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INTEGRATED COST MANAGEMENT IN SUPPLY CHAIN

Summary: The article presents the basic foundations of cost management in the supply chain. In the first part of the paper the scope of cost management in the supply chain and the importance of supply chain costing are explained. The second part of the paper presents the total cost of ownership (TCO) according to the opinions of various authors and discusses the most important components of the total cost of ownership. In the last part of the article the use of activity-based costing method for the assessment of cooperating partners within the value chain is presented. Moreover the need for integration of activity-based costing (ABC) and total cost of ownership (TCO) are explained. Such an integrated approach can be further supplemented by the computation of the supplier performance index (SPI). These methods of management accounting can provide a basis for the assessment of suppliers with respect to the activities performed in the supply chain.

Keywords: supply chain, activity-based costing, total cost of ownership.

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1. Introduction

Cost analysis and cost management in the supply chain play an important role in the area of management accounting. On the one hand there is a need to monitor and assess the costs incurred in maintaining relationships with suppliers, on the other this is very needed to analyse costs to serve various customers. Therefore, the total supply chain costs are analysed both from the perspective of suppliers and across its customers. Revenues, however, are obtained solely through the sale of products to different customer groups. Reporting profitability in terms of the supply chain is therefore a two-way analysis. First, it requires the computation of the total costs incurred due to the relationships between the company and its suppliers, second, it involves the profitability measurement across the customers.

Cost management in the supply chain requires the use of multiple instruments such as the total cost of ownership, activity-based costing, balanced scorecard, etc.

Therefore, the aim of this paper is to present the nature and structure of the costs incurred by the company while maintaining relationships with its suppliers as well as to show the use of management accounting tools to support cost management in the supply chain. The argument supported in the paper states that the increased competition involves the integrated use of total cost of ownership and activity-based costing. Such an integrated approach allows for accurate assessing of the costs of relations between suppliers and recipients, and therefore making decisions aimed at effective cost control.

2. The scope of cost management in supply chain

Cost management in the supply chain involves monitoring and analysing costs incurred while dealing with both suppliers and customers. Thus cost management takes into account both the upstream supplier relations and downstream customer relations. The situation is illustrated in Figure 1.

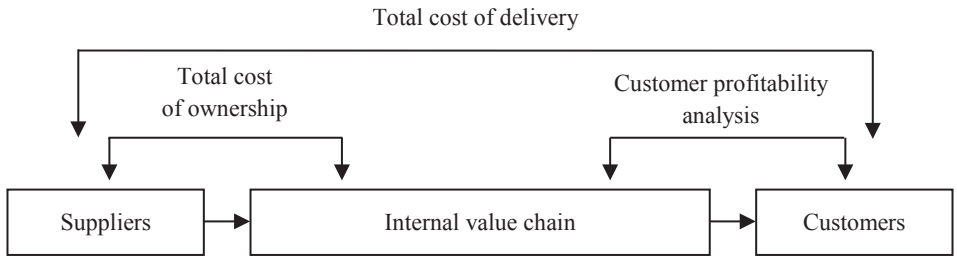

Figure 1. Supply chain profit management

Source: author's own elaboration based on: [Reeve 2005, p. 338].

It may be concluded from the figure that there are two fundamental tools used to support total supply chain profit management: total cost of ownership and customer profitability analysis. The total cost of ownership takes into consideration upstream supplier relations, whereas the customer profitability analysis focuses on downstream customer relations. Both methodologies may be supported by activity-based costing. In this paper the emphasis is put on the relationship between supplier and recipients. Thus the discussion would refer to the integration of the total cost of ownership and activity-based costing under the framework of the supply chain costing.

According to B.J. LaLonde and T.L. Pohlen [1996, p. 5] supply chain costing may be defined as the mechanism for developing cost-based performance measures for the activities comprising the key processes within supply chain. The capabilities provided by the supply chain costing include the ability to [LaLonde, Pohlen 1996, p. 5]:

- determine the overall effectiveness of the supply chain,
- identify opportunities for further development or reengineering,

- measure performance of individual activities or processes,
- evaluate effects of technology improvements.

Based on their expertise and research E.J. Marien and J. Keebler [2002] identified six stages of cost orientation in supply chain costing.

