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IMPROVED COST MANAGEMENT AT SMALL AND MEDIUM SIZED ROAD TRANSPORT COMPANIES: CASE HUNGARY

ABSTRACT

Small and medium sized road freight transport companies located in Hungary are facing strong competition on the logistics market. An advanced cost management system supporting decisions on capacity allocations or pricing may be a competitive advantage for them and indirectly for the whole economy as well. Still, they generally apply simple, traditional cost calculation regimes, potentially sufficient in case of a homogeneous service portfolio. Nevertheless, road haulage companies with heterogeneous service structures may witness information distortions when using traditional costing methods. So it might be recommended for them to introduce better costing principles. To support an improved transport costing, a multi-level full cost allocation model has been set up and tested in this paper. The research results have pointed out that such a methodological development accompanied by the extension of the data collection mechanism can contribute to making the cost management systems of road freight transport companies more effective.

KEY WORDS

cost calculation; road freight transport; multi-level; cost allocation;

1. INTRODUCTION

According to previous surveys road freight transport companies running business in Hungary apply generally ex post costing methods of a simple kind [1]. This might be true in case of other road freight transport enterprises located in Central-Eastern-European (CEE) countries as well, since they have similar political and economic background as the Hungarian ones do. The cost management methods used are mainly based on average aggregate costs of transport services. These are regarded as traditional costing methods. Sometimes performance independent fixed and performance dependent variable cost components are separated, and thus the calculation becomes slightly differentiated. Nevertheless, the main costing principle, i.e. averaging aggregate costs, remains the same. As the output of the costing regimes, that is, service cost data constitute the basic input of decision-making and ex ante pricing procedures it is of high importance to make cost calculations more accurate.

Transport costs are often regarded as one of the main influencing factors of a relevant firm's competitiveness. More effective transport services, i.e. cost reductions of haulage may increase the export share of companies involved in international trade [2]. So more efficient transport operations controlled by adequate decision support systems are essential not only for the transport companies themselves, but for the firms utilizing their services as well.

According to public and comparable data of EUROSTAT only less than 7% of the Hungarian road freight transport companies employed at least 10 employees in 2009. This value was almost the same in Slovenia and only about 3% in Poland. The ratio of enterprises having 50 or more employees was less than 1% in each country. These data seem to indicate that the majority of road haulage companies in Hungary and possibly in other CEE countries also belong to the category of small and medium sized enterprises (SME). This phenomenon is confirmed by [3] who highlight the coexistence of two very different production models in this industry: 'the model of large enterprises combining haulage, freight forwarding and logistics, more likely in north-western Europe, and an SME model, principally in road freight (...) particularly in southern and eastern Europe.' The authors attribute the latter to the low production costs derived from lower wages and social welfare charges than EU average. This might also be the explanation for flagging out mentioned by [4] and in the report of the respective high level group [5]. Simple costing regimes may be sufficient for decision support and pricing purposes in case of micro scale road transport companies which generally provide homogeneous services. Some small and even medium scale road transport companies may also have homogeneous operational and service structures which allow them to employ traditional cost management techniques.

The remaining group of small and medium scale road transport companies disposes of more complex operational structures using multiple resources and managing inhomogeneous service systems. More complex organisations require generally more developed management accounting systems [6]. These companies, however, do not make use of advanced, sophisticated costing schemes although the application of such calculation methods could deliver advantages to them: understanding the drivers of costs, differentiating costing and pricing regimes by taking into account the differences of various services and service generators, determining the real costs of elementary services and using this information for pricing activities. Thus the aim of this paper is to elaborate and test an improved cost calculation method applicable to road freight transport companies requiring more accurate costing information. The improved costing model:

- shall be more detailed and sophisticated and go beyond the use of simple aggregate values;
- provides benefits by differentiating the direct and indirect cost components, just as well as the fixed and variable cost components;
- shall be governed by the cause-effect based allocation of indirect costs;
- shall use differentiated performance indicators;
- has to take into account the operational characteristics, i.e. the variety of resources or resource types of the examined company;
- has to consider the special features of different transport services or service types.

The methodology is derived from the relevant existing costing principles applied or at least piloted at transport or logistic companies. Nevertheless, these principles shall considerably be improved to meet the requirements set before. The costing methodology is then adapted to a typical road transport company having a generalised operational and service architecture. Having developed the calculation equations, a pilot application with real input data is carried out. The pilot calculation and the comparison of the possible calculation schemes make it possible to distinguish the advantages of the improved cost calculation model.

2. LITERATURE REVIEW

Transport companies, particularly small and medium sized ones, are seldom object of cost calculation case studies reported in the literature. Although there are several research results on the theoretical issues of costing principles available, concrete and full-scale applications assessing and evaluating the cost structure of transport enterprises can hardly be found. The few existing case studies in this field use either activity-based costing (ABC) or multi-level full cost allocation (MFCA) for solving costing problems. Both of them are characterised by the relative performance consumption based allocation of indirect costs. While the former method uses activities, the latter one takes into account the organisational structures to support cost allocations.

