

Wrocław University  
of Economics

**FACULTY OF MANAGEMENT, COMPUTER SCIENCE AND FINANCE**

Paulina Bełch

**COST ANALYSIS  
IN CONTROLLING OF LOGISTICS PROCESSES**

PhD Thesis Summary

**Supervisor – dr hab. Marta Nowak, prof. UE**

**Auxiliary supervisor – dr Łukasz Szydelko**

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## Keywords:

- logistics in management of enterprise,
- costs of logistics processes,
- logistics processes,
- accounting focused on logistics processes,
- cost dynamics,
- cost structure,
- cost analysis,
- controlling of logistics processes,
- meters and cost indicators.

## **Introduction**

Global economic development, progressive globalization and growing consumption, constant changes in the functioning of enterprises, instability of the environment, dynamic management strategies, intensifying competition and the challenges of the 21st century make demand for current and useful information in *ex post* and *ex ante* mode for management needs bigger. Enterprises operating in a competitive environment perform various and complex tasks at the same time. Due to the need to minimize production costs while increasing the quality of products and timeliness of service, logistics is becoming the more and more important role in organizations. It covers not only flows of materials, goods and finished products, but also flows of information and cash. Based on logistics, managers can create an effective knowledge system about the entire enterprise.

Running a business is strictly correlated with incurring costs. They are a direct consequence of resource management and must be constantly analyzed and controlled. Specific management decisions are made on the basis of information on costs.

Logistics processes related to business activity carried out by business units result in the formation of specific logistics costs. These in turn have a direct impact on shaping the financial result of the entity. Modern production companies operate in unstable environments, therefore they must constantly adapt to changes occurring in it, and are constantly subjected to repeated verification of the "invisible hand of the market". As a result, managers are looking for new management support tools. Controlling is particularly important in this area.

### **Justification for the choice of topic**

As a result of the combination of logistics process, controlling and cost analysis, an interesting research area emerges, including cost analysis in controlling of logistics processes. The choice of such an area of theoretical considerations and empirical research for the purposes of a PhD dissertation was dictated by several reasons.

Firstly, globalization and increasing market competition have a significant impact on managers and lead to an increase in demand for cost information, especially in the area of corporate logistics. When implementing logistics processes, their performance and efficiency become crucial. Their fulfillment and implementation depend on the logistics process management system. This system should be based on reliable information from the accounting system. In addition, it should be supported by information from controlling of logistics processes, especially oriented the costs of logistics processes.

Secondly, decision-making problems and their specificity, as well as the conditions created by the economic reality, make the expectations and requirements for accounting increasingly higher. Contemporary accounting, in order to serve as an effective information system, must be subject to changes. In economic practice, there is a lack of a proper model of accounting policy oriented on the costs of logistics processes.

There is also no comprehensive study on cost analysis in controlling of logistics processes as one of the tools to increase the performance of these processes. It should also be emphasized that there are no publications taking into account the role of statistical methods of cost analysis in relation to controlling of logistics processes. Additionally, the choice of research issues is dictated by the possibility of using the results of work in economic practice.

## **Work objectives and thesis**

Due to the fact that the performance of logistics processes is important for managers, it is reasonable to point out that cost analysis becomes particularly important in this context. The main objective of the study was to indicate the possibility of using cost analysis in controlling of logistics processes and to assess its usefulness in increasing the performance of logistics processes.

The achievement of the main goal of the dissertation is possible through the implementation of the following specific objectives:

1. definition of economic efficiency at the level of logistics processes;
2. defining the essence and scope of controlling of logistics processes and recognizing the conditions of its functioning in manufacturing companies;
3. identification of data acquisition sources for cost analysis of logistics processes, with particular emphasis on accounting;
4. indication of the accounting policy areas in the manufacturing company relevant for the cost analysis of logistics processes;
5. determining the scope of the analysis of costs of logistics processes;
6. adaptation of statistical methods used in the area of cost analysis of logistics processes;
7. determination of measures and verification of their classification for the purpose of controlling of logistics processes;
8. creation of a system of cost measures in controlling logistics processes;
9. practical verification of the system of cost indicators in a production company.

The PhD thesis: cost analysis in controlling of logistics processes contributes to improving the performance of logistics processes.

## **Research methods and the scope of the dissertation**

Achieving the assumed goals and verifying the thesis was based on the research procedure, which included:

- a critical review of Polish and foreign literature (in English and German) and legal acts,
- analysis of the content of internal documents of the production company,
- case study,
- surveys,
- methods of inductive and deductive reasoning,
- reasoning by analogy,
- method of analysis and synthesis.