- stage 1: functional cost minimization,
- stage 2: lowest delivered costs,
- stage 3: total cost of ownership,
- stage 4: enterprise value-add costs of sales,
- stage 5: inter-enterprise value-add cost with immediately adjacent trading partners,
- stage 6: lowest end-user delivered supply-chain cost.

At the first stage many employees in their functional areas of responsibility are recognized for minimizing the costs directly attributable to what management has assigned as their main area of focus. At the second stage, as firms begin to realize that functional cost minimization is not optimal for the firm, in-bound and on-bound shipments are scrutinized as to the impact and trade-offs of purchasing, asset management and transportation on acquisition and delivered price. In the third step companies realize that inventory carrying costs and the investment in assets to support the firm's decisions as to how much product should be flowing in, through and out of the enterprise, are the big missing elements. In the next stage companies start focusing on value-add costs of sales. These are costs that add customer value beyond the total cost of material ownership. Now, firms are addressing costs associated with marketing and sales, engineering and technical support, field service support, information technology costs, general and administrative costs. Fifth stage addresses "immediate supplier, customer and intermediary" cost analyses. The focus of analysis is on multi-enterprise and includes the firm's customers, suppliers and also supporting intermediaries, such as logistics service providers and information technology providers. The final stage addresses issues and analyses that go beyond the company. Supply chain trading partners address service and economic trade-offs among all trading partners in the supply chain.

3. Total cost of ownership in supply chain

Performance evaluation in terms of supply chain requires a two way street. First, it requires the calculation of the total costs incurred due to the relationships of the company with its suppliers. Secondly it requires the examination of the profitability across its customers. Performance measurement and reporting on the relationships among the parties in the supply chain shall include in particular the so-called total cost of ownership (TCO).

The concept of the total cost of ownership was proposed by L.M. Ellram and S.P. Siferd in 1993 [Ellram, Siferd 1993], but the general idea has been known prior to 1993 under many different names: total cost, cost-based supplier performance

evaluation system, cost of ownership, etc. All these concepts have three common features:

1) cost must be examined from a long-term perspective beyond just the initial price,

2) purchasing must consider the effects of other business functions on the value of specific purchase,

3) purchasing must understand the cost impacts of all purchasing activities.

According to L.M. Ellram and S.P. Siferd [1993, p. 164] the TCO concept requires firms to consider the activities they undertake that cause them to incur costs. The total cost of ownership implies that all costs associated with the acquisition, use, and maintenance of an item be considered in evaluating that item and not just the purchase price.

The total cost of supplier relationships can be defined very broadly as the sum of all costs incurred while making and maintaining business relationships between companies in value supply chain. Therefore it includes not only the purchase price of materials needed to manufacture the product, but also the costs of activities that are performed in the supply chain and result from the relationships occurring between the supplier and the recipient.

The total cost of ownership is presented in Table 1 as the sum of the six cost components referring to quality, management, supply, support, communication and price.

Bearing in mind that relationships with suppliers begin before ordering and taking delivery and these relationships last after the completion of the transaction, the total cost of ownership may be decomposed into three components [Ellram 1993, p. 7]:

1) pre-transaction cost components that include costs related to activities such as identifying a need and investigating a source,

2) transaction cost components include price, delivery, tariffs, inspection, etc.,

3) post-transaction cost components include cost categories such as field quality problems and cost of repair parts.

According to L.P. Carr and C.D. Ittner [1992] the total cost of ownership includes the costs associated with dealing with a particular supplier:

1) costs of purchasing including the costs of ordering inventory, delivery, receiving, and inspection,

2) costs of holding inventory including carrying costs, including storage, insurance, obsolesce, and opportunity costs associated with holding inventory,

3) costs of poor quality including the costs of rework, scrap, returning defective material to suppliers, and downtime caused by using low-quality material,

4) costs of delivery failure including costs triggered by late or early delivery by a supplier, and include expediting costs, additional labour costs to receive late or early deliveries, downtime due to late deliveries, and lost contribution margin form lost sales due to failed deliveries.

