likert scale (Likert, 1932), plus a zero level. The indicator importance measurement scale was developed to determine the strength of impact according to an average of the results obtained. The position of many research teams presented in the literature indicates that the analyses based on the assumptions of Likert scale are quantitative (Elliott, Woodward, 2007; Gamst, Meyers, Guarino, 2008; Gatignon, 2013). The scores mean the following:

- 0 – no significance,
- 5 – very high significance.

When analysing the importance of each indicator, it should be noted that all the evaluated indicators were considered important. The decision threshold was an average of the results obtained above 3.0 (medium significance). Table 1.8 presents detailed results for individual indicators used for evaluating the supply process efficiency.

Tab. 1.8 Detailed importance analysis of individual efficiency evaluation indicators

Perspective	Name of indicator	Indicator importance [number of responses]						Average value
		0	1	2	3	4	5	
Learning and growth perspective	Share of faulty raw materials deliveries	22	10	7	26	41	31	3,073
	Flexibility of delivery	3	9	4	40	46	35	3,620
	Reliability of delivery	6	6	8	26	42	49	3,745
	Load standardization	5	12	20	32	39	29	3,277
Internal business process perspective	Efficiency of acceptance of materials	4	4	16	36	36	42	3,609
	Reliability of delivery	3	1	12	15	36	71	4,123
	Share of faulty raw materials deliveries	4	8	16	38	43	29	3,413
	Untimeliness of deliveries	8	1	2	18	43	66	4,065
Customer perspective	Efficiency of order realization	0	6	3	20	54	55	4,080
	Quantitative and value market share	3	10	33	24	34	34	3,290
	Average duration of delivery	0	7	11	14	56	50	3,949
	Share of incomplete deliveries to the client	0	6	8	15	56	53	4,029
Financial perspective	Index of complaints and returns	1	4	14	28	43	48	3,826
	Index of valuable incompleteness of deliveries	5	7	13	43	43	27	3,399
	Material inventory turnover index	6	6	18	39	32	37	3,420
	Average value/ cost of delivery	11	9	13	40	30	35	3,261

Source: own study in a group of 138 enterprises from the manufacturing industry, TSL and trade

1.5. Conclusions

Supply is a key element of the logistics process, due to the guarantee of the availability of materials for the production process or goods for the sales and distribution. In this chapter, the authors presented the study on the supply process efficiency based on the Balanced Scorecard. This methodology of developing indicators system is a continuation of research conducted by the author of the

production process (Koliński, 2013), warehousing (Koliński, Śliwczyński, 2015) and transport (Koliński, Zhuravskaya, 2015; Stajniak, Koliński, 2014). The research, which involved the importance analysis of the developed indicators in individual perspectives, have also been carried out in accordance with a standard developed by the author and presented in the publication (Koliński, Śliwczyński, Golińska-Dawson, 2016). The main objective of this methodology is to develop a comprehensive system of indicators to assess the efficiency of logistics processes in the supply chain.

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