The most detailed and tested transport-related ABC model has been elaborated for the case of a road haulage company [7]. A medium sized road haulage company operating 122 trucks has been analysed in the case study. Instead of single transport tasks, 28 transport service groups categorised according to the target countries have been identified as elementary profit objects. (Note that ABC applications may use the designation of "cost object" for profit objects.) A two-stage indirect cost allocation has been carried out using differentiated resource drivers and cost drivers and applying 19 cost pools and 17 activities. It turned out that there may be significant differences between the results of traditional and activity-based cost calculations so it is worth investing into the development of the costing regime. The costs of individual airplanes and flights have been analysed with ABC in an empirical study examining the operating costs in the airline industry [8]. Four activity pools containing 10 activities have been used for allocating overheads. The overheads have been allocated to the airplanes first and then the costs of airplanes have been assigned to individual flights proportionally to their relative transport performance. An ABC system has been introduced in timber harvesting including road transport [9]. Here transport operations can be regarded as internal secondary processes while one lot of timber from a specific assortment has been selected as elementary profit object. Seven activities for forest transport and eight activities for long-distance transport have been identified in the ABC model. The cost drivers of transport-related activities were time or distance based.

In spite of the relatively limited transport-related research results several ABC studies can be found in the field of logistics. Most of them deal with internal or external logistics processes of production or manufacturing systems, i.e. distribution management [10], warehousing [11], storage systems [12] or entire material flows [13]. Even supply chains have been evaluated by ABC owing to the standardised cost definitions and allocation procedures [14]. Logistics service providers offering, among others, transport services have at the same time been less analysed. A basic ABC model of such companies using matrix algebra has been elaborated through a case study defining sample activities and cost drivers [15]. Eight activity centres have been defined and the cost of a sample complex logistics service offered to a certain customer has been calculated. In another example the theoretical cost structure of third-party logistics service providers has been evaluated by ABC with special regard to general activities of warehousing and transport [16]. Nine activities have been found for warehousing and for transport. Most of transport-oriented cost drivers proposed are volume based and some of them are distance or time based.

A later costing approach is the so called time-driven ABC [17]. This approach identifies the processes consisting of activities, their costs and their effective capacities. The capacity of logistics processes can be expressed for example by the amount of total working or operation time. The cost per time unit is calculated by dividing the total cost by the capacity. Costs are then allocated to the profit object by multiplying the cost per time unit by the time needed to perform the corresponding activity. The time of performing an activity is estimated by detailed time equations containing so-called time drivers. Time equations describe the different characteristics of specific cases. As time drivers include various performance indicators, they make multiple cost driving also possible. Although a detailed time analysis is not foreseen in this study, the importance of time consumption is acknowledged in the modelling procedure. The outputs of the empirical ABC studies, especially the road haulage costing results can be used as a starting point for our analysis. Nevertheless, the intention is to analyse single freight transport tasks instead of service groups and the multi-level structure of cost centres is to be taken into account. Another task is the differentiation between fixed and variable cost items. Thus, it shall be assessed whether MFCA applications in transport or logistics support these additional methodological requirements.

MFCA models have been set up and used for logistics processes integrated in production systems [18] and for road transport based logistics service providers [19]. Relevant from these calculations is the one evaluating the costs, performances and profits of logistics service providers operating road freight transport services. The article gives guidance on the general methodology of MFCA and elaborates a generalised calculation model applicable by logistics service providers [19]. The model has been illustrated by a full scale sample calculation where 13 cost centre types have been used for calculating the costs of 10 logistics service packages. Some of the input data, however, have been just estimated using empirical experience as no real data were available for the pilot calculation. A more detailed description of MFCA algorithms can be found in the methodology paper analysing the costing techniques in complex transport systems [20]. A generalised costing model for rail freight transport operators has been developed with 14 cost centre types. The general equations have been then exploited for conducting a parametric sample cost calculation of elementary rail freight transport tasks.

The results of the analysed MFCA applications are useful as they can help building up the multi-level costing model, identify the cost drivers and define the necessary equations. Nevertheless, small and medium sized road transport companies require specific, usually simpler models depicting their operational structures. Furthermore, none of the reported MFCA models has paid attention to fixed and variable costs so this problem is to be tackled by the improved algorithms. Last but not least, real-world input data are required to test MFCA models in practice.

Note that MFCA is a full cost allocation method. It means that finally, all costs are allocated to the profit objects. By doing so, decision makers are able to see the full profitability of their products or services; that is why they often prefer full cost allocation to other costing techniques. At the same time, MFCA and other full cost allocation methods require cost drivers for all cost elements and types. Usually, the problem set up cannot be solved in an exact way so some simplifications need to be incorporated into the calculation models. Thus, the outputs of such models are generally not fully accurate, which is the main limitation of the chosen methodology.

3. METHODOLOGY

After having reviewed the corresponding transport and logistics costing approaches the MFCA model fulfilling most of the prescribed requirements seems to be a suitable business management tool which is worth being implemented in road freight transport. As mentioned, the costing algorithms shall be revised since fixed and variable cost items are to be differentiated in the calculation process. Fixed costs are not dependent on performances so only variable costs can be included into the allocation procedure governed by the relative performance consumption. When using the MFCA principle indirect costs are first recorded in the cost centres. These are the so called primary costs of the cost centres. The primary cost of a cost centre can be determined on the basis of the resources assigned to it. The secondary cost of a cost centre consists of the allocated items coming from the serving cost centres, where appropriate. Cost allocations are carried out according to the relative performance consumption. So each cost centre with cost items to be allocated shall be provided with an indicator measuring its performance and the consumption of this performance. These indicators serve as cost drivers during the cost allocation.

