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Source / Izvornik: **Montenegrin Journal of Economics, 2023, 19, 83 - 93**

Journal article, Published version
Rad u časopisu, Objavljena verzija rada (izdavačev PDF)

https://doi.org/10.14254/1800-5845/2023.19-1.7

Permanent link / Trajna poveznica: https://urn.nsk.hr/urn:nbn:hr:277:550876

ELIT
Economic Laboratory Transition
Research Podgorica

Montenegrin Journal of Economics

For citation:

Galic Potnik, K., Stavlic, K., Dokic, K. (2023), "Development of an Integrated Strategic Cost Management Model", *Montenegrin Journal of Economics*, Vol. 19, No. 1, pp. 83-93.

Development of an Integrated Strategic Cost Management Model

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ARTICLE INFO

Received january 13, 2022
Revised from February 15, 2022
Accepted March 16, 2022
Available online January 15, 2023

JEL classification: D24; D61; G17; M11

DOI: 10.14254/1800-5845/2023.19-1.7

Keywords:

Strategic cost management,
integrated cost management system,
modern cost management methods,
profitability

ABSTRACT

The individual application of strategic cost management techniques has shown significant shortcomings in calculating total costs and assessing product profitability. Therefore, there is a need for a comprehensive decision-making system that would integrate modern cost management techniques to calculate product life cycle costs, which is increasingly being affirmed. The possibility of integrating different cost management methods in this paper is conducted to develop a model for integrated cost management and a systematic presentation of techniques for practical application of modern cost management methods at all stages of the product life cycle. This paper aims to provide guidelines for developing, implementing, and applying an integrated cost management system, emphasising its application in the new product development process and proving that this model contributes more to business results than individual methods. The subject of research is the possibility of integrating modern cost management methods. The aim of this paper is to propose a unified model of strategic cost management aimed at the integrated application of modern cost management methods. In this context, the research hypothesis is as follows: a cost management model that integrates modern cost management methods reduces costs of the product and increases product profitability. This hypothesis has been proven by several scientific methods, the most important of which are analysis, comparison, mathematical and statistical methods, modelling and simulation. After conducting research using the above scientific methods, it was proven that integrated cost management systems more objectively assess the total cost of products. They also reduce total costs and thus increase product profitability.

INTRODUCTION

Due to changes in the business environment and more dynamic business conditions, there is a growing need for comprehensive decision-making systems whose requirements the traditional cost management model cannot meet due to the short-term nature of the information it provides (Augustyniak, 2020).

Traditional cost management systems were developed when direct labour cost had a large share in the total cost of products. Changes in production technologies, such as "just in time" philosophy, robotics, development of flexible production systems, etc., have reduced direct labour costs and increased overhead costs (Rymarczyk, 2020, Krenkova et al., 2021). Therefore, modern costing methods, which allocate overheads to products based on process activities, have a higher degree of objectivity in allocating overheads to products compared to traditional methods. However, the problem is that modern cost management methods are mainly applied individually, and the information on the amount of costs, obtained by a particular method is not used to calculate the amount of costs by the method that occurs chronologically after it. For example, target costs are calculated based on standard costs and do not consider information on the amount of costs obtained by the ABC method, although it provides more realistic data on the number of overheads. Furthermore, value analysis, Kaizen costs and lifecycle cost analysis are also based on standard cost data, although information on the amount of costs obtained by modern calculation methods is available. Following all the above, the aim of the paper is to develop and *propose an integrated cost management model that would represent a comprehensive conceptual framework for strategic cost management.*

1. METHODOLOGY OF RESEARCH AND RESEARCH HYPOTHESES

1.1 Research hypotheses

Integrated cost management systems can more accurately estimate actual costs, identify cost drivers and find ways to reduce overhead through product redesign or changes in product development, production and sales. This research aims to examine the impact of the application of integrated cost management systems on the business results of a particular business entity. According to the stated goal of the research, the following hypothesis is set:

H1: A cost management model that integrates modern cost management methods reduces product costs and increases product profitability.

The impact of the application of an integrated cost management model on business results will be examined by model simulation. Namely, the costs of one product from a metal processing company will be compared with the costs obtained by simulating the application of an integrated cost management system and based on the obtained results, and the set hypothesis will be accepted or rejected. The inductive approach using analysis and synthesis methods, statistical and mathematical methods, modelling and simulation methods, comparative methods, generalization and specialization methods and compilation methods will be used to examine the impact of integrated cost management systems on total costs and product profitability.