Table 1. Activities contributing to the total cost of ownership

Component of TCO	Activities related to the components
1. Quality	• select and approve suppliers • assess supplier performance • understand suppliers' processes • maintain supplier relations • acquire parts for rework • return rejected parts • inspect incoming materials • dispose of scrap
2. Management	• determination of purchasing strategy in conjunction with corporate strategy • hire, evaluate, promote, fire purchasing personnel • coordinate with other functions • training of purchasing personnel • initial orientation • ongoing procedure changes • professional development
3. Delivery	• accept delivery • accept partial shipment • expedite late orders • arrange for correction of incorrect orders
4. Service	• oversee installation of equipment • oversee maintenance • order parts for warranty repairs • involvement in customer training • maintain spare parts inventory for nonwarranty repairs • supply service manuals • conduct product recalls • respond to complaints • general trouble shooting
5. Communications	• update forecasts and communicate to suppliers • prepare and send purchase orders by mail, phone, fax, and electronic data interchange • maintenance of purchasing information system • match purchase orders with receipts • make invoice adjustments • bill back returned items • maintain inventory records
6. Price	• negotiate terms of contract with respect to: – quantity – quality – delivery conditions – freight costs – purchase discounts – contract length – degree of coordination and cooperation

Source: author's own elaboration based on: [Ellram, Siferd 1993, p. 166].

J. Anklesaria [2008] proposes another cost classification for the purposes of the TCO analysis. Figure 2 shows the examples of cost components in the total cost of ownership. There are two basic categories of components: purchase price and in-house costs consisting of three elements. The proposed breakdown is only a guideline, because components of the total cost of ownership depend on the type of business and products/services offered.

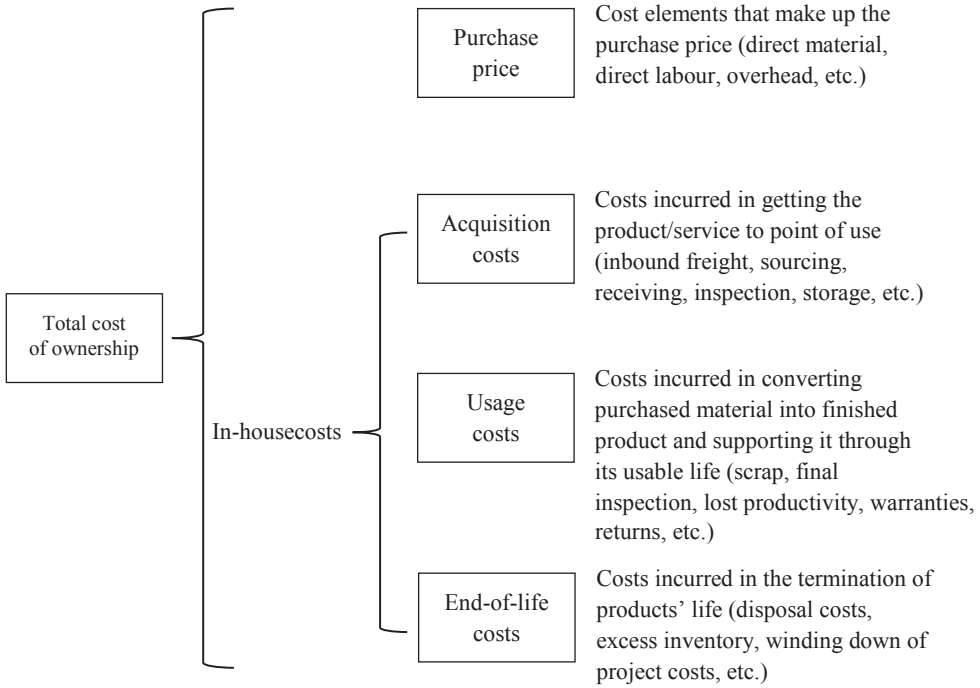

Figure 2. Cost elements in the total cost of ownership

Source: [Anklesaria 2008, p. 70].

Regardless of the classification adopted, the problem is how to measure theses cost components in the management accounting system. In practice, indeed, the costs discussed above are not disclosed in the traditional financial accounting system. Thus there is a need to integrate the concept of the total cost of ownership with activity-based costing.