Cost centres can be organisational units and pieces of equipment, etc. representing resources consumed by multiple objects. They are arranged into a multi-level hierarchy according to the operational structure of the company. Cost centres can serve other cost centres or contribute to the production of elementary or end transport services. Cost centres are indexed as k = 1…n. When they play the role as service cost centre the indexing is i = 1…n. Note that cost centres may also be interrelated in several ways. The model assumes that there is a one-way performance flow between the cost centres and no feedbacks are allowed. Of course this is a simplification and it may reduce the accuracy of the calculation. Nevertheless, this simplification makes it possible to avoid iterative approaches which would also reduce accuracy. Profit objects are the elementary transport services gaining revenues and bearing costs. Direct costs are assigned to the profit objects while indirect costs are allocated using the cost centres and their hierarchy. The allocation is governed like before: cost items are allocated proportionally to the performance consumption. Profit objects are indexed as j = 1…m.

The allocation of indirect costs goes from the highest level to the lower levels of calculation hierarchy. The calculation is finished as soon as all indirect costs have been allocated to the profit objects. When introducing the differentiation between fixed and variable costs the original calculation equations [18, 19, 20] shall be modified. The new equations have been elaborated by the authors on the basis of original equations.

Here, the performance independent fixed indirect cost items are not included into the multi-level indirect cost allocation. They shall be collected and aggregated separately and are assigned to the profit objects at the end of the calculation. So the cost of a cost centre can be divided into fixed and variable parts. Fixed costs in cost centres can be regarded as assigned primary costs as fixed cost items are not allocated in the multi-level model. At the same time variable costs can be divided into assigned primary and allocated secondary parts:

$$C_k = C_{f_k} + C_{v_k} = C_{f_k} + C^p_{v_k} + C^s_{v_k} \tag{1}$$

where:

C_k – cost of cost centre k;

C_{f_k} – fixed cost of cost centre k;

C_{v_k} – variable cost of cost centre k;

$C^p_{v_k}$ – variable primary cost of cost centre k;

$C^s_{v_k}$ – variable secondary cost of cost centre k.

The variable secondary cost is the sum of allocated variable cost items coming from the serving cost centres on the basis of relative performance consumption. So the cost of a cost centre can be calculated as follows:

$$C_k = C_{f_k} + C^p_{v_k} + \sum_{i=1}^{n} C_{v_i} \frac{P_{ki}}{P_i} \tag{2}$$

where:

C_{v_i} – variable cost of service cost centre i;

P_i – performance of service cost centre i;

k_i – performance consumption of cost centre k at service cost centre i.

The cost of a profit object can be divided into direct and indirect parts. The classification of direct and indirect costs depends on the applied accounting or data collection rules. Direct costs do not need to be split up into fixed and variable parts as no additional allocations are necessary to determine them. Anyway, direct costs are generally variable costs in road transport practice. Indirect costs of profit objects, however, shall be further divided into fixed and variable parts as the calculation of the two types of indirect costs differs:

$$C_j = C^d_j + C^{id}_j = C^d_j + C^{id}_{f_j} + C^{id}_{v_j} \tag{3}$$

where:

C_j – cost of profit object j;

C^d_j – direct cost of profit object j;

C^{id}_j – indirect cost of profit object j;

$C^{id}_{f_j}$ – fixed indirect cost of profit object j;

$C^{id}_{v_j}$ – variable indirect cost of profit object j.

The variable indirect cost is the sum of allocated variable cost items coming from the serving cost centres on the basis of relative performance consumption. The fixed indirect costs of profit objects can be determined in different ways:

1) using the accounting-based approach where the aggregated sum of fixed costs collected in cost centres is distributed among the profit objects proportionally to their direct costs;
2) applying the time-based approach where the aggregated sum of fixed costs collected in cost centres is distributed among the profit objects on the basis of their relative service time.

The latter solution may be regarded to be more reasonable since fixed indirect costs as overheads can be connected to time rather than to direct costs. So the cost of a profit object can be calculated as follows:

$$C_j = C^d_j + \frac{T_j}{\sum_{j=1}^{m} T_j} \sum_{k=1}^{n} C_{f_k} + \sum_{i=1}^{n} C_{v_i} \frac{P_{ji}}{P_i} \tag{4}$$

where:

P_{ji} – performance consumption of profit object j at service cost centre i;

T_j – duration or transport service time of profit object j.

When using the traditional costing approach the average fixed cost values and average variable cost values are elaborated at company level. The aggregated fixed cost of the company is averaged by time while the aggregated variable cost is averaged by transport performance. Having the generalised average cost values, the cost of a profit object can be calculated through multiplying these values by the time consumption and by the transport performance respectively. Dedicated costs are directly assigned to the profit object, i.e. to a transport service. These are direct costs but may not cover the full set of direct costs specified in equation (4). This depends on the accounting system used. So the cost of a profit object can be calculated as follows:

$$C_j = \frac{C_f}{\sum_{j=1}^{m} T_j} T_j + \frac{C_v}{\sum_{j=1}^{m} D_j} D_j + C_j^t \quad (5)$$

where:

- C_f – fixed cost of the company;
- C_v – variable cost of the company;
- D_j – transport performance of profit object *j* which is the distance performed by the transport service;
- C_j^t – dedicated cost of profit object *j*.

Analysing equation (5) we can conclude that the fixed cost of the company is distributed among profit objects on the basis of their relative time consumption. This is the same solution as used in equation (4). At the same time, the variable cost of the company is distributed among profit objects on the basis of their relative transport performance instead of using differentiated cost drivers as applied in equation (4). However, it should be noted that many road transport companies use specific cost indicators where the total cost of the company is averaged by transport performance only. It means that even the relatively simple equation (5) may sometimes be ignored when determining the costs and prices of certain road transport services.

