# Activity Based Costing in Logistics

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Summary

Activity based costing is a widely used method to reshape the traditional accounting systems into management information systems providing a reliable guidance for decision makers. The currently applied logistics costing procedures can also be further developed by using this methodology. Doing so calculation distortions preventing the exact cost-benefit evaluation of logistics or supply chains – and their components – can be reduced significantly. The paper aims to identify the related problems and propose a solution for logistics costing by adopting the activity based approach. The corresponding basic mathematical formulas are elaborated, too. As the recommendations are derived from a theoretical point of view additional practical validations of the model are intended in the near future.

Keywords: logistics controlling, activity based costing

## 1. Problem identification

The efficient and effective controlling of logistics services or supply chains needs a sound information base supporting operative as well as strategic management decisions (e.g. resource allocation, outsourcing vs. insourcing, etc.). This information base shall be created by using up-to-date cost and performance calculation methods being able to deliver reliable inputs to profitability assessments.

Current practices applied in case of logistics cost calculations often prefer using average values of aggregated costs. Indirect cost items are allocated to the different product or service units on an arbitrary basis. Ignoring cause and effect relationships in cost allocation, however, can lead to distorted information: so profit or loss generators in the supply chain may not be identified properly [3].

The task is to find a methodology which is able to overcome the problems mentioned. A possible solution can be the inclusion of technology principles into logistics cost calculation mechanisms. Thus cost allocation can be realised in a more exact way by taking into account cause and effect relations between activities within business processes.

The central elements of dedicated examinations shall be the logistics or supply chains consisting of different kinds of logistics tasks. These tasks are performed by logistics activities. If we are able to measure the cost and performance efficiency even in activity levels the reliability of logistics cost and benefit analyses can be improved significantly. It will make it possible to prevent using generalised average values not taking into account the different characteristics of each service chain. Nevertheless, average values can not be absolutely eliminated but they are used in lower aggregation levels (see later). It causes much smaller incorrectness than relying on no cause-effect cost allocations.

## 2. The principles of proposed logistics cost calculation model

Activity based logistics costing (ABC) uses the principle of including technology process performances into cost calculations to make them more exact. The key elements of the methodology are logistics activities, which enables to support not only operative resource allocation decisions but also business process reengineering (BPR) of supply chains [6]. Extending logistics functions to entire supply chain requires rather a process oriented management point of view and ABC corresponds to its criteria in contrast with the traditional operative logistics controlling (adopted from the manufacturing industry).

Most of the research articles dealing with activity based costing have their focus on manufacturing operations, although this approach can be applicable across the spectrum of other company functions – like logistics [7]. The adaptation of ABC had been carried out in Hungarian transport economics practice first for the case of rail transport sector [2]. This model can be improved by taking into account the specifications of logistics service chains. Figure 1 illustrates the mechanism of ABC adapted to logistics. It is also inevitable to define the necessary mathematical or logical formulas so that the model can be implemented in practice, too.

The followings summarise the essence and calculation procedures of logistics ABC based on the outcomes of a research work aiming to elaborate a consistent methodological framework [1].

