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USE OF ACTIVITY-BASED COSTING APPROACH FOR COST MANAGEMENT IN A RAILWAY TRANSPORT ENTERPRISE

Summary. This research outlines a research study wherein an implementation of the activity-based costing (ABC) approach for cost management in a railway transport enterprise is addressed. ABC is an efficient technique for enhancing the quality of provided services and process complexity of certain railway companies, executing its activities at a regional or international scale. It is one of the new costing approaches that eliminate the inaccuracies and deficiencies of the traditional costing system. Compared to other costing techniques, considerable change lies especially in the way of assigning indirect cost units to activities

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based on actual causations, and subsequently, assigning activities to the very cost items by the intensity of their consumption. Furthermore, this approach allows decision-makers to identify specific cost item in terms of determining ways of how they can be managed. The main objective of this work is to elaborate a particular study with a draft application of the ABC method encompassing a description of procedure steps, along with relevant quantifications, as well as summarising the results obtained.

Keywords: railway enterprise, cost management, indirect transport cost, activity-based costing approach

1. INTRODUCTION

Cost calculation (or costing) approaches refer to various ways for quantification of cost entries and their assigning to calculation unit. Identifying an adequate technique depends on the nature of the performances and conditions in which the processes are carried out. The way of costing depends on the subject of calculation, required cost structure, method of cost's assignment as well as its conversion to a cost calculation unit [10, 13, 24].

Calculation by dividing and calculation by surcharge are the most commonly used costing approaches [6]. These techniques are applied mostly in enterprises where costs for a certain time period or certain performance volume (such as production or services provided) are related only to one type of performance or, in the same production process, a small number of species of homogenous products varying in their weight, labour content, or quality [23].

Costs of transport enterprises are characterised by significant differentiation of products, wherein it is necessary to provide a large number of service activities. In such a scenario, it is suitable to apply the activity-based costing (ABC) approach, which is primarily focused on indirect transport costs [16, 29].

As aforementioned, the ABC technique is one of the most advanced costing approaches, which removes the deficiencies of the traditional calculation system. This approach was founded by R. Cooper, R. S. Kaplan and H. T. Johnson [8] and its purpose is to assign corporate indirect costs to relevant cost items having the crucial significance in expending these costs [4].

In general, it is possible to perceive a company (in our case, railway transport enterprise) as a system of processes, activities and operations, which are imperative to be able to carry out a company's mission [5]. The ABC approach tries to structurally specify all the processes, activities and operations being executed in an enterprise with their mutual relationships [19, 21]. Activities carried out in an enterprise can be regarded as partial processes and procedures necessary to be performed to provide services [18]. Grouping operations, which are related to each other and can be assigned to a relevant cost item, form an essential activity of an enterprise [27].

2. DATA, METHODS AND LITERATURE REVIEW

A detailed insight into an enterprise can be achieved by the decomposition of basic processes [7]. The prime aim is to get on a level of activities, which are considered the centre of attention when managing costs using the ABC approach. For completeness, it is necessary to mention that a level of activities is not the lowest level of decomposition, given that the activities per se

can be further analysed and diversified in terms of operations being performed in individual examined activities [2, 12].

Furthermore, as far as a hierarchy of this approach is concerned, processes being a set of interdependent activities stand on the highest level. These processes support the key functions of an enterprise and have identifiable outputs. On the level below, activities, which identify what people conduct in enterprises in detail, are included. When applying the ABC technique, the manager's major object of interest is represented by activities responsible for generating corporate costs. From the long-term standpoint, it can be stated that if a company does not perform, no costs will be generated [17]. Moreover, vice versa, executing activities causes a generation of fixed and variable costs for an enterprise and that is why it is inevitable to deal with a relationship among costs and activities [12, 28].

The principle of the ABC approach consists of several steps as follows. For the first step, direct costs are assigned to relevant outputs. In the second step, indirect (overhead) costs are assigned to appropriate activities. This process represents a significant change in comparison with other techniques dealing with cost calculation. While at the third step, activities are assigned to individual cost items depending on the extent of demand for consumption of activities needed for their provision; that is, by the intensity of activities consumption. The entire procedure of this approach is specified in detail, for example, in the paper [1] written by Bokor (2012) and in the work [11] compiled by Foltinova et al. (2007).

Unlike the traditional costing approach "everything to everyone with the same piece", thus, a selective application of indirect costs based on the actual causalities occurs, that is, "to everyone only what he consumes, or what is consumed because of him", which is stated for example in the publication [22].

The ABC technique focuses on indirect (overhead) costs and converts them to direct costs. Specifically, indirect costs are assigned to the corresponding performance type instead of being arbitrarily divided into all performance types. In this case, it is possible to find out actual costs of performance (operation) with greater accuracy compared to the traditional cost system. The ABC approach is a suitable tool to be applied in the following scenarios [4, 9, 11]:

- corporate indirect costs are high,
- products or performances are differentiated,
- costs related to malfunctions and defects are high,
- strong competition on the market,
- production and services are automated,
- share of service activities being provided increases (indirect cost increases).