Transport companies often face a high ratio of fixed costs. The set of fixed costs is, however, not homogeneous [21]. There may be some resources behind the fixed costs whose capacities can be adjusted to performance changes for a mid-term period. The costs caused by such resources can be regarded as semi-fixed costs. At the same time the capacities of remaining resources cannot be changed in line with short or mid-term performance fluctuations. The costs induced by such resources can be regarded as real fixed costs. In this paper a cost calculation model with a mid-term time horizon is used. So, when applying detailed allocations in the cost calculation process it is reasonable to differentiate the fixed and semi-fixed cost items where appropriate. If semi-fixed cost items can be separated in the set of fixed costs and suitable cost drivers are available, such cost items may be regarded as variable costs and can be included into the allocation procedure. This may provide more accurate service cost data as the use of semi fixed costs enhances the ratio of cause-effect based cost allocations and at the same time decreases the number of sometimes hardly explainable fixed cost allocations.

4. CALCULATION MODEL

The methodology proposed can be regarded as an improvement of the traditional costing practice as it overcomes the problems of simple, arbitrary cost allocations. Before applying this methodology to particular enterprises it is worth conducting a deductive parametric calculation. This can then be the starting point of real-world applications by providing the necessary theoretical framework. It shall be noted however, that the theoretical proof is to be adapted to the operational circumstances of the examined company as each

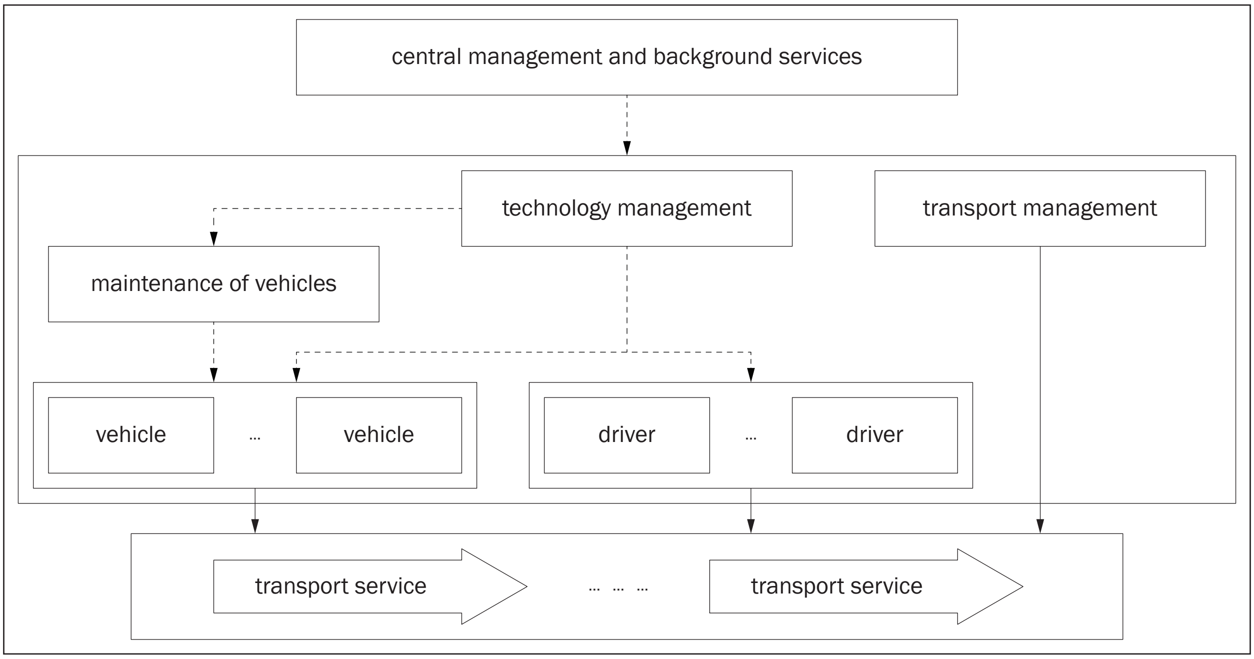

Figure 1 – Operation model of a typical small and medium sized road transport company

Table 1 – Cost structure of cost centres and profit objects

Calculation object (abbr.)	Primary or direct cost items	Cost driver	
		Indicator (abbr.)	Dimension
central management and background services (CM)	fixed costs only: all cost items which can not be connected to the other objects	–	–
technology management (TE)	semi-fixed: personnel costs	working time (wt)	man-hour
transport management (TR)	semi-fixed: personnel costs	working time (wt)	man-hour
maintenance of vehicles (MA)	fixed: depreciation semi-fixed: personnel costs variable: material costs	maintenance time (mt)	man-hour
vehicle (VE)	semi-fixed: leasing costs (leased vehicles), depreciation (own vehicles), insurances and taxes variable: material costs including outsourced maintenance	vehicle running (vr)	kilometre
driver (DR)	semi-fixed: wage-related personnel costs variable: bonus or performance related personnel costs	working time (wt)	man-hour
transport service (TS)	direct: dedicated costs (tolls, charges, etc.), fuel costs (where appropriate)	–	–

market actor has its own special features. As the first step a generalised calculation model has been set up representing the main technology and management processes of a typical small and medium sized road transport company offering full truck load services. The calculation model is based on the operation model of *Figure 1* consisting of the profit objects and the cost centres; furthermore, the identified performance relationships between them, rely on the empirical experience from the CEE countries and on former research results [19].