1.2 Methodological Framework of Research

The main goal of this paper is to determine the impact of the application of an integrated cost management system on the business results of the company. The main research method in this paper is simulation modelling through several phases described below.

The development of an integrated cost management system refers to the development of system components or subsystems related to strategic cost management instruments and the identification of possible interactions between them.

The collection of input data includes identifying individual details of the model and collecting the necessary documentation from the company, which provides the necessary information for the calculation of costs according to the methodology of the integrated cost management system. Specifically, data on target costs, activity costs and standard costs of product components were obtained by interviews and questionnaires with competent persons from the analyzed company and by reviewing business

books. Based on market research results, the target price of the product is defined, and individual product characteristics are ranked according to market requirements. Using the information on the amount of target costs, costs of business process activities and parameters required for value analysis, it was possible to analyze the impact of these methods on business results.

Development of a simulation model and simulation program within the Ms Excel program included the development of a model that corresponds to the system and allows the hypothesis to be tested. This phase of systematic simulation referred to the modular structure of the model (determining the structure of the system, technology and work organization, cost management system, etc.) and determining the performance of the system (resource utilization, costs of individual product components, costs of individual activities, quality costs, etc.)

The analysis of the simulation results enables the acceptance or rejection of the set hypothesis. If the simulation results' analysis shows that the integrated model's application achieves lower unit product costs, the hypothesis will be accepted.

1.3 Expected scientific contribution

The scientific contribution of this paper is contained in the development and systematic presentation of integrated cost management models. It is important to note that the model presented in this paper is unique and developed by the article's authors. Some authors and researchers (Cooper and Kaplan, 1998; Cooper and Slagmulder, 1997; Sakurai, 1996; Hill and Jones, 2001; Cookins, 2002; Terdpaopong et al., 2019; Stanczyk-Hugiet et al., 2021; Wang et al., 2021) have developed partial models of an integrated cost management system that include a combined application of ABC methods and target cost methods or target cost methods and value analysis. The model, which includes a combination of all methods involved in strategic cost management, cannot be found in any available bibliographic item. Therefore, the scientific contribution of this paper is of great importance for the development of economic and financial science. This model can be applied in industrial enterprises and should make the most significant contribution to determining the cost of the product lifecycle, providing more realistic information of total costs than existing models.

2. OVERVIEW OF PREVIOUS RESEARCH

Integrated cost management systems can be viewed from several aspects, and authors have a different approaches in defining these systems. Thus, for example, Cooper and Kaplan (1998) talk about integrated cost management systems, which imply the integration of the ABC method with the ERP – system (enterprise resource planning). These authors are based on two basic questions in their paper:

- Does the ERP system provide accurate data on the costs of activities, processes and products? and
- Can the ERP system automatically provide relevant, timely information necessary for managers and employees to make strategic decisions?

Namely, the work of these authors is based on the possibilities of applying the information obtained by the ABC method in all business segments.

Furthermore, R. Cooper and R. Slagmulder (1997) researched the cost management system at Olympus Optical and concluded that the integration of individual cost management methods provides greater cost savings compared to the application of individual cost management methods. These authors based their research on the impact of the integration of the target cost method and the product life cycle cost method on cost reduction.

J. Kreuze and G. Newel (1994) integrated the ABC method and product lifecycle cost method and concluded that this integration provides many advantages in cost management and affects the reduction of overall costs.

G. Cookins (2002) researched the possibilities of integrating the ABC method and target cost method and concluded that at each stage of the calculation of the target costs, the information obtained by the ABC method can be used and that the integration of these two methods provides more realistic information about the amount of costs and profitability of the product.

From the previous research and analysis of the available literature in the field of integrated cost management systems, it can be concluded that to date a complete model of integrated cost management has not been developed, covering all the most important methods of strategic cost management, namely the ABC method, target cost method, value analysis, Kaizen method and method of calculating product lifespan costs. In fact, unlike previous research based on partial integrations of strategic cost management methods, this article will present a comprehensive model of an integrated cost management system.

From the review of previous research and analysis of available literature in the field of integrated cost management systems, it can be concluded that no comprehensive model of integrated cost management, including all modern methods for cost calculation, has been developed. Namely, previous research has been based on partial integrations of strategic cost management methods (Tamulevicienė et al., 2020; Hu et al., 2019). This article will present a comprehensive model of an integrated cost management system.

