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An Overview of the Problematic Issues in Logistics Cost Management

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ABSTRACT

Logistics cost management is associated with certain specific challenges, since increasing the quality of logistics services for customers often comes with increased logistics costs. In addition, reducing the costs of one logistic component causes an increase in the costs of another logistic component, which results in higher total logistics costs. Various cost models have been developed to support the optimisation of logistics activities, which represent the main focus of research and a key practical tool for logistics management. The purpose of the study is therefore to determine whether current scientific studies are addressing the issues related to logistics cost management. The aim of the study is to determine the scope of the optimisation of individual logistics models from the point of view of how individual logistics costs categories and processes are treated. The analysis of logistics costs management issues provides an important empirical foundation for the improvement of logistic processes in supply chains and synthesises scientific literature in the field of logistics cost modelling, which represents an important framework for future empirical studies.

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1 Introduction

Logistics costs account for most of the costs in the supply chain of a company and also cover a significant share in the overall cost structure of the company. There are major differences in logistics costs among companies in different industries, however, several scientific studies [11, 26, 35] state that their share in the company's sales revenue is at least six percent. The sales revenue percentage varies widely among the studies and ranges from 6% to 25% [36]. The complexity of logistics costs management is a result of several key factors that are present both in theory and practice. When managing the costs of logistics, we must bear in mind that reducing one group of logistics costs can result in an increase in another group, which is reflected in the increase in the company's overall logistics costs and the reduction in profitability.

Awareness of the interdependence of logistics costs and of the impact of the level of quality of logistics services on the overall logistics costs represents one of the next aspects of planning high-quality and efficient logistic processes [14, 18]. A higher level of service in logistics potentially leads to greater customer (buyer) satisfaction, but at the same time, it leads to higher costs. This results in the necessity to achieve a balance between the quality of logistics services and the level of logistics costs. The next key factor relates to the difficulty of measuring logistic costs, as they are present in various business areas, such as sales, purchasing, manufacture and logistics. However, logistics processes should be measured in order to ensure that they are controlled effectively.

In the last thirty years, various cost models have been developed to support the optimisation of logistics activities, which represent the main focus of research and a key practical tool for logistics management. The purpose of the study is therefore to determine whether current scientific studies are addressing the issues related to logistics cost management. The aim of the study is to determine the scope of the optimisation of individual logistics models from the point of view of how individual logistics costs and processes are treated.

An overview and analysis of logistics cost management issues provides important empirical support for improving logistic processes in supply chains. The presented study also provides a synthesis of the scientific literature in the field of logistics cost modelling, which represents an important framework for future empirical studies.

2 Literature Review - The Specific Challenges of Logistics Costs Management

Logistics costs and supply chain costs are industry terms that are often used as synonyms in theory and in practice, which leads to some confusion when defining these terms, as there are obvious differences when it comes to explaining their role in the business process of a company. Logistics costs are usually defined as cost components that are connected to the distribution of goods and costs related to the warehouse, which is reflected in the definition of logistics according to Lambert et al. [16]. Bowersox and Closs [8] define supply chain costs as cost components that are directly related to order handling, purchasing and stock handling. Byrne and Heavey [9] add manufacturing costs to supply chain costs, giving supply chain costs a wider definition, compared to logistics costs. Figure 1 shows the supply chain costs of a company, in which logistics costs play an important role. In the supply chain, only manufacturing costs, installation costs and partially capital costs do not fall within the definition of logistics costs.