Elementary freight transport tasks or services are defined as profit objects while a determined set of cost centres depicts the operational technology. Cost centres are explained further in the text. The vehicles, vehicle drivers and the transport management unit performing various operative tasks like customer care or forwarding take part mainly in the production of the basic transport services. The maintenance unit, if available, serves the vehicles by ensuring the required state of repair. Dedicated maintenance units are worth operating in case of a relatively big vehicle fleet only. Otherwise, maintenance tasks are normally outsourced. Technology management is responsible for controlling vehicle maintenance and carrying out capacity allocations, i.e. the assignments of vehicles and vehicle drivers. Finally, the unit of central management and background services covers all other administrative functions required for managing and operating the organisation of the company. Note that the basic model presented above concentrates on the main activity field only, i.e. on full truck load road freight transport. If the company offers additional services like groupage transportation or value-added logistics services, the calculation scheme is to be extended by these elements. As the model is flexible it can easily be adapted to the operational and service structure of a particular company.

The next task is to analyse the cost structure, i.e. the primary costs of cost centres and the direct costs of profit objects. The primary costs of cost centres shall be divided into fixed, semi-fixed and variable parts. For the differentiation between these cost categories their general definitions have been used. Nevertheless, it is sometimes not easy to decide whether a certain cost type is fixed or semi-fixed. Sound managerial experience can help overcome this problem. Where cost allocations are foreseen, i.e. in case of cost centres having variable or at least semi-fixed cost items, cost drivers are also to be determined. Typical direct costs can be dedicated costs, e.g. tolls or other infrastructure user charges, etc. connected to the transport service. Fuel costs may also be direct costs. If these cost elements cannot be regarded as direct costs then they are normally assigned to vehicles as variable costs. The results of the structural analysis of costs are summarised in *Table 1*. The calculation objects are linked to *Figure 1*. Note that the cost items defined here are the most typical ones and may vary from company to company. Furthermore, the duration of a transport service may exceed the total working time of drivers involved in this task, as it may contain unproductive operations.

If semi-fixed cost items are considered as fixed costs, then, vehicle x (x = 1...X) and driver y (y = 1...Y) take part in the production of the profit object, the cost of transport service j can be calculated, by exploiting and extracting the general equations (1) – (4) and considering the operational structure of *Figure 1*, as follows:

$$C_j = C_j^d + \frac{T_j}{\sum_{j=1}^{m} T_j}(C_{CM} + C_{TE} + C_{TR} + C_{f_{MA}} + \sum_{x=1}^{X} C_{f_{VE_x}} + \sum_{y=1}^{Y} C_{f_{DR_y}}) + C_{v_{DR_y}} \frac{wt_{jDR_y}}{wt_{DR_y}} + \frac{vr_{jVE_x}}{vr_{VE_x}}(C_{v_{VE_x}} + C_{v_{MA}} \frac{mt_{VE_xMA}}{mt_{MA}}) \qquad (6)$$

For the definitions and abbreviations of the variables see *Table 1*. If the semi-fixed cost items are considered as variable costs equation (6) shall be modified as follows:

$$C_j = C_j^d + \frac{T_j}{\sum_{j=1}^{m} T_j}(C_{CM} + C_{f_{MA}}) + \frac{wt_{jDR_y}}{wt_{DR_y}}(C_{DR_y} + C_{TE} \frac{wt_{DR_yTE}}{wt_{TE}}) + \frac{vr_{jVE_x}}{vr_{VE_x}}(C_{VE_x} + \frac{mt_{VE_xMA}}{mt_{MA}}(C_{v_{MA}} + C_{TE} \frac{wt_{MA,TE}}{wt_{TE}}) + C_{TE} \frac{wt_{VE_xTE}}{wt_{TE}}) + C_{TR} \frac{wt_{jTR}}{wt_{TR}} \qquad (7)$$

The scheme described by equations (6) or (7) can serve as the improved cost calculation tool of elementary road freight transport services. It is namely expected that the service cost data produced by the application of these equations are in general more accurate than the ones derived from traditional costing procedures represented by equation (5). This can be explained by the transparent allocation of differentiated indirect costs. Thanks to the consequent use of cause-effect based allocations and assignments the accuracy of transport costing can be significantly increased. However, the applicability of the sophisticated procedures and equations may be influenced by the availability and the quality of requested input data. Thus actual data collection and processing practices may lead to modifications regarding the applicability of the theoretical parametric equations. Similarly, if the operational mechanism of the examined company differs from the one presented in *Figure 1* the basic calculation algorithms may also need adaptation. Nevertheless, the principles of the calculation remain the same even if the equations are slightly altered.

5. CASE STUDY

To demonstrate the advantages of the improved costing procedure sample calculations have been performed based on real data and relying on the algorithms developed. The input data have been provided by a Hungarian road freight transport company operating 20 vehicles and employing 22 drivers at the end of the reference year. Two employees are responsible for technology management while transport management is carried out by five persons. The vehicles are owned by the company. Maintenance is fully outsourced so the maintenance costs are part of the material costs. The drivers are paid on the wage basis only. The authors confirm that they have permission to anonymously use the data provided by the company.