3. INTEGRATED COST MANAGEMENT SYSTEM

The concept of strategic cost management has a broad focus. It is not limited to continuous cost reduction and cost control but is more focused on using cost information by management that is relevant to decision making. Strategic cost management is not limited to the application of cost management techniques but also other actions and tools that reduce costs and at the same time improve the strategic position of the company.

Authors define modern methods of cost management differently. H. Johnson and R. Kaplan (1991) define them as "a complex and integral part of management accounting practice, representing an efficient control and planning tool that provides quality information to create successful management decisions that affect the overall business."

The research problem is based on the fact that the individual application of specific strategic cost management techniques does not allow a realistic estimation of the total costs that a particular product incurs during its lifetime. This statement primarily refers to the calculation of target costs, which uses data on direct standard costs while ignoring indirect costs. Given that there are fewer and fewer costs in the modern production system that can be directly related to the product, and the share of overhead costs is growing, the calculation of target costs based on direct standard costs becomes insufficient. The integration of the target cost method, ABC method, value analysis method, Kaizen cost, quality cost and product lifecycle cost analysis eliminate these shortcomings by allowing simpler and more accurate estimation of actual product costs, determining cost drivers and finding ways to reduce total costs through product redesign or changes in the process of product development, production and sales.

3.1 Overview of the integrated strategic cost management model

The simplified methodology for calculating total costs under the integrated model is based on estimating costs at certain stages of the product's life cycle using modern cost management methods. All individual cost management methods, except the Kaizen method, are applied from the very beginning of the product idea before the product research and development phase. The Kaizen method can be applied only in the production phase because this method is based on a comparison of actual data on the company's business with the desired and planned. By the production phase, the target cost method and value analysis identify the components of the product and cost optimization activities, and then the Kaizen method determines how or how much it is necessary to reduce or increase costs. The ABC method, in this context, is used to allocate overhead on products as a starting point for calculating target costs.

Throughout implementing an integrated cost management system, the optimization of the amount of quality costs is implied. Based on the data prepared in this way, the lifetime costs of the product are calculated.

The following figure 1 shows the chronology of the inclusion of particular strategic cost management methods under an integrated cost management system.

From the previous figure, it can be concluded that the costing of the proposed integrated model begins with the calculation of activity-based costs (ABC method), which allocates indirect costs to products. Based on the cost data obtained by the ABC method, the target costs are calculated to determine the maximum allowable costs. According to market research results, these costs are determined by the target price and the desired level of profit. This model needs to include value analysis, whether the calculated target costs exceed the allowable ones. Value analysis will answer which product components and activities can reduce costs by respecting the functional characteristic of the product and market requirements.