More so, the ABC approach is a powerful technique to improve product, service, process and market strategies in a variety of companies. Xu et al. stated that this method allows the transport enterprise's management to understand the cause of cost generation and how it can be managed [30]. The crucial objective of their research was to examine transport enterprises in terms of addressing specific issues such as information asymmetry in transport processes when implementing a technique of linear programming of time-driven activity-based costing model. According to this approach, an enterprise can gain insight into the effective conversion of corporate resources to value-added, as presented by Yang et al. in the literature [31]. They applied selected methods of multi-criteria decision-making (when using ABC) to evaluate the sustainable development of transport infrastructure projects while considering a wide array of social, financial, traffic and environmental criteria to deal with the strategic decision-making process under resource constraints as well as the carbon footprint aspect. A similar subject is discussed in the manuscript [25], elaborated by Rouse and Putterill, wherein various factors of

the cost driver framework and application to planning and control accountability are analysed, and dynamic relationships among activity-based costing and activity activity-based management are characterised with an emphasis on the nature and extent of an effect of environmental cost drivers on costs regarding transport infrastructure maintenance.

Unambiguously, a railway transport enterprise can identify those activities which consume a disproportionately huge amount of costs and bring small value-added, and thus, these activities can be excluded or at least limited, which is outlined for instance in the literature sources [3, 6, 26].

As previously mentioned, the basic principle of the ABC approach is to assign consumed resources to relevant activities (operations). Subsequently, those activities can be grouped into activity sets which are then assigned to cost items [14]. For clarity, this stage of application of the ABC technique is summarised in the following table (Table 1):

Tab.1

The assignment of consumed resources to cost items

Consumed resources	Operations (activities)	Set of activity	Cost item
Traction energy	Traction energy consumption	Transport	The number of transport performance operations
Railway infrastructure charge	Railway infrastructure use		The number of transport performance operations
Engine-driver labour cost	Transport performance execution		The number of transport performance operations
Administrative-staff labour cost	Administrative activity	Administrative	The number of administrative operations
Electric power consumption	Electronic registry entry		The number of operations carried out electronically

Source: authors

The next step is to create the calculation formula. To this end, the following formula for three types of performance; I, II, and III (representing different railway transport sections with various kinds of cargo being carried) even with input data values is compiled (Table 2).

Tab. 2

Calculation formula for performance types "I", "II" and "III"

Calculation formula element		Performance type		
		I	II	III
Traction energy		14,300 €	15,200 €	16,020 €
Railway infrastructure charge		6,100 €	7,050 €	8,500 €
Engine-driver labour cost		800 €	900 €	1,000 €
Administrative overhead cost	Administrative-staff labour cost	13,000 €		
	Electric power consumption	15,000 €		

Source: authors according to the [11]

Input data, namely, values of individual cost items for performance types I, II, and III needed for costing is summarised in the following table (Table 3):

Tab. 3

Values of cost items for performance types "I", "II" and "III"

Cost item	Performance type			In total
	I	II	III	
The number of transport performance operations	200 €	500 €	80 €	-
The number of administrative operations	8 €	6 €	14 €	28 €
The number of operations carried out electronically	2 €	6 €	3 €	3,640 €

Source: authors

3. FINDINGS AND DISCUSSION

3.1. Quantification of direct costs by the ABC approach

Traction energy consumption per one calculation unit is quantified as a share of direct material value corresponding to the performance type I and the number of transport performance operations for I (Equation 1).
Accordingly, as previously mentioned, direct cost per one calculation unit for performance types II, and III is calculated analogously (Equations 2 and 3):

$$Traction\ energy\ (I) = \frac{14{,}300}{200} = 71.50 \qquad (1)$$

$$Traction\ energy\ (II) = \frac{15{,}200}{500} = 30.40\ €/km \qquad (2)$$

$$Traction\ energy\ (III) = \frac{16{,}020}{80} = 200.25\ €/km \qquad (3)$$

Charge for the use of railway infrastructure per one calculation unit is determined likewise as traction energy consumption per one calculation unit – share of a railway infrastructure charge for certain performance type and the number of executed performance operations (Equations 4, 5 and 6).

$$Railway\ infrastructure\ charge\ (I) = \frac{6{,}100}{200} = 30.50\ €/km \qquad (4)$$

$$Railway\ infrastructure\ charge\ (II) = \frac{7{,}050}{50} = 14.10\ €/km \qquad (5)$$

$$Railway\ infrastructure\ charge\ (III) = \frac{8{,}500}{80} = 106.25\ €/km \qquad (6)$$

By analogy, as for engine-driver labour cost, its calculation is as follows (Equations 7-9):

$$Engine - driver\ labour\ cost\ (I) = \frac{800}{200} = 4\ €/km \qquad (7)$$

$$Engine - driver\ labour\ cost\ (II) = \frac{900}{500} = 1.80\ \text{€/km} \tag{8}$$

$$Engine - driver\ labour\ cost\ (III) = \frac{1000}{80} = 12.50\ \text{€/km} \tag{9}$$

3.2. Calculation of indirect costs by the ABC approach

Administrative overhead cost is referred to as indirect cost. The fundamental idea regarding administrative overhead costing is to specify a cause of occurrence of individual cost items [11].