Research into cost analysis in controlling of logistics processes was conducted in two areas. First, the conditions of the functioning of controlling of logistics processes in manufacturing enterprises were examined, the basic logistics processes of supply, production and distribution occurring in enterprises were identified. In addition, various aspects of the analysis of the costs of logistics processes occurring in the production enterprise selected from the Podkarpackie Voivodeship, selected for the needs of the dissertation, were examined.

The subject scope of the dissertation covers issues in the area of logistics processes management, cost analysis and controlling of logistics. On the other hand, the scope of the subject has been indicated by the selection of an appropriate company in which it is possible to apply solutions in the area of controlling of logistics processes. The dissertation is a production company from the Podkarpackie Province. In addition, the survey subjects are production companies located in the Podkarpackie Voivodeship, which have implemented a process approach according to PN-EN ISO 9001: 2009 or PN-EN ISO 9001: 2015.

## **Work structure**

Formulated goals and thesis were reflected in the structure of the dissertation. It consists of four chapters preceded by an introduction and summarized by the ending. Their complement is the table of contents, a bibliography (broken down into literature, legal acts, Internet sources and other sources), a list of drawings, a list of tables and three annexes.

The first chapter is entitled: "The efficiency of logistics processes and controlling of logistics processes" covers issues related to the role of logistics in managing a production enterprise, identifying and classifying logistics processes, as well as the efficiency of logistics processes in economic terms. The relationship between logistics infrastructure and processes is presented. In addition, the controlling of logistics processes was defined and its objectives were set. Based on them, its functions and tasks were determined. This chapter also presents the organizational aspects of controlling of logistics processes. In the practical part of the first chapter, the determinants of the functioning of controlling of logistics processes were examined in production enterprises from the Podkarpackie Voivodeship.

In the second chapter titled: "Accounting as a data source for the costs analysis of logistics processes", sources of data acquisition for the costs analysis of logistics processes were identified with particular emphasis on accounting and the accounting policy areas in the production enterprise were identified in the cost analysis of logistics processes. The role of accounting policy as an information base for acquiring cost data was also defined and the possibilities of using information accounting in controlling of logistics processes were clarified. The main IT systems were also presented (such as Business Intelligence), with particular emphasis on their importance in order to obtain cost data. Then an attempt was made to adapt the accounting system of the studied production company to the needs of cost analysis in the controlling of logistics processes.

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In the third chapter entitled: "Examination of costs in controlling of logistics processes", the scope of the analysis of the costs of logistics processes was determined. The statistical methods used in the area of this analysis were indicated, such as structure analysis, cost dynamics and causal analysis of deviations of logistics processes costs. The summary of this chapter is the presentation of the possibility of using the cost analysis for controlling of processes in an enterprise unit.

"Cost measures in controlling of logistics processes" is the title of the fourth chapter. An attempt was made to determine the measures and to develop the possibility of their classification for the purpose of controlling of logistics processes. The importance of cost measures as a special form of financial measures is described and the principles and methodology for their creation are presented. As part of this chapter, an attempt was made to create a system of cost metrics in the controlling of logistics processes for a selected enterprise.

The final part of the dissertation presents a summary of the conducted research by indicating the most important research results, implications for the theory and practices, limitations resulting primarily from the adopted methodological approach and directions of further research.

## **Results of research**

Questionnaires with covering letters were sent out to 128 enterprises. Finally, completed questionnaires were obtained from 44 companies, which gives a response rate of 34.38%. After initial verification of completed surveys, it turned out that not all are complete. Therefore, 42 questionnaires filled in by enterprises were finally used to analyze the results, which is 32.81%.

Generally in the research sample, there are large or medium-sized enterprises, being limited or joint-stock companies. They were the most often represented by top management or mid-level management.

### **Survey results**

In most enterprises, the controlling department is separated. The most common type of controlling used is functional controlling. The vast majority of analyzed entities also apply strategic controlling.

The two most frequently indicated areas of controlling include finance and logistics. Therefore, it can be concluded that these are the most important functional areas in the majority of surveyed enterprises. The implementation of controlling of logistics is associated with the separation of logistics processes, as indicated by the result of the independence test. This means that in these companies there is controlling of logistics processes.