According to R.M. Monczka et al. building a TCO model requires input from different parts of the organization and understanding of the process through the entire life cycle. They propose the following six steps to be taken to ensure that all costs are captured correctly in the model [Monczka et al. 2009, pp. 408, 409]:

1. Map the process and develop TCO categories. Construct a process map from the time a need for the product, service, or capital equipment is identified all the way

through the life cycle. The activities that you identify will help to develop broad TCO categories.

2. Determine cost elements for each category. Using the process map as a guide, identify the sub-cost elements that make up each TCO category.

3. Determine how each cost element is to be measured. This is a critical step. The metrics must be determined to quantify each of the cost elements identified in step 2. For example, to quantify the costs of sourcing labour, the hourly rate of the individuals performing the sourcing activity and the amount of time they spend or will spend doing it will need to be known.

4. Gather data and quantify costs. This is the most difficult and time-consuming step. In this step gather data for each of the metrics identified in step 3 and quantify the respective costs. This requires information from various sources including interviews, surveys, the A/P system, and other internal databases. If information from internal databases is used, make sure to validate the numbers. Input errors can sometimes cause the numbers generated by these databases to be significantly inaccurate.

5. Develop a cost timeline. Construct a cost timeline for the length of the life cycle. Place each cost element quantified in Step 4 in the appropriate time period. Then calculate totals for each time period as shown in the example.

6. Bring costs to present value. Computing the present value allows decisions to be made based on present dollars. This is important because money spent one year from now is not worth the same as money spent now. The value of money spent any time in the future will depend on the organization's cost of capital. To calculate the present value, therefore, obtain the organization's cost of capital from its finance department. Then calculate the present value of each total in the cost time line by using a present value table or a financial calculator. The sum of present values for each time period represents the total cost of ownership.

4. Activity-based costing in supply chain

In practice, for the purposes of the TCO calculation, it is possible to use activity-based costing methodology.[1] As previously mentioned, the idea of the total cost of ownership is based on the premise that a lot of activities are performed to deal with relationships between suppliers and recipients. Cost assignment for such activities is very similar to the indirect costs allocation in production processes. Thus to derive the total cost of ownership in supply chain the activity-based costing may be applied by means of five steps [Roodhooft et al. 2003, p. 29].

1. Define the activities related to external purchasing. These activities are specific to every company and should be expressed through activity analysis. Examples include: negotiations with suppliers, placing orders, reception of incoming goods.

[1] See further elaborations on activity-based costing in: [Kaplan, Cooper 1998; Kaplan, Atkinson 1998].

2. Assign costs to the different activities. This is the traditional in activity-based costing system.

3. Define cost drivers, which requires determining the factors raising the cost of a given activity.

4. Determine which activities are generated in the purchasing organization by each individual supplier.

5. Compute the total cost of ownership.

While assigning the cost of activities performed to deal with relationships with suppliers one should take into account two aspects. On the one hand, it is needed to consider the hierarchy of activities, on the other, the sequence of these activities in the internal value chain of the company. The first aspect of the analysis requires an identification of at least three levels of activities performed in relations with suppliers. Three main hierarchical levels may be identified as follows [Roodhooft et al. 2003, pp. 29, 30]:

1. Supplier level. Costs only occur at this level if a given supplier is being used. Examples include the cost of a quality audit and the salary of a purchasing and supply manager who may manage the relationship with the supplier.

2. Ordering level. At this second level, the method considers all costs that depend on the number of different products purchased. Activity arises at this level each time an order is placed with a given supplier. Costs could include receiving costs, invoicing costs, or transport costs. The costs of demand planning for all different products are one example.

3. Unit level. Activities are performed for a unit product in specific order. Costs here could be the additional costs for a production shutdown caused by a fault in a product purchased from a supplier. Another example would be the cost arising from a product failure that was caused by a component purchased from a supplier. Inventory holding costs will also be allocated to the third level.

The second dimension concerns the analysis of the sequence of activities performed in the value chain of the company. This is a process-based view which takes into account the sequence of actions performed in the company as a result of the relationships occurring between the company and its suppliers. The relation between the sequence of activities in the internal value chain and hierarchy of activities is presented in the form of matrix in Table 2.