Assignment of cause of occurrence to relevant cost item is conducted in Table 4.

Costing – administrative overhead cost

Cost item	Cause of occurrence
Administrative-staff labour cost	The number of administrative operations (I+II+III)
Electric power consumption	The number of operations carried out electronically (I+II+III)

Source: authors

First, to quantify administrative-staff labour cost per one calculation unit, it is necessary to split these cost items into individual administrative activities (for each type of performance in total) (Equation 10):

$$Administrative - staff\ labour\ cost\ \frac{13,000}{28} = 464.29\text{€}/1\ administrative\ operation \tag{10}$$

Subsequently, the outcome is multiplied by the number of administrative operations for the given type of performance and is divided by the number of executed performance operations of a certain type. Specific calculations are listed as follows (Equations 11, 12 and 13).

$$Administrative - staff\ labour\ cost\ (I) = \frac{464.29*8}{200} = 18.57\ \text{€}/1km \tag{11}$$

$$Administrative - staff\ labour\ cost\ (II) = \frac{464.29*6}{500} = 5.57\ \text{€}/1km \tag{12}$$

$$Administrative - staff\ labour\ cost\ (III) = \frac{464.29*14}{80} = 81.25\ \text{€}/1km \tag{13}$$

To quantify the cost item called electric power (or energy) consumption per one calculation unit, its value is divided by the number of administrative operations carried out electronically (for each type of performance in total), then, determined for each type of performance (Equations 14, 15, 16 and 17):

$$Electric\ power\ consumption\ \frac{15,000}{3640} = 4.12\ \text{€}/1\ administrative\ operation \tag{14}$$

$$Electric\ power\ consumption\ (I) = 4.12 * 2 = 8.24\ €/1km \qquad (15)$$

$$Electric\ power\ consumption\ (II) = 4.12 * 6 = 24.73\ €/1km \qquad (16)$$

$$Electric\ power\ consumption\ (III) = 4.12 * 3 = 12.36\ €/1km \qquad (17)$$

A summary of the ABC procedure when converting to one calculation unit for each type of performance is shown in Table 5.

Tab. 5

The resulting table of quantified cost items for each performance type

Cost item	Performance type		
	I	II	III
Traction energy	71.50 €	30.40 €	200.25 €
Railway infrastructure charge	30.50 €	14.10 €	106.25 €
Engine-driver labour cost	4.00 €	1.80 €	12.50 €
Administrative-staff labour cost	18.57 €	5.57 €	81.25 €
Electric power consumption	8.24 €	24.73 €	12.36 €
In total	156.88 €	84.85 €	438.39 €

Source: authors

Following the findings, transport performance type III represents the most costly performance type (438.39 €), followed by performance I (156.88 €), and the lowest value is assigned to performance type II (84.85 €).

The outcomes of this research confirm that the ABC approach can be used for indirect cost management in a railway transport enterprise, even with more precise results compared to traditional costing approaches. Nonetheless, using this technique requires a comprehensive and thorough analysis of operations, processes and activities as performed in the analysed enterprise [15].

4. CONCLUSION

The ABC approach is one of the most advanced costing techniques, which removes the inaccuracies of the traditional cost calculation system. Unlike other costing methods, significant change lies, in particular, in the way of assignment of indirect (overhead) costs to activities (or operations) based on actual casual links, and then, assignment of activities to individual cost items by the intensity of their consumption.

Since the ABC technique belongs to powerful costing approaches, which eliminate error rate and other deficiencies of traditional cost calculation methods, a railway transport enterprise can identify activities and operations which consume a disproportionately huge amount of costs and do not bring value-added by applying it, thus, these operations can be excluded or at least confined. This is why the ABC approach can be regarded as a very strong mechanism to improve the quality of services, processes and market strategies of companies being investigated. Furthermore, this technique allows corporate management to understand where the cause of cost generation is and how it can be managed. By implementing this approach, an enterprise can better understand the effective conversion of its resources on value-added.

However, the implementation of the ABC tool in our research indicates multiple subjects that might require streamlining and recommendations for research experiments in the future. For instance, it would be reasonable to decompose individual set of activities according to their function or transport territory (in our scenario, regional versus international territory), or even to differentiate each transport operation individually. Indirect cost analysis may be improved as well, while conducting a thorough analysis of a function, structure and purpose of corporate costing procedure and system, thereby influencing indirect cost assignment to the cost item.

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