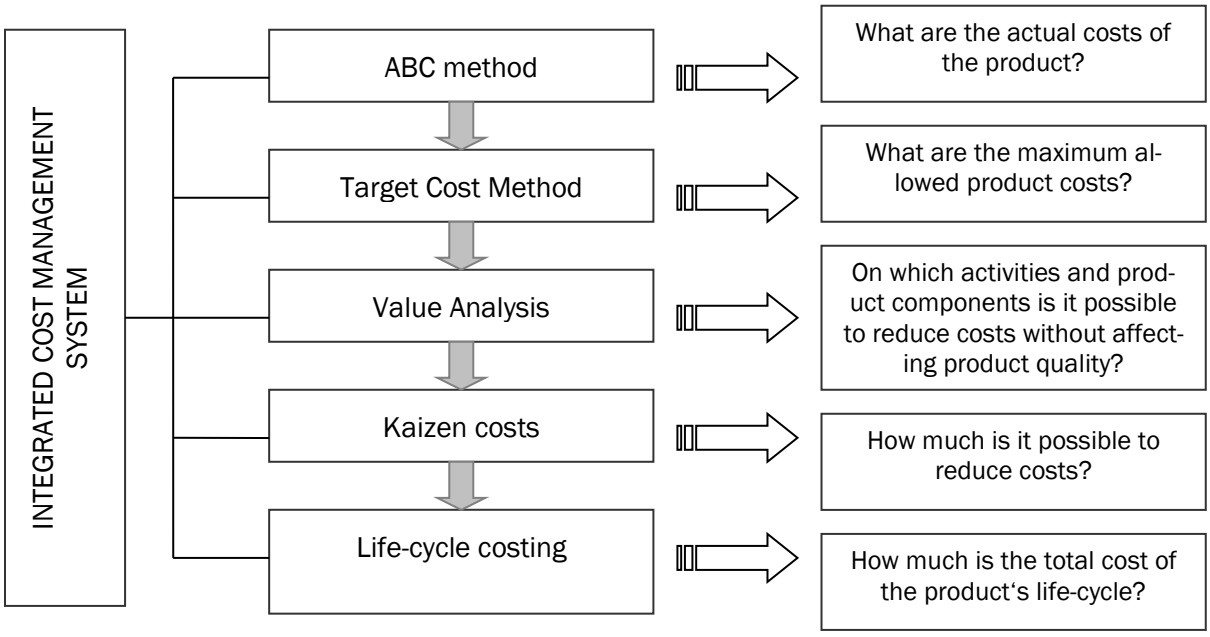

Figure 1. Overview of individual cost management methods within an integrated system

Source: Potnik Galic, 2015.

Once the value analysis determines which components and activities savings can be achieved, the Kaizen method will answer the question "by how much" it is possible to reduce costs on the specified components and activities. After that, it is possible to analyze the cost of the product lifecycle, which will provide an answer to the question of how much costs a product incurs during its life cycle, both from the perspective of producers and users of the product, respecting the time value of money by applying the discounting method and reducing all future product costs to present value. It is important to note that at all stages of the implementation of the integrated model of cost management implies the application of the concept of "quality management".

3.2 Analysis of the impact of integrated cost management system application on the business result

The product that is the subject of the analysis within the integrated model refers to the product of medium value and long lifecycle of the metalworking enterprise. The test method was used to collect

data necessary for research of the impact of integrated systems on business results. The interview method was conducted to provide the information necessary to develop an integrated cost management system model. According to the pre-prepared interview plan, an interview was conducted with competent persons in the company. The modelling method included a research procedure by which a practical integrated model was generated, which enabled a simulation study of the impact of the model application on the company business result. After completing the modelling process, the simulation was performed with the computer support of Ms Excel. This method enabled quantitative analysis of business processes and provided an answer to the question "what if" the company starts applying integrated cost management systems? In this context, this method made it possible to test the hypothesis.

3.2.1 Research the impact of the application of integrated cost management model on business results

The investigation of the impact of the application of the integrated cost management model on business results begins with the calculation of the target costs, as shown in the following table.

Table 1. Calculation of Product Target Costs

Calculation of target costs	*Amounts in HRK*
Net sales price (excluding VAT)	2.741,20
Target gain (30% of the sale price)	822,36
TARGET AND COSTS	1.918,84
STANDARD COSTS	1.858,89
DIFFERENCE	59,95

Source: Authors Calculation.

The target costs in the previous table were calculated based on the collected data on the amount of standard direct and indirect costs. The data in the table indicates that the company achieves the target costs because its standard costs are less than the allowable costs. The next step is to apply a value analysis model based on an attempt to identify the components that have the strongest impact on the product characteristics that customers rated as the most important when making a purchasing decision. The next step in the analysis is to research customer preferences regarding product characteristics.

Table 2. Customer Preferences by Product Characteristic

Product characteristic	*Average market rating*	*% in the overall rating*
C_1	4,50	17,86%
C_2	3,10	12,30%
C_3	4,10	16,27%
C_4	2,90	11,51%
C_5	1,10	4,37%
C_6	3,80	15,08%
C_7	2,30	9,13%
C_8	3,40	13,49%
ALTOGETHER		100,00%

Source: Business Records of Company "X".

Table 2, which lists customer preferences according to product characteristics, shows that the most important characteristics for potential customers when deciding to purchase this product are C-1 and C-3, and the least important characteristics are C-7 and C-5.

The integrated model method includes the calculation of target costs using data from the ABC method (integration of the TC and ABC methods), value analysis based on data from the integrated TC model and ABC method (VA, TC and ABC method integration). As a product of value analysis, the value index will identify the activities that are "candidates" for reducing costs. The Kaizen method will determine the amounts of possible decrease per individual activity (integration of the TC[1], ABC[2], VA[3] and Kaizen methods).

