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RESEARCH ARTICLE

Cost drivers in transport and logistics

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Abstract

Improving costing methods is a current issue and at the same time a real challenge in transport and logistics business. Due to financial problems more and more companies in these sectors decide to adopt developed costing techniques like activity-based costing (ABC). This calculation methodology, however, needs to identify applicable performance measures as cost drivers. Cost drivers are key factors in ABC as they are the basis of cost allocations. This paper aims to establish a sound theoretical framework of cost driver analysis in the field of transport and logistics. After defining the scope of cost drivers in general the relevance of such measures in transport/logistics costing is examined. Methods for driver selection are described and validated by empirical results. The main conclusion of the study is that cost driver analysis plays an important role in transport and logistics management and shall be supported by using mathematical methods as far as possible. Correlation/regression counting and analytic hierarchy process (AHP) have been identified as possible methods for making cost driver selections more reliable.

Keywords

cost drivers · transport management · logistics management

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1 Introduction

Organisations – among them transport and logistics companies – shall spend considerable resources to identify, measure and understand the nature of costs and the factors causing them. Cost drivers can be defined as factors which have a cause-effect relationship with costs. Cost drivers are any factors which cause a change in the costs of work performed in an organisation or in a process. Cost driver analysis is the examination, quantification and explanation of the cause-effect relationship between the cost drivers and the indirect costs of an operation [10].

In response to the need for more accurate and useful cost information, the approach of activity-based costing (ABC) was developed which makes use of multiple cost drivers. In assigning indirect costs to profit objects (products or services) ABC determines cost drivers to measure the utilisation of overhead resources by cost objects. Overhead costs are then allocated to cost objects in proportion to their cost driver demand [8].

However, the careful selection of cost drivers is the key to achieve the benefits of activity-based cost calculation systems. Thus special attention shall be given to the methods supporting the exact elaboration of these drivers. It means that the technology related performance flows and their indicators describing the examined business area are to be modelled and evaluated according to the selected methodologies.

To make the improved costing systems operative the company has to undertake a process of selecting appropriate cost drivers. The selection process involves the examination of cost items and their causes in order to identify candidate cost drivers, furthermore to explain and – as far as possible – quantify the driver-cost relationships. At least one cost driver and often a set of multiple cost drivers are selected from the available candidates for a cost item. So the implementation of ABC requires numerous cost driver selection decisions. The number and complexity of candidate drivers from which to choose can cause considerable selection problems for the decision maker [10].

ABC can be adapted to the specific features of transport and logistics, too (by considering the fact that the first applications had been used for the case of manufacturing industries). The selection problems identified above can be overcome when ad-

equate mathematical or estimation methods are applied. Before analysing these methods it is worth explaining why the use of cost drivers and the implementation of ABC are important not only in manufacturing but also in the transport/logistics business.

2 The relevance of cost drivers in transport and logistics

Transport and logistics companies are facing management problems of enhancing operation efficiency at limited resources. These problems have become stronger due to the ongoing financial crisis. The decision making procedures applicable to solve such problems can be made more reliable if relevant information on the basic components of business or technology processes are available. The core idea of improving transport/logistics costing is to include additional, technology related information – resulting in exact cost drivers – into the calculation. Doing so indirect costs are allocated to profit objects through using technology performance flows instead of ad-hoc, arbitrary distribution keys [3].

Fig. 1 shows the operation model – including cost drivers – of activity-based costing adapted to transport and logistics. The cost elements which can not be allocated to elementary transport or logistics services (as profit objects) directly shall be assigned to activities taking part in the production of them. Technology systems deliver performance indicators (cost drivers) for each activity. This makes it possible to elaborate calculation prices (variable average costs) for the cost objects or activities. After monetising the performances "consumed" by a certain profit object and adding its direct costs, the prime cost of a transport or logistics service/product will turn out. If revenue data can be made available at this accounting level the margins of profit objects can be analysed, too. When aggregating the elementary prime cost and margin data fixed cost items can also be taken into account in the calculation [3, 5, 6].

The core mathematical formula of the ABC model is the following [5]:

$$C_{po} = \sum_x C_{d_x} + \sum_y c_{a_y} P_{a_y} i_{a_y} \tag{1}$$

where:

- C_{po} – prime cost of the profit object;
- C_d – direct cost item;
- c_a – internal price (average variable cost) of a certain logistics activity;
- P_a – performance (cost driver) of a certain logistics activity;
- i_a – rate (intensity) of performance consumption of the profit object at a certain activity.