Logistics costs result from activities that support the company's logistic process. Various authors [11, 38, 40] classify logistics costs as a percentage of the revenues from the sale of goods and identify at least six individual cost components such as transport, warehousing, stock management, administration, packaging and indirect logistics costs. Ojala et al. [22] make a distinction between direct logistics costs (transport and warehousing costs) and indirect logistics costs (stocks costs and administration costs). Stock and Lambert [32] provide a more detailed definition of logistics costs that covers an even greater share of the costs of the supply chain, as they include order processing costs and lot quantity costs. Regardless of the different definitions of logistics costs, studies are limited to measuring transport costs, warehousing costs, stocks costs, administration costs and other logistics costs. In these measurements, transport costs are at the forefront, as they represent the largest share in the structure of the logistics costs of a company. In these studies, individual logistics costs have the following share in terms of sales revenues [11, 22]: transport costs (from 4.08% to 5.3%), stocks costs (from 1.79% to 5.7%), warehousing costs (from 1.75% to 3%), administration costs (from 0.23% to 1.5%) and other logistics costs (from 0.33% to 1.1%).

Logistics costs management has a significant impact on a company's operations. Companies that lack awareness of the importance of reducing logistics costs do not have a clear perception of how these costs affect their perform-

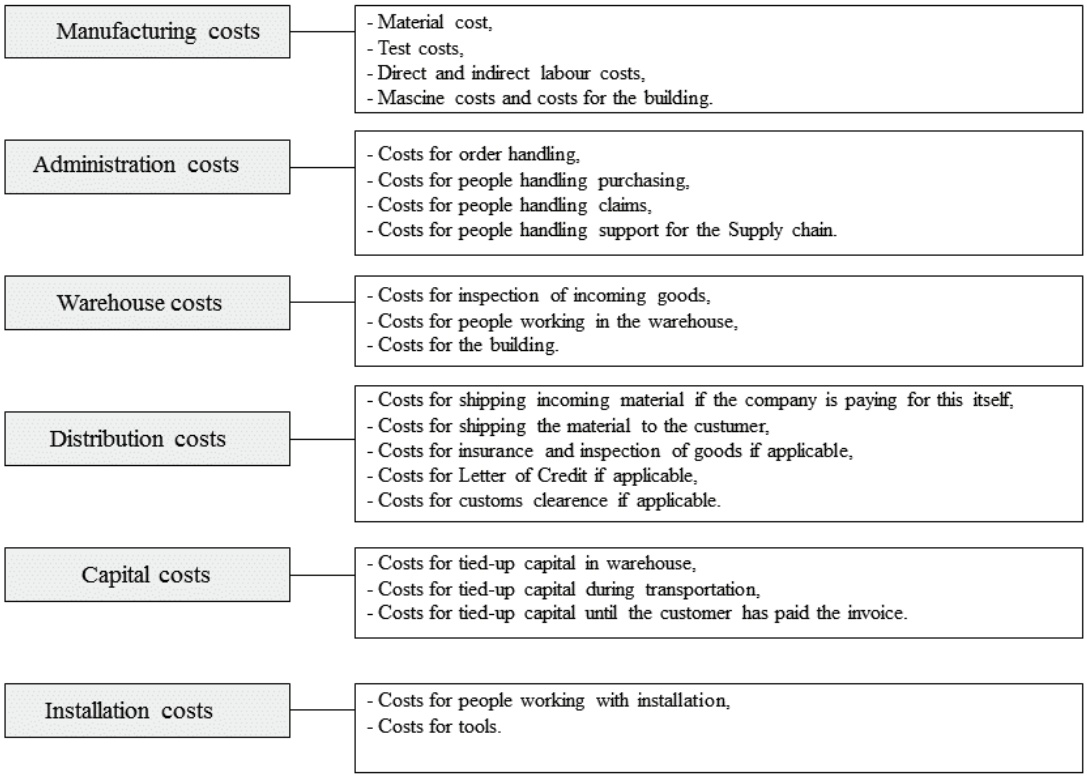


Figure 1 Supply chain costs of a company
Source: [25]

Table 1 Impact on profits by reducing logistics costs

If net sales profit is 2.0%:			
Savings from:		**Resulting sales increase:**	
EUR	0.02	EUR	1.00
	2.00		100.00
	200.00		10,000.00
	2,000.00		100,000.00
	20,000.00		1,000,000.00
	200,000.00		10,000,000.00
	2,000,000.00		100,000,000.00