Table 3. Correlation matrix between costs of business process activities, required market properties and product functionality

	PRODUCT CHARACTERISTICS									
ACTIVITY	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	TOTAL	RANK
	% / %	% / %	% / %	% / %	% / %	% / %	% / %	% / %	%	
A_1	45 / 8,04	20 / 2,46	15 / 2,44	5 / 0,58	10 / 0,44	25 / 3,77	30 / 2,74	35 / 4,72	**25,18%**	**1**
A_2	25 / 4,46	20 / 2,46	25 / 4,07	10 / 1,15	30 / 1,31	10 / 1,51		50 / 6,75	**21,71%**	**2**
A_3		35 / 4,31	30 / 4,88		5 / 0,22	25 / 3,77	15 / 1,37		**14,54%**	**3**
A_4	5 / 0,89	5 / 0,62		15 / 1,73	15 / 0,65				**3,89%**	**7**
A_5			10 / 1,63	20 / 2,30	5 / 0,22	20 / 3,02	5 / 0,46		**7,62%**	**4**
A_6				30 / 3,45	10 / 0,44				**3,89%**	**7**
A_7				5 / 0,58	15 / 0,65				**1,23%**	**14**
A_8	5 / 0,89	20 / 2,46		/ 0,00			15 / 1,37		**4,72%**	**6**
A_9				10 / 1,15	10 / 0,44		/ 0,00		**1,59%**	**12**
A_{10}			15 / 2,44				30 / 2,74	15 / 2,02	**7,20%**	**5**
A_{11}	5 / 0,89			5 / 0,58	0 /	10 / 1,51	5 / 0,46		**3,43%**	**9**
A_{12}	10 / 1,79								**1,79%**	**10**
A_{13}	5 / 0,89					5 / 0,75			**1,65%**	**11**
A_{14}			5 / 0,81			5 / 0,75			**1,57%**	**13**
TOTAL %	100 / 13,39	100 / 9,84	100 / 13,02	100 / 5,75	100 / 4,37	100 / 15,08	100 / 9,13	100 / 13,49	100,00%	

Source: Authors Calculation by Company Business Records

The research continues by analyzing the influence of individual activities on product characteristics and functional analysis based on activities. This analysis was performed using the correlation matrix and the calculation of the value index of each activity.

[1] TC – Target costing
[2] ABC – Activity based costing
[3] VA – Value analysis

The left columns in the previous table represent the percentage impact of individual activities on product characteristics required from the market, while the right columns show the results obtained by multiplying the share of costs of individual activities in total costs with the percentage impact of individual activities on product characteristics in meeting market demands. The results of this matrix show which activities contribute the most to product quality from the customer's perspective and which activities are unnecessary, ie which activities could reduce costs without affecting product characteristics that are important to customers when making a purchase decision.

It resulted in the conclusion that the activities A-1, A-4, A-5, A-6, A-8, A-9, A-10, A-13 and A-14 have an index value of more than 1, which means that these activities should be given more attention because they are most affect the characteristics of the products that customers rated as the most important when deciding to purchase the product. If there is a possibility to increase the quality of product characteristics through these activities, the costs of these activities should not be reduced but find the optimal level of costs that will provide a better quality final product. The following table shows the determination of costs after business process reengineering.

Table 4. Determination of costs after product redesign

Activities	*Costs before redesign (in HRK)*	*Value Index*	*Costs determined by value index*	*Maximum quality costs*	*Minimum quality costs*	*Costs after redesign (in HRK)*	*Savings on activity costs*
1.	*2.*	*3.*	*4.*	*5.*	*6.*	*7.*	*8.*
			*2.*3.*				*(7. - 2.)*
A_1	178,00	1,00	178,00	186,00	163,00	178,00	0,00
A_2	224,00	0,69	154,56	232,50	211,00	211,00	13,00
A_3	112,00	0,92	103,04	115,00	109,00	109,00	3,00
A_4	15,00	1,83	27,45	16,50	15,00	16,50	-1,50
A_5	45,00	1,20	54,00	46,20	42,30	46,20	-1,20
A_6	11,00	2,50	27,50	12,30	11,00	12,30	-1,30
A_7	9,00	0,97	8,73	8,40	7,20	8,40	0,60
A_8	11,50	2,91	33,47	12,40	10,30	12,40	-0,90
A_9	8,50	1,32	11,22	8,50	8,50	8,50	0,00
A_{10}	17,60	2,90	51,04	18,50	17,00	18,50	-0,90
A_{11}	36,00	0,67	24,12	38,20	31,50	31,50	4,50
A_{12}	18,00	0,70	12,60	21,35	16,50	16,50	1,50
A_{13}	11,50	1,01	11,62	11,50	9,25	11,50	0,00
A_{14}	10,50	1,06	11,13	10,50	10,50	10,50	0,00
TOTAL	707,60		708,47	737,85	662,05	690,80	16,80