Index x goes through the direct cost items related to the profit object while index y goes through the activities taking part in its value chain.

Here the role of cost drivers can be highlighted clearly: they contribute to refining the activity cost structure (by separating fixed and variable costs) on the one hand, they make it possible to calculate accounting prices – average variable costs – for the activities (so the performance flows can be monetised) on the other hand. Thus the activity cost distribution among transport or logistics services is carried out on a cause-effect basis. Sometimes the indirect cost assignment (to activities) may also require cost drivers. This is the case when the accounting system is not able to allocate the resource costs to the activities in an exact way: first and second stage cost drivers shall be used. First stage (or resource) drivers connect indirect resource costs and activities while second stage (or activity) drivers relate activity costs and profit objects.

3 Methods for selecting cost drivers

Researches aiming to compare ABC practices at international level have brought the results that there are no uniform methods for selecting cost drivers. The methodology varies mainly with the industries and their branches, but some differences between implementations in different countries can also be observed [9].

The applicable methods can be grouped into two main clusters:

1 methods based on statistics theory (correlation and regression analysis);

2 methods based on operations research theory (analytic hierarchy process – AHP).

In the first case sound data bases of detailed cost and performance time series shall be made available. The longer time series can be used – in general – the more accurate estimations of cost-performance relations can be derived. Here all activity costs in the reference time intervals are examined by a variety of regression functions: time series of activity costs and performance indicators are coupled for the examined time period. The calculations are carried out for each performance indicator separately. In case of each activity the best correlation (R^2) is to be found. The relationships between costs and performances can then be described through the proper regression functions.

When too many activities shall be examined it is worth grouping them in order to simplify the selection process by finding general performance indicators (as joint cost drivers) for the groups. Naturally grouping will probably result in worse correlation values. According to empirical calculations less than 10% of the reliability of final evaluation statements is lost because of such kind of simplifications [4].

Selection of appropriate cost drivers from the larger set of available candidate drivers is based mainly on human judgment supported by analyses using simple accounting techniques or more sophisticated correlation techniques from statistics. These methods are limited as they are not able to evaluate multiple decision making criteria. AHP may be a solution to these problems. It is typically used in decision situations which involve selecting one or more decision alternatives from several candi-