Source: [32]

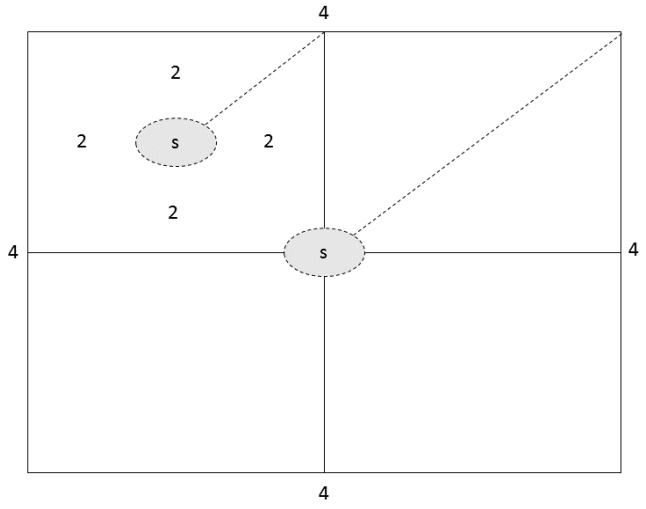


Figure 2 Comparison of transport distances with respect to the number of warehouses. Source: [18]

ance and profits. Table 1 shows that an increase in sales by €1 does not automatically result in an increase in profits by €1. If, for example, a company's profit margin before taxes is 2% (sales revenue minus costs), the company receives only €0.02 of pre-tax profit from each euro sold. Each euro saved in the logistics process does not automatically mean an increase in sales or a reduction in other costs. Nonetheless, each euro saved in logistics costs does mean increased profits. A reduction in logistics costs has a greater impact than an increased sales volume [32].

When managing logistics costs, we must bear in mind that reducing one group of logistics costs can result in an increase in another group of logistics costs, which is reflected in the increase in the company's overall logistics costs and the reduction in profitability. Awareness of the interdependence of logistics costs and of the impact of the level of quality of logistics services on the overall logistics costs represents one of the most important aspects of planning high-quality and efficient logistic processes [38].

Transport costs, warehousing costs and stocks costs represent the main share of the costs in the structure of logistics costs, which is why they are interdependent in various situations, as illustrated in the case of deciding on the number of warehouses needed for the purpose of servicing the logistics process of a company. Figure 2 shows an example when one warehouse is replaced by four warehouses; one warehouse covers 16 km^2, while four warehouses on the same surface each cover 4 km^2, therefore the way to the centre of the four squares is shorter, which means that transport costs are reduced. On the other hand, the operating costs for the four warehouses are higher, because each warehouse requires a certain number of people. In addition, the total inventory level is increased, as minimum and/or safety stock quantities are set for each additional warehouse [18].

Figure 3 shows that transport costs decrease as the number of warehouse locations increases. At a later point,