The company has performed 770 freight transport services in the reference year. Its market covers whole Europe, and domestic as well as international services are offered. The service structure can be regarded as inhomogeneous as the company's transport tasks depend on several factors like geography, types of goods, complexity of forwarding process, etc. Thus, the introduction of the improved cost calculation seemed to be reasonable. Cost calculations have been carried out for several profit objects. Sample calculations have contributed to refining the model as well as to identifying the gaps between the current and the desired data collection practice. To demonstrate the procedure, the evaluation of five selected elementary transport services performed by two vehicles and two drivers is presented in the following phases:

a) based on input data of the original data collection;
b) based on input data of improved data collection.

Both phases make use of the following calculation methods:

1) traditional cost calculation using equation (5), without differentiating fixed and semi-fixed costs;
2) traditional cost calculation using equation (5), differentiating fixed and semi-fixed costs where semi-fixed costs are regarded as variable costs;
3) improved cost calculation using equation (6) where semi-fixed costs are regarded as fixed costs;
4) improved cost calculation using equation (7) where semi-fixed costs are regarded as variable costs.

The input data provided by the original data collection mechanisms are not detailed enough to support the full-scale application of the improved costing equations. The current management accounting system neglects most of the proposed performance indicators, i.e. cost drivers, on the one hand and uses only central management and vehicles as cost centres on the other hand. Furthermore, there are no costs directly assigned to the services. The input data for the cost calculation of the selected transport services derived from the current data collecting system are summarised in *Table 2* (for the abbreviations see *Table 1*).

The results of the cost calculation based on the original data collection system are shown in *Table 3*. Note that equations (6) and (7) could be used in a limited, i.e. simplified way only due to the fact that the detailed input data are mostly missing. The differences between the values calculated by the traditional and by the corresponding improved equations, i.e. equation (5) vs. equation (6) and equation (5) differentiated vs. equation (7), are within 2%, so that there are no relevant differences between the results. Thus, it can be concluded that it is not worth applying the improved costing method here without having the necessary input data of the requested quality and format. The latter means that the input data are not detailed enough or contain faulty records.

Table 2 – Input data from the original data collection mechanism

	Tr. service 1	Tr. service 2	Tr. service 3	Tr. service 4	Tr. service 5
CM	total cost (fixed): 229740 EUR				
VE (entire fleet)	depr. & interest (semi-fixed): 216,387 EUR tax & insurance (semi-fixed): 45,393 EUR driver wages (semi-fixed): 222,012 EUR material costs (variable): 30,914 EUR fuel (variable): 591,506 EUR infra. user charg. (variable): 251,376 EUR				
	total km run: 1,915,813 km				
VE I	depr. & interest (semi-fixed): 14,259 EUR tax & insurance (semi-fixed): 3,106 EUR driver wages (semi-fixed): 14,146 EUR material costs (variable): 3,239 EUR fuel (variable): 41,022 EUR infra. user charg. (variable): 17,189 EUR		–	–	–
	total km run: 131,957 km				
VE II	–	–	depr. & interest (semi-fixed): 14,563 EUR tax & insurance (semi-fixed): 3,108 EUR driver wages (semi-fixed): 14,231 EUR material costs (variable): 1,944 EUR fuel (variable): 37,781 EUR infra. user charg. (variable): 17,125 EUR		
			total km run: 127,433 km		
distance	2,851 km	3,200 km	1,284 km	489 km	1,045 km
duration	total duration of services: 2,310 days				
	4 days	4 days	2 days	1 day	2 days

Table 3 – Cost calculation results in EUR, based on the original data collection mechanism

	Tr. service 1	Tr. service 2	Tr. service 3	Tr. service 4	Tr. service 5
equation (5)	2,536	2,695	1,203	532	1,094
equation (5) differentiated	2,418	2,665	1,109	446	939
equation (6)	2,563	2,726	1,191	527	1,084
equation (7)	2,406	2,652	1,093	440	927

The improvement of the cost calculation system involved the introduction of new cost centres, cost drivers and direct cost categories according to the calculation model presented in *Figure 1* and described in *Table 1*. The data collecting system was also refined according to the requirements of the new calculation structure, i.e. more detailed and more precise input data were sought. Of course, the specific operational features of the examined company have been taken into account, too.

As most of the additional financial and technical data could be exploited from the existing information systems or records with only minor transformations and estimations, no considerable effort was necessary to build up the extended input database (see *Table 4*, for the abbreviations see *Table 1*). The transformations were carried out with the help of additional tables while the estimations were obtained from brainstorming. All these efforts required some man-days only. The results of the cost calculation based on the improved data collection system are shown in *Table 5*. As it can be seen, these values differ from the ones presented in *Table 3*. The differences between the cost values produced by the same equations but based on dissimilar, i.e. conventional or extended, input databases range between 1% and 14%.