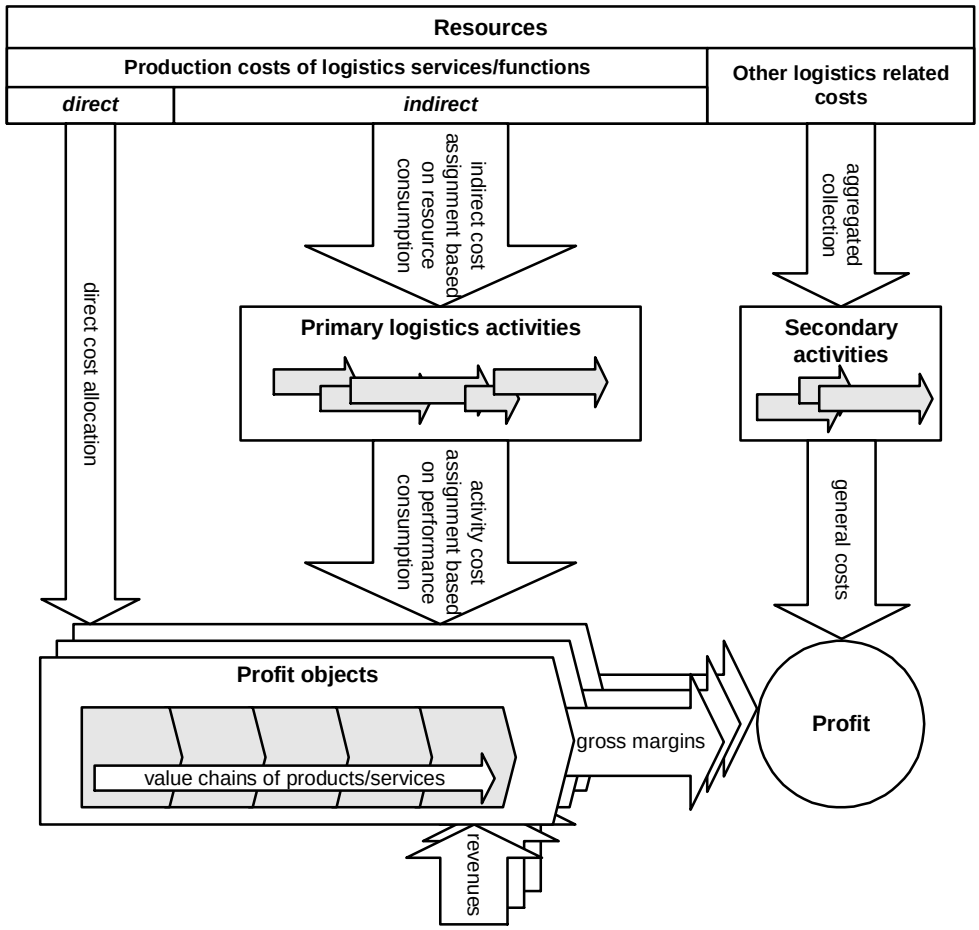


Figure 1. The activity based costing model adapted to logistics

3. The mathematical logic of activity based logistics costing

First the logistics related cost items shall be identified and collected (from the general ledger). Then they are to be differentiated as follows:

(1) $$C = C_p + C_g$$

where:
$C_p$ – production cost of logistics services or functions;
$C_g$ – general logistics cost.

(2) $$C_p = C_d + C_{id}$$

where:
$C_d$ – direct logistics cost;
$C_{id}$ – indirect logistics cost.

This cost differentiation needs to introduce the concept of profit objects. They are products or services gaining revenues and at the same time consuming different resources so bearing costs. Here one shall distinguish between companies where logistics is the core activity (logistics service providers) and where logistics is a background function (e.g. in manufacturing industry or FMCG sector). In the former case profit objects are complex logistics services or their chains. They are fully examined by logistics cost calculations. In the latter case profit objects are different kinds of – not logistics – products or services. Here logistics controlling covers only a certain part of cost calculations so complete cost and benefit analyses can be realised in connection with other areas – e.g. manufacturing, sales, marketing, etc. – only.

Production costs can be related to profit objects in a direct (direct logistics costs) or indirect way (indirect logistics costs). The latter ones are the monetised values of resource consumption of so called primary activities producing logistics services or functions. The general costs reflect the resource consumption of so called secondary activities – e.g. PR, HR, financials, general management – which are in the background from the point of view of logistics performance generation. The dividing line between primary and secondary activities is company specific, can not be definitely generalised. The secondary activities and their costs are rarely analysed in details in the frame of ABC – they are generally the objects of dedicated examinations.

Direct logistics cost items can be allocated to profit objects in one step, no additional performance measurement is needed. Such cost elements could be e.g. the infrastructure user charges in case of a transport task. Nevertheless, the resources causing indirect costs (e.g. of disposition, operative administration, maintenance) are consumed by multiply profit objects so the cost intensity of a single object can not be investigated in a simple way. ABC concentrates on these indirect cost items as it tries to allocate them to profit objects based on cause-effect relationships.