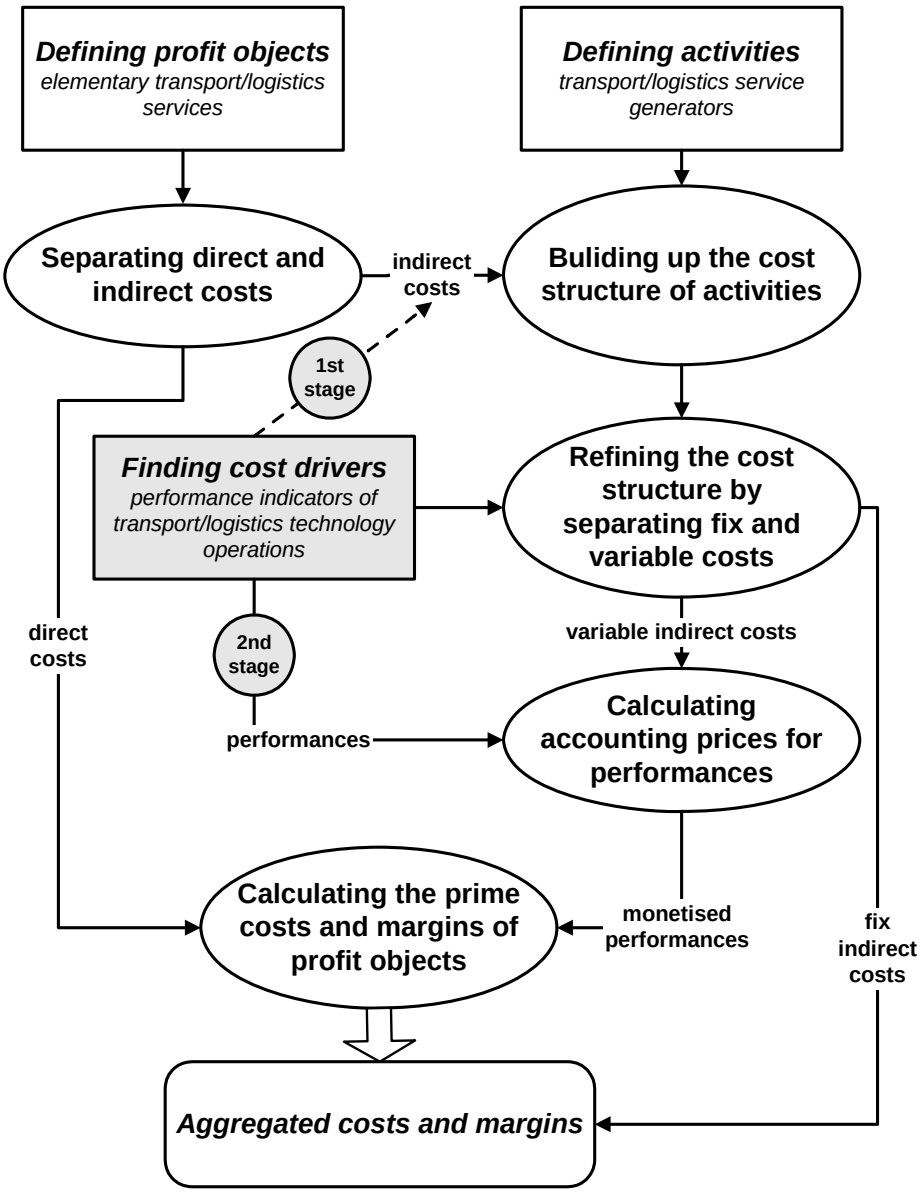

Fig. 1. The role of cost drivers in improved transport/logistics costing model

date decision alternatives on the basis of multiple decision criteria. Researches have shown that AHP helps achieve consistency in selection problems where the decision criteria are subjective measures based on professional experience.

This is the case when cost drivers are elaborated by conducting targeted surveys among accounting, controlling or management experts. The problem shall be decomposed into a multilevel hierarchy as shown in Table 1. The criteria used during the decision are based on the pre-defined selection rules. Relative preference/importance matrices shall then be formulated for different levels of the hierarchy which reflects the personal opinion of the involved professionals evaluated by numerical ratings. After having these input data, dedicated software solutions (like Expert Choice) help compute the relative priorities of examined cost drivers. During the process consistency shall also be checked continuously. The implementation of AHP results in a preference vector where the assigned preferences of the different candidate cost drivers are expressed quantitatively [10].

Empirical examples of statistics based cost driver selection already exist in Hungarian transport-logistics management practices. AHP based solutions, however, have not been applied yet: here international results can be analysed only.

4 Applied cost drivers in transport and logistics practice

One can find only some examples for cost driver selection processes carried out in the transport-logistics sector. At the same time case studies in the manufacturing industry are more often available. Here cost (resource and/or activity) drivers can be derived from technology processes directly. Typical drivers are for instance:

- resource drivers: human resources – labour hours, tooling centres – number of tools used, building rents – square me-

Tab. 1. AHP problem hierarchy for cost driver selection

Overall goal	**Selecting the best fitting cost driver(s)**			
Criteria	*#1: Matching activity type*	*#2: Correlation with activity consumption*	...	*#m: Measurement costs*
Decision alternatives	Driver #1 Driver #2 ... Driver #n	Driver #1 Driver #2 ... Driver #n	...	Driver #1 Driver #2 ... Driver #n

ters, software and IT network – hours of usage, etc;

- activity drivers: design – design hours, machining – machining hours, material handling – number of parts, purchasing – number of orders, etc. [2].

Some of the showed drivers can be used in transport/logistics companies as well. These are mainly resource drivers which are more general and less company specific. Nevertheless, activity drivers reflect more the specific features of transport-logistics technology so they need additional investigations. During these investigations the methods described before can also be applied (provided the necessary input data are available).

Two transport or logistics related case studies are analysed in the followings to give a short overview about possible cost drivers. The first one (rail infrastructure management, Hungarian case) uses statistical methods while the other one (road haulage, Turkish case) attempts to apply the AHP methodology.

In the Hungarian case first stage cost drivers were not necessary as the integrated management information system of the rail company enabled direct resource cost allocation to activities by using dedicated activity codes when recording the transactions. So each indirect cost item – reflecting various resource consumptions – could be coupled to one or more activities while recording it. As a result of the examination of activity codes about 700 activities were related to the infrastructure unit. A directed query to the selected activity codes yielded the activity cost data for five years.