Evaluation of performance in supply chain across different suppliers may be done by means of the supplier performance index (SPI). This is the ratio of the supplier cost to the total purchase price:[2]

$$SPI = \frac{Total\ supplier\ costs}{Purchase\ price}$$

[2] See for further elaboration: [Correira et al. 2008, p. 768].

Table 2. Two dimensions of the total cost of ownership with regard to activity analysis

		The sequence of activities in the value chain				
		Acquisition	Reception	Possession	Utilization	Elimination
Hierarchy of activities	Supplier level	• Supplier vetting costs • Request for proposal (RFP) costs • Contract administration costs • Supplier follow-up costs • Supplier change costs	• Litigation costs for breach of contract	–	• Engineering costs • Personnel training costs • System adaptation costs	–
	Order level	• Ordering costs • Payment delay savings or costs	• External transportation costs • Receiving costs • Invoice and payment processing costs • Quality testing costs • Quantity testing costs • Litigation costs for problems with quality	• Internal transportation costs	• Quality control costs • Production delay	• Waste collection costs
	Unit Level	• Price • Product discounts • Service costs for installation and assembly • Testing costs	–	• Inventory holding costs • Order picking costs	• Intrinsic efficiency • Replacement costs • Production failure costs • Maintenance costs • Installation costs	• Recycling costs or revenues • Disposal fees or revenues • Cost of removing obsolete materials • Disposal management costs

Source: based on: [Roodhooft et al. 2003, p. 30].

The measure is very useful to compare the performance of various suppliers and choose the best supplier from the point of view of the total cost of ownership. The lower the level of the ratio (SPI), the better relation of the supplier cost to the

offered price. This index allows for estimating the total cost of the relationship with the supplier at a given price offered by him. For example, given the SPI index of 1.3 zł and a price equal to 500 zł for a unit of a product, the total cost of the relationship is 650 zł (1.3 × 500), and thus the cost of the relationship with the supplier without taking into account the purchase price is 150 zł per unit.

5. Summary

Cost analysis and management in supply chain takes into account both the upstream supplier relations and downstream customer relations. Moreover, the costs of supplier relationships can be grouped for the purposes of cost management taking into account two criteria. First, it is possible to analyse costs in terms of the sequence of activities in the internal value chain, and, secondly taking into consideration the hierarchy of activities performed in the value chain. This two-dimensional approach allows to integrate two methods of management accounting: the concept of supply chain costing and activity-based costing. Linking these tools facilitates to derive the total cost of relationships (TCO) originally proposed by L. Ellram and S. Siferd in 1993. This methodological approach may be complemented with the calculation of the supplier performance index (SPI) which is the relative measure of the supplier cost to the total purchase price. Finally, it may be concluded that the use of the methods discussed in the paper clearly shows that the choice of providers does not depend solely on the prices offered by the supplier, but requires a detailed analysis of the total costs incurred as a consequence of performing various activities throughout the entire value chain of the company.

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ZINTEGROWANE ZARZĄDZANIE KOSZTAMI W ŁAŃCUCHU DOSTAW

Streszczenie: W artykule przedstawiono podstawowe założenia zarządzania kosztami w łańcuchu dostaw. W pierwszej części opracowania wyjaśniono zakres zarządzania kosztami w łańcuchu dostaw oraz istotę rachunku kosztów łańcucha dostaw. W drugiej części zaprezentowano całkowity koszt relacji z dostawcami (TCO) w ujęciu różnych autorów oraz omówiono jego komponenty. W ostatniej części artykułu zaprezentowano zastosowanie metody rachunku kosztów działań na potrzeby oceny kontrahentów kooperujących w ramach łańcucha wartości. Wyjaśniono przy tym potrzebę integracji rachunku kosztów działań i metody oceny całkowitego kosztu relacji z dostawcami (TCO). Takie zintegrowane podejście można ponadto uzupełnić oszacowaniem indeksu dokonań dostawców (SPI). Wymienione metody rachunkowości zarządczej mogą stanowić podstawę oceny dostawców z uwzględnieniem działań wykonywanych w łańcuchu dostaw.

Słowa kluczowe: łańcuch dostaw, rachunek kosztów działań, całkowity koszt relacji z dostawcami.