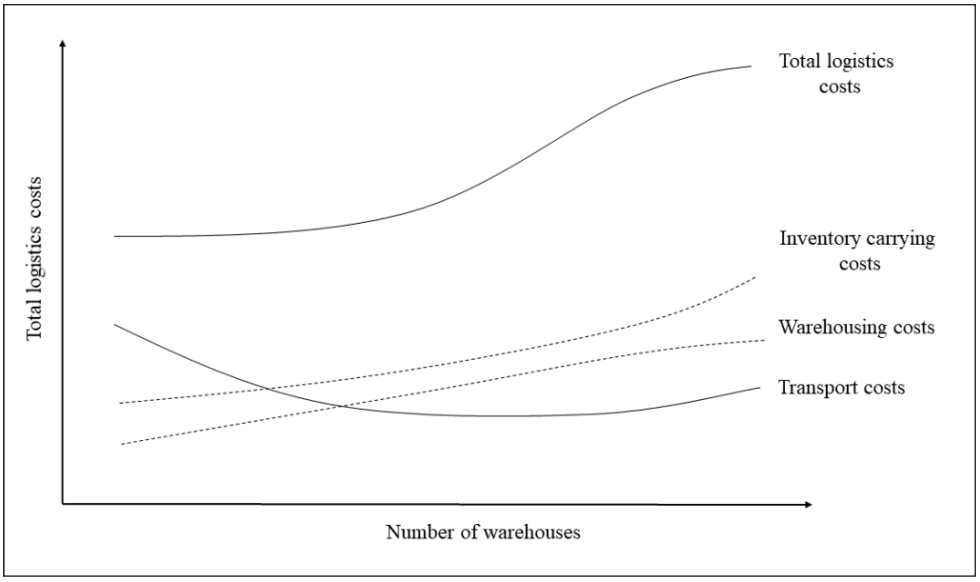


Figure 3 The ratio between total logistic costs and the number of warehouses. Source: [16]

the transport costs curve moves upwards due to poor coordination of inbound and outbound supplies between warehouse locations [16]. It is therefore important to calculate the number of warehouses that would result in levelling both groups of logistics cots and thus in reducing the total costs of logistics as much as possible.

The level of quality of the logistics service has a major impact on the level of logistics costs. Therefore, when planning logistics processes, an appropriate level of customer service should be planned. A higher level of service in logistics potentially leads to greater customer (buyer) satisfaction, but at the same time results in higher costs. This results in the necessity to achieve a balance between the quality of logistics services and the level of logistics costs. The location of the ideal point is extremely difficult to determine, because this ratio is marked by a set of complex and interconnected logistics factors. One possible solution is to control costs by finding the balance between the elements of logistics, where Logožar [18] emphasises balancing. In these activities, different conflicting costs and other elements of logistics are compared, and those that show the lowest overall logistics costs in a given ratio are selected. Conflicts can also arise between costs at the logistics service level and the costs of customer loss. If the speed of supply increases, the costs increase, and if this level decreases, costs are also reduced, which can result in loss of customers. In this case, it is also necessary to reduce the level of service to the point where the customers are still retained.

For the purpose of achieving the highest efficiency of logistics, each component of the logistics system should operate at the highest level. Measuring the logistics process is important from the point of view of the company in order to reduce logistics costs and from the point of view of the customers in order to improve the level of services [32]. Logistics processes must be measured in order to enable us to control them. Measuring the impact of logistics activities is the key to reducing inefficiencies in a company's system, while at the same time increasing its opportunities for growth. Effective measurement of logistics activities enables the achievement of the following objectives [3]:

- improving profitability by reducing operational and administrative costs,
- improving profitability by assessing the value of individual activities in relation to customers and suppliers,
- increasing revenue growth by providing an appropriate level of service to the customer, while at the same time maintaining customer satisfaction,
- identifying or discovering different products and services that enable improvement of the level of service to the customer, as well as the potential for revenue opportunities,
- determining which operations should be improved.

Cost measurement or estimation is not a simple process, so it is usually performed by experienced experts. Measurement problems arise because assumptions are often used instead of actual data, which points to the need for cost modelling [28]. Logistics costs arise in different business areas, which is why their location in the process of providing a service or making a product becomes unclear, and why the need for assessing and estimating logistics costs from the initial phase of product development to the completion of after-sales activities is even more evident. Figure 4 shows a cost estimation study in the automotive industry where several issues can be identified that prove the difficulty of measuring logistic costs. Discrepancies occur in the order in which logistics costs