Indirect logistics costs are first assigned to primary activities and business-technology processes constituting of them (like transport, loading, warehousing, providing information, etc.) based on the resource consumption of each activity. It can be solved mainly by direct cost accounting to activities as the different input resources – like workforce, machinery, infrastructure elements – are assigned to activities (if possible). However, even here estimation techniques may be necessary when the ratio of direct activity costs is low.

Thus indirect logistics costs are collected on primary activities. Another task is to find an appropriate performance indicator – e.g. number of handled pieces, operation time, number of orders, vehicle km, etc. – for each activity. The indicators shall be measurable. Activity costs are then to be differentiated into variable and fix parts according to their relations to performance intensity:

(3) $$C_a = C_v + C_f$$

where:
$C_a$ – total cost of a primary logistics activity;
$C_v$ – variable activity cost;
$C_f$ – fix activity cost.

A fix cost item can be e.g. the simple time based depreciation while a variable one the piece wage rate. The integration of technology principles into cost calculation is realised here as the so called “intern price” (average variable cost) of the activity can be counted here:

(4) $$c_a = \frac{C_v}{P_a}$$

where:
$c_a$ – intern price (average variable cost) of the primary logistics activity;
$P_a$ – performance of the primary logistics activity.

For example, if we measure the performance of a disposition activity by the number of directions the intern price is measured in EUR/direction. The intern prices concentrating on variable costs reflects cause and effect relations better as only performance dependent items are posted up into profit object calculation (see later). Fixed cost elements are not neglected but they are taken into account during the higher levels of margin calculation only (similar to general logistics cost items).

Each profit object uses different activities and their performances to produce added value. For example a logistics service chain of a certain piece of goods (as profit object) may make use of performances of different

disposition as well as physical processes. If it is possible to elaborate the performance values consumed by profit objects driving over (variable) activity costs to profit objects can be carried out as follows (by using also intern prices):

(5) $$C_{po} = \sum_x C_{d_x} + \sum_y c_{a_y} P_{a_y} i_{a_y}$$

where:
$C_{po}$ – production cost of the profit object;
$i_a$ – rate (intensity) of performance consumption of the profit object at a certain activity:

(6) $$i_a = \frac{P_{po}}{P_a}$$

where:
$P_{po}$ – performance consumed by the profit object at a certain activity.

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

Using the calculation method described before the prime cost of a complex logistics service (chain) or the logistics related part of the prime cost of a certain product/service can be elaborated in an exact way. Of course an important precondition of it is to realise and operate a comprehensive performance measurement regime being able to exploit technology knowledge, too.

In case of companies offering complex logistics services (so their key activity area is logistics = logistics service providers) the margins of profit objects can also be counted by including revenues. Margins show how revenues can cover production costs. The first level margin (or gross margin) is calculated as follows:

(7) $$MI_{po} = R_{po} - C_{po}$$

ahol:
$MI_{po}$ – gross margin of the profit object;
$R_{po}$ – revenue of the profit object.

The second level – aggregated – margin constitutes of the summarised gross margins of cost objects debited with the summarised fix costs of primary activities:

(8) $$MII_{po} = \sum_w MI_{po_w} - \sum_z C_{f_z}$$

where:
$MII_{po}$ – the second level, aggregated margin of profit objects.

Index *w* goes through all profit objects while index *z* goes through all primary activities.

Finally, we will come to the logistics service company's/provider's profit if the second level margin is debited with the general logistics costs:

(9) $$PR = MII_{po} - C_g$$

where:
*PR* – total profit of the logistics service company/provider.

## 4. Practical usefulness of the model

The costing model described before contributes to (at least partly) eliminate the shortcomings of traditional logistics accounting systems by including additional technology information. Their inputs and outputs, however, are the same: detailed cost/revenue data and aggregated profit data. The real added value of the methodology can be identified if we look at the details: the use of performance data makes it possible to evaluate the effectiveness of elementary (not aggregated) logistics profit objects as well as of elementary logistics performance generators

(activities) in a more exact and transparent way. One can find out what logistics products/services realise profits or have negative margins. It will turn out what logistics performance generators (activities) have relatively high resource consumption in comparison to their actual performance levels: it may be reasonable to rationalise or even outsource them, etc.