Source: Authors Calculation by Company Business Records Data

The previous table shows the result of a value analysis that, in addition to identifying activities where costs can be reduced, also allows you to determine the level of optimal costs for individual activities. The costs determined by the value index, shown in column 4, are calculated by multiplying the standard costs by the value index. If the amount of costs thus obtained exceeds the costs necessary to achieve maximum quality, the costs are determined at the level that ensures the maximum quality of the product. Conversely, if the costs determined by the value index are at a level that does not ensure the minimum quality of the product, they increase to the amount of minimum quality costs. From the last column of the previous table, it can be concluded that the application of the integrated cost management model achieves savings on the total cost of products of HRK 16.80 per product unit.

3.2.2 Hypothesis verification results

Based on previous calculations, it is possible to conclude the impact of the application of integrated cost management systems on the business result.

Table 5. Results of the analysis of the impact of the integrated cost management system application on the amount of profit achieved

In HRK	*Savings achieved using an integrated cost management model*	*Production Quantity*	*Increase realized profits from product x using an integrated system*
1.	*2.*	*3.*	*4.*
ENTERPRISE X	16.80	15.545	261.156

Source: Authors Calculation by Company Business Records

By applying the integrated model in the calculation of each method, the results obtained by the previous integration of the methods are used. By allocating overheads to products based on process activities and including the results obtained in the value analysis, which have previously passed the verification of maximum allowable costs by calculating target costs, it is possible to achieve greater savings in product costs. It is necessary to consider that this research covers the calculation of costs by an integrated model and focuses on a much broader aspect of research into the possibility of reducing costs through the cost management process. Namely, cost management is a much broader concept than accounting cost coverage (cost calculation) and includes budgets based on the consideration of the possibility of optimal determination of product costs. Therefore, in addition to data from the accounting records of the analyzed company, this study also used data collected from the entire team of experts involved in the business process at all stages of the product life cycle. In this context, marketing experts provided the information necessary for the calculation of target costs and value analysis, based on the results of market research, and obtained information on the required characteristics of products from the market. The joint work of authors and engineers, experts in the technical-technological process field, has enabled the reduction of costs on product components and business process activities. The involvement of product quality assurance staff in the research provided information on the costs of minimum and maximum quality of individual components and product activities. This way, all costs after product redesign and business process reengineering are determined. Competent persons from accounting provided data on the purchase value of individual product components and the costs of business process activities. Also, information was obtained on the share of costs of individual components and product activities in the structure of total costs based on accounting data. The simulation method is used to calculate costs by individual methods and an integrated model, and the simulation results show that the application of an integrated cost management system can significantly impact product profitability.

According to the results from Table 5, the hypothesis that the integrated cost management system has the effect of reducing total costs and increasing product profitability has been proven.

CONCLUSION

This paper presents a critical analysis of literature and previous scientific contributions in the field of modern cost management and presents practical models for the application of an integrated cost management system. The scientific contribution of this paper is in the development and systematic presentation of a comprehensive model of integrated cost management. It is important to note that the model presented in this paper is unique and developed by the article's author.

The objectives of this research related to the research of the possibility of applying integrated cost management systems have been met. The presented model of integrated cost management allows for very simple implementation and application within the enterprise with the necessary minimal modifications. Modifications refer to adjusting the model to the number of components and properties of the product and business process activities.

In accordance with the defined problems and goals of the research, a research hypothesis was set up. The hypothesis that the application of an integrated cost management system reduces costs and increases product profitability has been proven by modelling and simulation methods.

Further research should focus on studying the possibilities of applying integrated cost management systems in service companies, which would require further modifications of the model. It would also be desirable to examine the cost-effectiveness of implementing an integrated cost management model by including the investment costs that the implementation of the model causes. Namely, in this paper, it is assumed that the company applies modern cost management methods, and the costs of their implementation are not included in the calculations. If this system were to be implemented in an enterprise where the modern cost management system had not previously been implemented, investment costs should be included in the feasibility assessment.

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