The differences between the outcomes of the traditional and the corresponding improved calculation schemes are significant when using an extended input database. The deviations can be 10-15% or even more. The more irregular the transport service, the higher is the variance of its calculated cost and the higher may be the risk that the real cost remains hidden as result of the simple averaging practices. To give an example, *Figure 2* compares the various calculation results of transport service 3. As it can be seen, this is an irregular transport service, and the outcome depends on the calculation equations applied: the calculated

Table 4 – Input data from the improved data collection mechanism

<table>
<tr><th></th><th>Tr. service 1</th><th>Tr. service 2</th><th>Tr. service 3</th><th>Tr. service 4</th><th>Tr. service 5</th></tr>
<tr><td>CM</td><td colspan="5">total cost (fixed): 109,319 EUR</td></tr>
<tr><td rowspan="3">TE</td><td colspan="5">personnel costs (semi-fixed): 32,978 EUR</td></tr>
<tr><td colspan="5">working time: 3,872 man-hours</td></tr>
<tr><td colspan="2">working time for VE I: 39 man-hours
working time for DR I: 141 man-hours</td><td colspan="3">working time for VE II: 31 man-hours
working time for DR II: 146 man-hours</td></tr>
<tr><td rowspan="3">TR</td><td colspan="5">personnel costs (semi-fixed): 87,443 EUR</td></tr>
<tr><td colspan="5">working time: 9,680 man-hours</td></tr>
<tr><td>working time for service 1: 13 man-hours</td><td>working time for service 2: 5 man-hours</td><td>working time for service 3: 20 man-hours</td><td>working time for service 4: 4 man-hours</td><td>working time for service 5: 4 man-hours</td></tr>
<tr><td rowspan="2">VE (entire fleet)</td><td colspan="5">depr. & interest (semi-fixed): 216,387 EUR
tax & insurance (semi-fixed): 45,393 EUR
material costs (variable): 30,914 EUR
fuel (variable): 591,506 EUR</td></tr>
<tr><td colspan="5">total km run: 1,915,813 km</td></tr>
<tr><td rowspan="2">VE I</td><td colspan="2">depr. & interest (semi-fixed): 14,259 EUR
tax & insurance (semi-fixed): 3,106 EUR
material costs (variable): 3,239 EUR</td><td rowspan="2">–</td><td rowspan="2">–</td><td rowspan="2">–</td></tr>
<tr><td colspan="2">total km run: 131,957 km</td></tr>
<tr><td rowspan="2">VE II</td><td rowspan="2">–</td><td rowspan="2">–</td><td colspan="3">depr. & interest (semi-fixed): 14,563 EUR
tax & insurance (semi-fixed): 3,108 EUR
material costs (variable): 1,944 EUR</td></tr>
<tr><td colspan="3">total km run: 127,433 km</td></tr>
<tr><td>DR (full staff)</td><td colspan="5">wages (semi-fixed): 222,012 EUR</td></tr>
<tr><td rowspan="3">DR I</td><td colspan="2">wages (semi-fixed): 14,146 EUR</td><td rowspan="3">–</td><td rowspan="3">–</td><td rowspan="3">–</td></tr>
<tr><td colspan="2">working time: 1,936 man-hours</td></tr>
<tr><td>working time for service 1: 38 man-hours</td><td>working time for service 2: 39 man-hours</td></tr>
<tr><td rowspan="3">DR II</td><td rowspan="3">–</td><td rowspan="3">–</td><td colspan="3">wages (semi-fixed): 14,231 EUR</td></tr>
<tr><td colspan="3">working time: 2,033 man-hours</td></tr>
<tr><td>working time for service 3: 19 man-hours</td><td>working time for service 4: 8 man-hours</td><td>working time for service 5: 12 man-hours</td></tr>
<tr><td>direct cost (fuel)</td><td>1,252 EUR</td><td>1,362 EUR</td><td>511 EUR</td><td>196 EUR</td><td>417 EUR</td></tr>
<tr><td>dedicated (direct) cost (infra. user charg.)</td><td>330 EUR</td><td>262 EUR</td><td>143 EUR</td><td>55 EUR</td><td>98 EUR</td></tr>
<tr><td>distance</td><td>2,851 km</td><td>3,200 km</td><td>1,284 km</td><td>489 km</td><td>1,045 km</td></tr>
<tr><td rowspan="2">duration</td><td colspan="5">total duration of services: 2310 days</td></tr>
<tr><td>4 days</td><td>4 days</td><td>2 days</td><td>1 day</td><td>2 days</td></tr>
</table>

Table 5 – Cost calculation results in EUR, based on improved data collection mechanism

	Tr. service 1	Tr. service 2	Tr. service 3	Tr. service 4	Tr. service 5
equation (5)	2,491	2,537	1,178	523	1,055
equation (5) differentiated	2,344	2,500	1,060	416	862
equation (6)	2,887	2,938	1,291	568	1,149
equation (7)	2,638	2,675	1,274	472	901

values vary significantly. As it matters what equation one applies, the application of the improved, more transparent equations is worth considering. It can also be seen that the calculation results are influenced by the data collection regime as well, so the introduction of the improved equations shall be accompanied by the enhancement of the data collection system.