According to business surveys the use of activity based costing applied to logistics is often explained by the need of enhancing accuracy and reliability of cost or profitability information needed by short run executive decision making. Furthermore the exact preparation of strategic BPR decisions may induce developing effective logistics cost and performance management solutions, too. In the first phase of implementation generally a narrow scale pilot project concentrating on the main cost drivers and performance generators is launched. Decisions on the wider use are set after evaluating the first results: if the pilot project is successful the implementation towards a more sophisticated system will start. The necessary level of sophistication is determined through the ratio of indirect costs of logistics functions: if a considerable part of examined cost items can be regarded as indirect it will be worth investing in building up a more detailed logistics ABC [5].

Activity based costing can be used to support supply chain integration and management, too. Modelling tools can be provided for supply chains in different industries where a well parameterised ABC model calculates the consequences of changing activities or integrating certain functions. Nevertheless it is often concluded that applying accounting measures are important but it may not be sufficient for the success of supply chain management [4].

The Hungarian practice of logistics cost and performance management is in the initial phase only. It means that the applications concentrate on monitoring and influencing technology performances rather than on using this information also for (detailed) cost calculations. Mainly inventory and warehousing are the logistics functions which have IT supported management information systems. These systems have the tasks to make material flows more transparent and to rationalise inventory and ordering processes. The methods often used are the followings: portfolio analysis of inventory, monitoring of material handling and optimisation of purchasing schemes [3].

## 5. Conclusions

As a summary of the study we can conclude that the inclusion of technology performance data into logistics cost calculation procedures extends the scope of traditional accounting approaches. The results will be more reliable (but not absolutely) so that managers responsible for operative resource allocation or strategic process development issues can make better established decisions. Activity based costing have real perspectives in logistics sector as it is a suitable tool to enhance the business visibility and controllability throughout the entire supply chain.

The elaborated model, however, needs further verifications. The Hungarian logistics market offers an excellent environment to that as logistics controlling applications are still in initial phases (see above). So the author intends to validate his theoretical research results for the case of concrete logistics service chains. Logistics service providers as well as companies coming from manufacturing or trading industries shall be examined to test the relevance of the ABC model. After having a broad picture about the current practices and their problems it is expected that no a single solution applicable for all market actors exists but the basic principles and mathematical formulas can be probably widely used after the necessary customisations.

## References

[1] BOKOR, Z: Improving Logistics Cost Calculation by Using Controlling Tools. *Yearbook of Logistics 2006*, Z. Szegedi ed., Hungarian Association of Logistics, Budapest, 2006, pp. 198-207 (in Hungarian)
[2] BOKOR, Z: Applying activity based costing in rail transport. *Review of Transport Science*, Vol. 52 No. 12 (2002), pp. 449-456 (in Hungarian)
[3] BOKOR, Z: Supporting Logistics Decisions by Using Cost and Performance Management Tools. *Periodica Polytechnica ser. Transportation Engineering* Vol. 36 No. 1-2 (2008), pp. 1-7
[4] DEKKER, H. C. – GOOR, A. R. V.: Supply Chain Management and Management Accounting: A Case Study of Activity-Based Costing. *International Journal of Logistics*, Vol. 3 No. 1 (2000), pp. 41-52
[5] LA LONDE, B. J. – POHLEN, T. L.: Survey of Activity-Based Costing Applications within Business Logistics. *Study*, The Ohio State University, Columbus, 1998
[6] LA LONDE, B. J. – POHLEN, T. L.: Implementing Activity-Based Costing (ABC) in Logistics. *Journal of Business Logistics*, Vol. 15 No. 2 (1994), pp. 11-12

[7] PIRTTILA, T. – HAUTANIEMI, P.: Activity-Based Costing and Distribution Logistics Management. *International Journal of Production Economics*, Vol. 41 No. 1-3 (1995), pp. 327-333