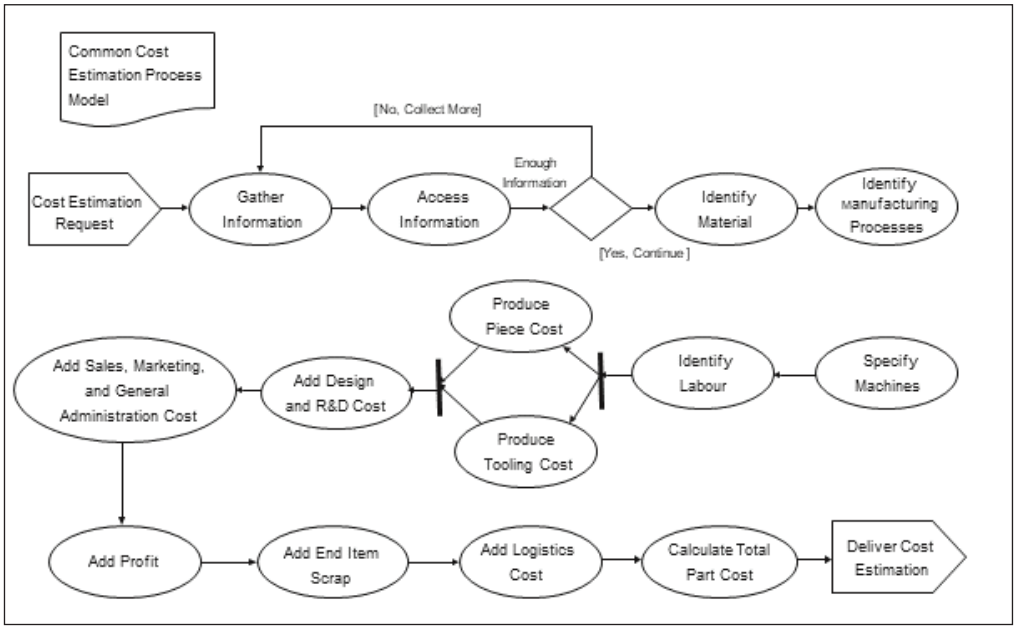


Figure 4 An example of the product cost estimation process in the automotive industry
Source: [28]

are estimated, as they are placed at the end (before calculating all product costs). Logistics costs estimation should be done in several stages, namely, after the estimation of manufacturing costs (Phase 1), before estimating the total cost of the product (Phase 2) and after the supply of the products (Phase 3), which would make it easier to determine the discrepancies or inefficiencies in the process of purchasing goods, manufacturing, sales and after-sales activities [28].

Measuring logistics costs is an extremely difficult process. The same applies to modelling logistics costs, because the relations between their decision variables are often unknown. For example, one such variable is the impact of the construction of an additional distribution centre on all logistics costs. In this case, inbound and outbound transport costs, stocks costs, labour costs and warehousing costs can be modelled, but all these estimates are based on current data, so the ability to forecast is limited for each of the listed variables. Logistics costs are therefore difficult to model, because they can be affected by so many exogenous factors, many of which are nonstationary [38].

3 Methods

For the purpose of obtaining information and searching the literature, the Clarivate Analytics database of the Web of Science (WoS) portal was used. An analysis and a synthesis of scientific articles dealing with the optimisation of logistics costs for the period from 1985 to 2018 were carried out. In order to analyse the subject of the study as widely as possible, the terms "logistics costs" and "logistics cost models" were used in the search. 24 scientific papers were analysed, of which 23 have an impact factor and are cited in the JCR (Journal Citation Reports).

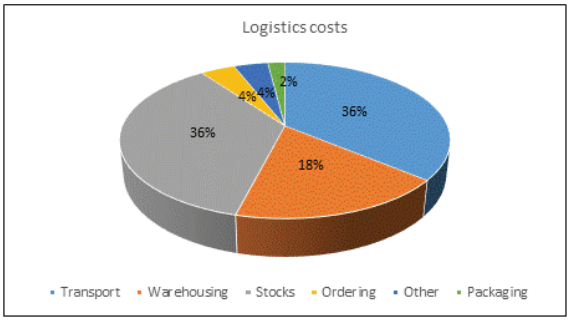
4 Results

The scientific papers introduce individual logistics costs models. Therefore, the purpose of the analysis is to determine the scope of the optimisation of individual logistics models from the point of view of how individual logistics costs categories and processes are treated. Figure 5 shows the treatment of individual logistics costs by year for the period from 1985 to 2018 [6, 7, 31, 5, 12, 41, 4, 10, 15, 39, 21, 19, 33, 30, 17, 37, 1, 13, 2, 34, 23, 29, 24, 20]. During this period, the authors developed various logistics cost models that focus mostly on handling transport costs (36%), stocks costs (36%) and warehousing costs (18%). The cost of ordering and other logistics costs represent a 4% share of all logistics costs.