A complex performance measurement was not available within the rail company. Therefore the necessary performance indicators – i.e. train km, station usage, passenger and tonne kilometre, seat kilometre, tonnes, etc. – were collected from multiple information sources (transactional technology systems). For the activities proper cost drivers had to be found which came from the dataset of performance indicators. Finding the most appropriate cost driver for each activity code was carried out by regression analyses using the time series cost and performance data. However, the high number of activities and cost drivers could not be handled by the calculation model. The problem was overcome by grouping the activities on the basis of their textual contents and the similarity of cost drivers. This process yielded 6 activity groups. Cost data were also added and a second round regression analysis took place to find out the general (second stage) cost drivers for each activity group. The results are shown in Table 2 [4].

In the Turkish case a two stage cost driver selection process was conducted in the field of road freight transport and logistics. In this study first stage cost drivers were determined by brainstorming meetings with the departmental managers. Some examples of them are the following: depreciation – kilometres, indirect labour costs – number of employees, vehicle tax – number of vehicles, legal service costs – number of customers, maintenance costs of buildings – area used. Resource consumption coefficients of some activities (according to the drivers selected) were known exactly so they did not need AHP support. However, consumption rates of other activities could not be easily estimated therefore AHP was employed as a method to allocate the overheads to activities. The rank of priorities derived from AHP was used as a driver coefficient for the allocation. So AHP was not used to select the drivers directly but to determine their coefficients.

The second stage cost drivers were determined also by interviewing the departmental managers. The activity driver coefficients were obtained by using the historical accounting data of the company – here no AHP support was necessary. Table 3 illustrates the selected second stage cost drivers and the activities applying them [1].

5 Conclusions

Cost drivers (should) play an important role in the management practices of transport and logistics service providers as they contribute to make the decision making procedures on costing issues more exact. Cost drivers – resource or activity drivers – make it possible to allocate indirect and overhead costs to activities and then to profit objects (different transport and logistics services/tasks) based on cause-effect relationships depicting performance flows within the company or even in a broader supply chain. Performance flows, however, are rather technology driven so management and technology knowledge shall be properly combined to adopt cost drivers based cost calculations.

Defining and selecting cost drivers are not easy when implementing ABC in transport/logistics practice. First stage (resource) drivers can often be adapted from manufacturing costing models as they are connected to general business management tasks like human resource management, facility management or information services. At the same time second stage (activity) drivers are more company and technology specific. Here no general instructions on driver selection can be recommended: drivers shall be chosen by considering the key perfor-

Tab. 2. Activity groups and their (second stage) cost drivers in rail infrastructure management

Activity group	Related cost drivers
train movement	train km; gross tonne km
path allocation	number of trains; number of transported vehicles
interim passenger train services	number of passenger train stops, number of passenger seat km
beginning/end of line passenger train services	number of passenger trains
marshalling/shunting for freight wagons	number of marshalled wagons; freight tonne km
consignment of freight wagons	number of consigned freight wagons; freight tonne km; transported freight tonne

Tab. 3. Second stage cost drivers in road freight transport and logistics

Cost driver	Related activities
transportation duration (hours)	information gathering about demand, freight rate determination, preparation of loading notification, transport documents preparation, vehicle re-fueling
number of transportation	preparation for freight agreement, vehicle scheduling, departure to customer, customs clearance, submission of documents, preparing and sending arrival notification, driver accounts calculation
freight transport performance (tonne kilometre)	transportation
distance (kilometre)	collecting transportation information, informing customers (tracking and tracing), vehicle maintenance

mance flows and activities of the examined company or business area. Some possible driver types can be the following:

- transport performance indicators: tonne, net or gross tonne kilometre, passenger, passenger kilometre, vehicle kilometre;
- time based indicators: duration of transportation, cargo or material handling time, lead time, working hours, service hours;
- quantity based indicators: number of handled/transported goods or vehicles, number of processed tasks or documents, number of dispositions.

Driver selection is often based on the decisions of staff members having enough experience to recognise the suitable measures. This solution may, however, contain several subjective considerations, which prevents reaching a high level accuracy. So it is reasonable to use additional, quantitative methods to ensure that the most appropriate indicators are chosen. Correlation and regression counting, furthermore AHP have been identified as possible mathematical methods for determining cost drivers. The former methodology has already been tested in the Hungarian transport sector while in case of the latter one only international empirical results are available. That is why it seems promising to pay more attention to the AHP method and conduct dedicated surveys among transport and logistics businesses interested in implementing activity-based costing.

It is worth noting that AHP has been used in Hungarian logistics sector to estimate and evaluate mid-term development trends. The experiences of this AHP application can be used as guidelines when extending the methodology towards cost driver analyses [7].

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