The results of the independence test ( $\chi^2$ ) for the evaluation of the implementation of the controlling section depending on the separated logistics processes. It was found that there is a significant relationship between the studied aspects.

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Table 1. The results of the independence test for the assessment of the implementation of the controlling of logistics section depending on the fact that logistics processes have been separated

	Results of statistical analysis				Relationship assessment
	Chi <sup>2</sup>	df	Chi <sup>0,05</sup>	p-value	
<b>Separating the section of controlling</b>	13,03	1	3,84	0,0001	Depends

Source: PhD dissertation, Table 1.22, p. 87.

In the surveyed enterprises, IT systems supporting controlling are used. The most important of them include: spreadsheet and own program. Enterprises also use databases and Business Intelligence systems.

In addition, various instruments are used as part of controlling of logistics processes. Most often these are index-based analysis, management reporting as well as budgeting and control of costs of logistics processes.

In most of the surveyed enterprises, the performance of logistics processes and the valuation of their resources are calculated. There is a relationship between the types of these resources and the calculation of the economic efficiency of the costs of logistics processes.

Also, various aspects of the analysis of the costs of logistics processes occurring in the production enterprise selected from the Podkarpackie Province, selected for the needs of the dissertation, were examined.

**The results of research in the enterprise**

Table 2 presents the structure of costs of logistics processes of the examined production enterprise in terms of generics in the years 2012-2017.

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Table 2. The structure of costs of logistics processes in terms of generics in 2012-2017

Specification	2012	2013	2014	2015	2016	2017	
						Plan	Implementation
The costs of logistics processes in total terms	100,0	100,0	100,0	100,0	100,0	100,0	100,0
Amortisation and depreciation	6,4	7,9	7,7	7,4	6,9	6,9	7,0
Consumption of materials and energy	68,4	66,1	63,4	62,5	59,6	59,9	60,3
External services	10,8	10,9	12,4	13,3	12,8	10,0	9,8
Payroll	9,0	9,5	11,1	11,2	14,4	15,9	16,0
Social security and other benefits	2,7	2,8	2,8	2,8	3,2	4,2	4,0
Taxes and charges	0,2	0,2	0,2	0,2	0,2	0,2	0,2
Other costs by type	2,6	2,5	2,4	2,7	2,9	2,9	2,7

Source: PhD dissertation, Table 3.8, p. 179.

In the analyzed period, the structure of costs of logistics processes changed slightly. In 2017, the dominant element of the costs of logistics processes was the Consumption of materials and energy (60.3%), the second Payroll (16.0%), External services 9.8%, and the lowest share was characterized by Taxes and charges related to the costs of logistics processes (0.2%).

In addition to examining the cost structure of logistics processes, it is important to analyze the dynamics of these costs. The dynamics of costs of logistics processes in the genre approach of the surveyed enterprise is presented in Table 3. These data determine the relatively favorable situation in the area of formation of logistics processes costs both in terms of generic types and their individual types.

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Table 3. Dynamics of logistics processes costs and sales revenues in 2013-2017

Specification	Indicators of dynamics					Plan execution indicator in 2017 (%)
	2012 = 100					
	2013	2014	2015	2016	2017	
The costs of logistics processes in general	98,0	105,7	104,4	112,4	106,0	102,4
Amortisation and depreciation	121,6	102,1	100,4	104,6	108,9	104,3
Consumption of materials and energy	94,7	101,4	102,9	107,2	107,3	103,2
External services	99,8	119,7	111,6	108,7	80,6	100,3
Payroll	103,8	123,3	105,4	145,5	117,1	102,5
Social security and other benefits	102,1	104,9	105,1	127,2	131,3	95,9
Taxes and charges	104,7	100,7	103,2	103,9	105,9	101,0
Other costs by type	94,5	101,7	116,3	120,1	101,1	96,8
Sales revenues goods and materials	96,4	104,4	103,7	103,6	108,9	No data

Source: PhD dissertation, Table 3.9., P. 181.

An increase in the total cost of logistics processes was found by PLN 858 103.6 about 6% compared to the previous year (2016) and by over 2% in relation to the plan's assumptions. However, in the entire audited period (from 2012 to 2017) there was an increase of PLN 3 409 189. The largest increase relates to the item "Payroll" of employees related to logistics processes by PLN 1 373 140.20 in 2017 compared to 2012 and by PLN 355 895.2 in 2017 compared to 2016. High increase also applies to items "Consumption of materials and energy", amounting to PLN 1 106 092,00 in 2017 compared to 2012 and PLN 621 677.1 in 2017 compared to 2016.