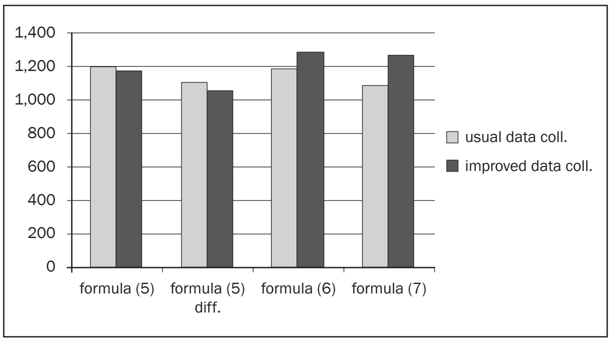

Figure 2 – Calculated cost values of transport service 3 in EUR

Summarising the outcomes of the case study one can conclude that the variance of transport service cost values may be rather high: the values depend on the costing method applied as well as on the input database used. Considering this variability it is of high importance that a well established and transparent methodology is used for cost calculations. The traditional method, i.e. equation (5), uses few cost drivers and aggregated cost items, which may lead to distorted costing information and to disregarding service characteristics in case of inhomogeneous transport tasks. Although equation (6) operates with differentiated cost items and cost drivers, it should not be utilized or it may even result in distortions when fixed costs or costs regarded as fixed ones dominate the company's cost structure. Considering the possible distortions of using equation (6) it is advisable for transport companies to use equation (7) and so benefit from the advantages of cost and cost driver differentiation as far as the data collecting system supports it. The more heterogeneous the service structure, the more advantages can be expected from the development of the cost and performance management system. When no developments in the data collecting regime can be executed or the heterogeneity of the service structure is low, equation (5) with a differentiation of fixed and semi-fixed costs may be a sufficient second best solution.

6. CONCLUSIONS

The methodological improvement of transport cost calculation enables a more effective cost management of small and medium sized road haulage companies. Service costs become more accurate through the application of the developed equations as the ratio of directly assignable costs increases and the allocation of remaining indirect costs is built on a transparent, cause-effect basis. To be able to utilize their advantages the new costing procedures shall be accompanied by the extension of data collection techniques as well.

At the same time the more sophisticated costing system requests high quality input data with special regard to differentiated cost components and performance indicators as cost drivers. Additionally, cost records shall be supplemented by performance records with regular updates. Finally, some data transformations may also be needed for the improved calculations. Of course, all these efforts may cause some additional expenses for the company, while general experience shows that the data necessary for the improved method are usually available within the company. Thus, if the enterprise has an extensive and inhomogeneous service system its decision support regime can be made more effective through the proposed method at a reasonable price. This more effective costing and pricing scheme may be a competitive advantage in the Central-East-European freight transport market where service supply usually exceeds the demand. Obviously, the average Central European road freight transport company with a human labour force of less than 10 employees cannot be expected to read scientific journals and thus apply the latest accounting methodologies, such as the one described in this article. Hence, it is of utmost importance to place adequate emphasis on disseminating the information given above, and to do so in a manner and layout appropriate to the target audience.

SMEs in road freight transport may be reached by different national stakeholders or advocacy organizations, like the Hungarian Road Freight Association, the Hungarian Logistics Association or the Hungarian Association of Logistics, Purchasing and Inventory Management in Hungary and other national organizations in the peer countries. International organisations, like the European Association for Forwarding, Transport, Logistics and Customs Services (CLECAT), the European Logistics Association (ELA) or the International Road Transport Union (IRU), etc. may also contribute to disseminating the best practices. These may rely on organizing dissemination events, which can serve as a platform for providing basic training in the improved costing method. At the same time, similarly to the endeavours of [22] a web-based tool could also be developed, which would enhance the uptake of the novel methodology, especially if the ICT-related gap between smaller haulage operators and larger logistics companies, as mentioned by [23] can be reduced. The advantages of improving the costing system are generally proportionate with the complexity of the operation, just as in the case of a public transport system [24]: the more sophisticated the operational structure of the road transport company, the more benefit is likely to be gained from the improvement of the cost management system. As the developed MFCA-based method is flexible the calculation scheme can be adapted to different kinds of road transport companies through the consequent use of basic algorithms and principles.

At the same time it shall be noted that the developed cost calculation model is not able to support all kinds of management decisions. It can be mainly used for planning or evaluating short and mid-term business operations in road freight transport of small and medium scale. Furthermore, the calculation equations (6) and (7) rely on a relatively simple operation model described by *Figure 1*. If more attention is paid to the operation model, i.e. more sophisticated operational structures are drafted, the calculation equations can also be refined and thus more complex decisions can be supported in the future.

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A KÖZÚTI ÁRUFUVAROZÓ KKV-K KÖLTSÉGGAZDÁLKODÁSÁNAK FEJLESZTÉSE: MAGYARORSZÁGI PÉLDA

ABSZTRAKT

A közúti árufuvarozással foglalkozó magyarországi kkv-k éles versenyhelyzetben vannak a logisztikai piacon. A kapacitásallokálással és a díjszabással kapcsolatos döntések meghozatalát támogató fejlett költségallokáló rendszer versenyelőnyhöz juttathatja nemcsak őket, hanem közvetve az egész gazdaságot. Ennek ellenére ezek a vállalkozások általában egyszerű, hagyományos költségszámítást alkalmaznak, ami homogén szolgáltatásportfólió esetén lehet megfelelő. Ugyanakkor a heterogén szolgáltatásstruktúrájú közúti árufuvarozó vállalatok esetében a hagyományos költségszámítási módszerek információtorzulást eredményezhetnek; ezért számukra indokolt lehet a fejlettebb költségszámítási módszerek alkalmazása. A fejlettebb közlekedési költségszámítás elősegítése érdekében a szerzők a jelen cikkükben egy többszintű költségallokációs modell kidolgozását és tesztelését végezték el. Az eredmények azt mutatják, hogy egy ilyen módszertani újítás az adatgyűjtő mechanizmus kiterjesztésével karöltve hozzájárulhat a közúti árufuvarozó vállalatok költségkezelési rendszereinek fejlesztéséhez.

KULCSSZAVAK

költségszámítás; közúti árufuvarozás; többszintű; költségallokáció;

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