The analysis of the combination of logistics costs that are analysed by individual models shows similar results. Of the n = 24 scientific papers, 10 cost models (41.67%) deal with transport/stocks cost optimisation. These are followed by studies dealing with transport costs (n = 2; 8.33%); transport/warehousing/stocks costs (n = 2; 8.33%); transport/warehousing/ordering costs (n = 2; 8.33%) and warehousing/stocks costs (n = 2; 8.33%).

Figure 6 shows the individual logistics processes within the treatment of logistic models 2018 [6, 7, 31, 5, 12, 41, 4, 10, 15, 39, 21, 19, 33, 30, 17, 37, 1, 13, 2, 34, 23, 29, 24, 20]. In the period from 1985 to 2018, the authors mainly dealt with the optimisation of the distribution process (57%), followed by the purchasing process (32%) and

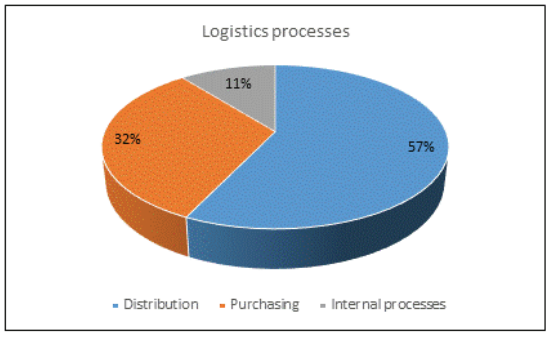
Authors	Logistics costs
Blumenfeld et al., 1985	transport, warehousing
Blumenfeld et al.,1987	transport
Speranza and Ukovich, 1994	transport, stocks
Bertazzi et al., 1997	transport, stocks
Ghodsypour and O'Brien, 2001	transport, warehousing, ordering
Zhao et al., 2004	transport, stocks
Berman and Wang, 2006	transport, stocks
Chow , 2007	transport, warehousing, other, stocks
Kutanoglu et. al, 2008	transportni, stocks
Wang and Cheng, 2009	transport, stocks
Miranda and Garrido, 2009	warehousing, stocks, ordering
Madadi et al., 2010	transport, stocks
Strack and Pochet, 2010	warehousing, stocks
Sajadieh et al., 2010	warehousing, stocks
Lau and Nakandala, 2012	stocks
Tancrez et al., 2012	transport, stocks
Ali and O'Connor, 2013	transport, stocks
Kim et. al., 2015	transport, warehousing, stocks
Becker et al., 2016	transport, warehousing, stocks, ordering
Škerlič et al, 2016	transport, warehousing, stocks, packaging, other
Perera et al., 2017	stocks, ordering
Rybakov, 2017	transport, warehousing, stocks
Petraška et al., 2018	transport
Min et al., 2018	transport, stocks



Combination of costs of individual models	f (%)
Transport, stocks	10 (41,67)
Transport	2 (8,33)
Transport, warehousing, stocks	2 (8,33)
Transport, warehousing, ordering	2 (8,33)
Warehousing, stocks	2 (8,33)
Transport, warehousing	1 (4,17)
Stocks	1 (4,17)
Transport, warehousing, other, stocks	1 (4,17)
Transport, warehousing, stocks, ordering	1 (4,17)
Transport, warehousing, stocks, packaging, other	1 (4,17)
Stocks, ordering	1 (4,17)

Figure 5 Individual logistics costs within the treatment of logistics models
Source: Author