The most important way to distinguish the overall development function of logistics costs is to determine the trend function. The rectilinear trend is usually examined using the least squares method. The essence of this method is to minimize the sum of squared

deviations of the observed values of the CLP<sup>1</sup> variable (costs of logistics processes) from its theoretical values determined in the trend function. The formation of the total costs of logistics processes is presented in Figure 1.

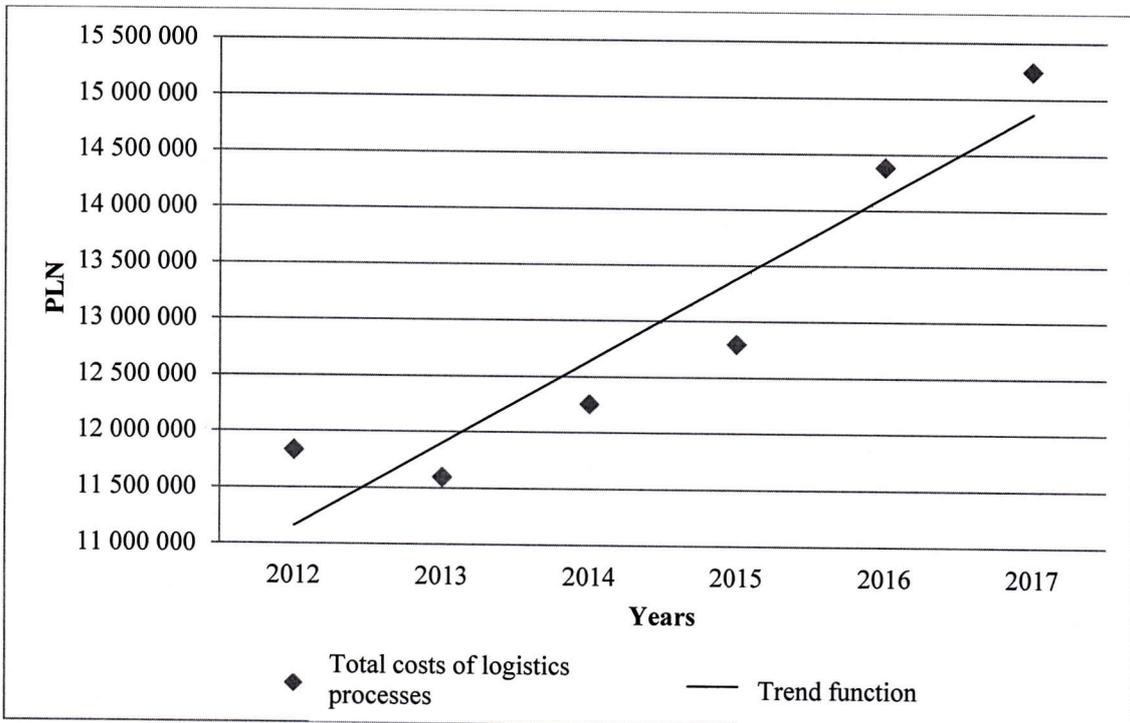


Figure 1. The formation of the total costs of logistics processes in the surveyed enterprise in 2012-2017  
Source: PhD dissertation, Figure 3.4., P. 184.

The distribution of empirical points presented in Figure 1 suggests that a linear trend function should be used to describe the development trend of the costs of logistics processes in the surveyed production enterprise.

An important aspect of the analysis of the dynamics of the costs of logistics processes is the detection of regularity in the scope of the development of these costs over time.

In addition to the classical method of analyzing the dynamics of logistics processes costs, the absolute deviation, dynamics index and rate of change should also be taken into account when assessing such costs.

<sup>1</sup> CLP – the costs of logistics processes

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The use of statistical methods is particularly important in the analysis of deviations in the costs of logistics processes for the needs of controlling.

The highest level of deviations in the examined enterprise occurs in the case of Material consumption costs and amounts to PLN + 160,502.5 (calculated as the share of deviations in the total deviation). Therefore, a causal analysis of deviations of these costs was carried out using the logarithmic method. The level of direct payroll of employees related to logistics processes is also undoubtedly influencing the amount of deviations.

The case study allows confirming the thesis that the costs analysis in controlling of logistics processes contributes to the improvement of the efficiency of logistics processes. However, in the analysis of the logistics activity of the production enterprise, the measures related to these processes should also be taken into account. The cost meter system is a tool that can help better manage the efficiency of processes in the controlling of logistics processes, provided that the company meets specific conditions. One of them is m.in. creation of appropriate infrastructure - efficiently and in a thoughtful way, a system of cost measures should be developed and then decomposed into selected organizational units.

The basis for the implementation of a system of cost metrics in the controlling of logistics processes is primarily the nature of the enterprise and its needs. Skillful selection of these measures and their correct application in the assessment of logistics processes are the key to proper comparisons that allow making decisions that contribute to the efficiency of these processes. No less important for measuring the efficiency of logistics processes is their *"balanced selection"*, taking into account both financial (cost) and non-financial indicators. They should refer to both the operational and strategic goals of the audited business unit.

## **Conclusions of epistemological character**

The most important conclusions from the carried out epistemological studies:

1. Controlling of logistics processes is incorrectly equated with controlling of logistics. Due to the lack of its definition in the literature, two perspectives for its definition were adopted: static and dynamic. This can help to complement the identified cognitive gap.
2. Cost analysis in controlling of logistics processes is a category falling within the area of finance, process management and logistics. It is justified that in the new scientific studies, which are interested in various aspects of finances with regard to the process approach in logistics, the content of the cost analysis is taken into account in controlling of logistics processes.
3. Accounting is the basic source of data for analyzing the costs of logistics processes. However, both in theory and in practice there is a lack of its appropriate model, oriented the costs logistics processes and the processes themselves. The proposed expansion of the chart of accounts with new synthetic and analytical accounts may help to supplement the cognitive gap in this area.
4. Controlling of logistics processes should be a key element of the enterprise management system in oriented process business units in which logistics is of particular importance.

### **Implications for business practice**

The results of the conducted research may also have implications for business practice. Managers lack the right accounting model of cost-oriented logistics processes. One of the achievements of this dissertation is the proprietary proposition of the Company's Plan of Accounts in a generic approach and calculation adapted to the needs of the analysis of the costs of logistics processes in the surveyed enterprise. It should be noted that after appropriate modification, it can be successfully used in other business units.

Policy makers do not pay much attention to the role of processes in the area of logistics, as a consequence of which cost-generating "bottlenecks" are created. In addition, logistics processes are not adequately identified in enterprises, and the costs associated with them have a "blurred" structure, making it difficult to analyze them. In order to eliminate such situations, managers may use the sheet to present the costs of logistics processes in enterprises.

In addition, proprietary proposals for these cards presented in this work may be used to assess the dynamics of procurement logistics processes. An important element of the company's logistics assessment is the use of an appropriate system of cost measures. Therefore, managers can successfully use the proprietary concept of a cost meter system for controlling of logistics processes prepared for the needs of the dissertation.

The circle of people interested in research results should primarily include representatives of management, logistics managers and controllers. This statement does not apply only to process-oriented enterprises, but also functionally organized ones, in which the controlling department has already been separated and those who are just intending to consciously introduce this sector to their unit.

The research conducted in the dissertation may be the basis for further research related to the broadly understood cost analysis in controlling (not only logistics) in process-oriented enterprises. As a result, a more detailed disaggregation of processes (logistics)

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in the enterprise can be made, and within the designated sub-processes, activities and activities, make in-depth identification and analysis of costs.

In conclusion, the ubiquitous and ever-accelerating technological progress has caused a spectacular development of many branches of the economy, of which logistics has become a strong pillar. As a result, the spectrum of its functionality is widening and application in global trade interactions. The consequence of the progressive competition on the economic markets is the visible progress of optimization in the field of efficient business management, with the emphasis on minimizing operating costs.

The size of costs of logistics processes is gradually increasing, which makes them become a subject of much more detailed analysis and calculation than before. Making accurate decisions and implementing appropriate actions aimed at increasing the efficiency of logistics processes brings tangible financial benefits in the form of reducing the costs of logistics processes, which directly correlate with the reduction of the company's operating costs. As a result, due to the increasing size and the importance of the costs of logistics processes, it affects the improvement of the financial results of the business unit, its profitability and financial liquidity.

Application of a proper cost analysis in controlling of logistics processes in the company, it ultimately translates into an increase in its value for the owners. The effects of the research efforts have implications for both theory and practice in both the financial and management aspects. Further research into the use of cost analysis in controlling of logistics processes may also help to eliminate the limitations of the presented methodology.

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Author's signature: .....*Paulina Beča*.....