Authors	Logistics processes
Blumenfeld et al., 1985	distribution
Blumenfeld et al.,1987	distribution
Speranza & Ukovich, 1994	distribution
Bertazzi et al., 1997	distribution
Ghodsypour and O'Brien, 2001	purchasing
Zhao et al., 2004	internal processes
Berman and Wang, 2006	distribution
Chow, 2007	distribution
Kutanoglu et. al, 2008	distribution
Wang and Cheng, 2009	purchasing
Miranda and Garrido, 2009	purchasing
Madadi et al., 2010	purchasing
Strack and Pochet, 2010	purchasing
Sajadieh et al (2010)	purchasing
Lau and Nakandala, 2012	internal processes
Tancrez et al., 2012	distribution
Ali and O'Connor, 2013	distribution
Kim et. al., 2015	distribution
Becker et al., 2016	distribution
Škerlič et al, 2016	distribution, internal processes, purchasing
Perera et al., 2017	purchasing
Rybakov, 2017	distribution
Petraška et al., 2018	distribution
Min et al., 2018	distribution, purchasing



Combination of processes of individual models	f (%)
Distribution	13 (54.17)
Purchasing	7 (29.17)
Internal processes	2 (8.33)
Distribution, purchasing	1 (4.17)
Distribution, internal processes, purchasing	1 (4.17)

Figure 6 Individual logistics processes within the treatment of logistics models
Source: Author

internal processes (11%). The analysis of the combination of processes that are analysed by individual models shows similar results. Of the n = 24 scientific papers, 13 cost models (54.17%) deal with distribution. This is followed by the studies that deal with the purchasing process (n = 7; 29.17); internal processes (n = 2; 8.33%); the distribution process/purchasing process (n = 1; 4.17%) and distribution processes/internal processes/purchasing processes (n = 1; 4.17%).

5 Discussion and Conclusions

The aim of the study is to determine the scope of the optimisation of individual logistics models from the point of view of how individual logistics costs categories and processes are treated. The extent to which each individual model can be optimised, depends on the type of processes covered by the model. Based on a detailed analysis of scientific studies, it can be concluded that most models are focused solely on controlling the cost activities of transport, warehousing or stocks. For a detailed definition of the logistics process and the optimal ratio between the costs and the quality of logistics processes, it is also necessary to identify different logistics costs. The studies focus on transport costs, warehousing costs and stocks costs, as they represent the largest share in the logistics costs structure. Other logistics costs are given less consideration, also due to the fact that different authors classify them differently and directly group them under the three most frequently studied types of logistics costs. However, this should not preclude the establishment of a system capable of estimating and measuring all logistics costs and then efficiently integrating the changes in the business process into a cost model.

The first obstacle to managing logistics costs therefore appears at the global level in their classification, as there is currently no uniform definition or standard to unify the individual logistics costs. This was the premise for the study conducted by Rantasila [27], which analysed 66 scientific papers and identified 24 different logistics cost components. Inconsistent classification can affect the identification of all relevant cost components in practice, as logistics costs arise in various business areas, such as sales, purchasing, manufacturing and logistics. Due to the lack of knowledge of logistics costs, the interests of individual functions (sales, purchasing, manufacturing, logistics, etc.) are often emphasised, which are not always in line with the common interests of a company's business process [34]. These are the main factors that affect the level of difficulty of managing logistics costs.

Therefore, it would be appropriate to develop a unified standard to define the field of classification of logistics costs that could be applied at a global level. This would facilitate the measurement and presentation of logistics costs, which are the two fundamental conditions for their effective management. Thus, an overview and analysis of logistics cost management issues provides important empirical support for improving logistics processes in supply chains. The presented study also provides a synthesis of the scientific literature in the field of logistics cost modelling, which can be an important framework for future empirical studies.

An analysis of past and current scientific studies was carried out, which is related to the development of logistics cost models. In the future, it would also be worthwhile to analyse any research related to the measurement of logistics costs in companies.

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