COST MEASUREMENT AND COST MANAGEMENT IN TARGET COSTING

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Firms are coping with a competitive scenario characterized by quick changes produced by internationalization, concentration, restructuring, technological innovation processes and financial market crisis. On the one hand market enlargement have increased the number and the segmentation of customers and have raised the number of competitors, on the other hand technological innovation has reduced product life cycle. So firms have to adjust their management models to this scenario, pursuing customer satisfaction and respecting cost constraints. In a context where price is a variable fixed by the market, firms have to switch from the cost measurement logic to the cost management one, adopting target costing methodology. The target costing process is a price driven, customer oriented profit planning and cost management system. It works, in a cross functional way, from the design stage throughout all the product life cycle and it involves the entire value chain. The process implementation needs a costing methodology consistent with the cost management logic.
The aim of the paper is to focus on Activity Based Costing (ABC) application to target costing process. So:
- it analyzes target costing logic and phases, basing on a literary review, in order to highlight the costing needs related to this process;
- it shows, through a numerical example, *how to structure a flexible ABC model – characterized by the separation between variable, fixed in the short and fixed costs* - that effectively supports *target costing process in the cost measurement phase (drifting cost determination) and in the target cost alignment;*
- it points out the effectiveness of the Activity Based Costing as a model of cost measurement applicable to the supplier choice and as a support for supply cost management which have an important role in target costing process. The activity based information allows a firm to optimize the supplier choice by following the method of minimizing the total cost of ownership (TCO). Moreover the activity based analyses reveals the opportunities for rationalizing the supply related activities and containing costs and it enables the effective involvement of the supplier in the process of target costing *when he provides activity based information on the costs sustained to produce the product/service: the purchaser can evaluate the impact, in terms of cost, of the activities requested of the supplier and, as a result, he has the chance to rationalize these activities by reducing their number or intensity* and enables the effective involvement of the supplier in the process of target costing.
The paper gives a contribution in the advancement of costing methodologies applicable to the target costing, *proposing* the use of a flexible model that supports the decision process according to different time horizons so that effectively supports target costing. The model is suitable for production characterized by high complexity in terms of number and intensity of activities.

Keywords: Activity Based Costing, Target Costing, Total Cost of Ownership, Supplier Selection, Supply Management

1. Introduction

The traditional approach of mark-up or cost plus pricing may be adopted in a market where demand exceeds supply and the number of competitors is limited. When the supply of the good outstrips customer demand, prices set on a cost basis can render the product uncompetitive. In such scenarios, pricing policies should be the related to external factors. To obtain margins that adequately exceed costs, firms must revise their logic and begin to manage costs as a function of an exogenous variable, i.e. the price that the market allows to be applied, then shift from the logic of *cost measurement* to *cost management*. The opportunity to use *target costing* depends not only on the characteristics of the market where the company operates but also on the characteristics of the production process and the product. The methodology is used mainly in manufacturing companies and is particularly suited, as Sakurai stated (Sakurai, 1989: 39-50), to companies that manufacture a wide variety of products in small-medium volumes, those implementing

production characterized by a continuity in the production process with high product differentiation, and to high technology firms. Whether the methodology is adopted or not depends on the complexity of the product portfolio: target costing becomes more appealing when products are differentiated, characterized by high quality and with short and contracting life cycles.

2. The logic of Target Costing and cost information

Target costing is the management tool that realizes this operational logic and is based on the assumption that price must take into account the prevailing market price conditions and that production cost must also be coherent with the objectives of profitability, maintaining a convenient product differentiation.

The definitions developed in the literature on the subject differ according to the particular feature the author wants to highlight. *Target costing* can be defined as a suitable tool for the reduction in new product costs (Afonso, 2008: 559-568)- already active in product planning and design (Monden and Hamada, 1991: 16-34) - or goods already existing that need to change. The logic of target costing directs the design and product development by focusing on customer and market opportunities, because the ultimate goal is not the minimization of cost, but product profitability maximization. Target costing is a cost management tool that works across the entire product life through the cooperation of the functions of production, research and development, and marketing and administration and control (Sakurai, 1989: 39-50) which fosters connection and coordination (Kato, Boer and Chow, 1995: 39-51). It was also defined as a methodology that allows the creation of new products claiming "reasonable cost", obtained by design and development aimed at meeting the objective costs of different business areas (Tanaka et al, 1993, p. 45). Target costing is a complex of behaviours and attitudes regarding the management of the factors that determine the cost of products and it is characterized by different approach (Everaert, 2008: 236-263). The various target costing features identified in literature are synthesized efficiently by the definition proposed by the CAM-I Target Cost Core Group (Ansari, Bell and the CAM-I Target Cost Core Group, 1997: 11): “The Target costing process is a system of profit planning and cost management that is price led, customer focused, designed centered, and cross functional. Target costing initiates cost management at the earliest stages of product development and applies it throughout the product life cycle by actively involving the entire value chain”. This approach stems from the fact that in conditions of strong competitive pressure, with a changing market, companies may be unable to impose a market price based on internal production characteristics: on the contrary it would be important to identify the selling price that customers are willing to pay, which would render the product competitive on the market. The difference between this value and the margin of profitability, defined by strategic planning, is the maximum sustainable cost to achieve consumer consent, attain a satisfactory market share and realize profit objectives. The cost of production then assumes the role of the dependent variable.

Determining the cost objective requires the identification and subsequent reduction of the product costs starting at the product planning stage. Therefore, target costing is not a tool to control costs but a planning tool based on the product specification required by the market. The traditional management of costs is configured as a closed system, oriented to efficiency rather than effectiveness, focusing on a system of internal efficiency measures that do not take into account the relationships between different business functions or relations with the external environment. It is based on feedback control through the analysis of variances between actual costs and standard or budget costs. Target costing is a management methodology aimed at driving the development process by effectively managing cross-functional relationships. It takes into account the external environment in order to obtain products that meet customer expectations. The cost of these products is consistent with business goals throughout the life cycle of the product and based on a feed-forward control (Cooper, 1994: 20-25).

The target costing process can be summarized in three main stages which are linked to the development cycle of the product (Sakurai, 1989: 39-50):
1-setting the *allowable cost* that relates to the planning stage *(corporate planning)* and initial design of the product;
2-setting and achieving the *target cost* that is linked to the detailed design of the product and to the production
3-plan (industrialization and *manufacturing preparation); target cost achievement* in the product implementation phase using standard cost, the *kaizen costing* technique or *value analysis*.
The first two stages make up the design phase of *target costing,* while the third constitutes the operational phase. The first stage of the target costing process is aimed at determining the allowable cost and is linked to strategic planning - identifying specific markets, consumers and products that the company intends to develop - and to the initial design of the product. This cost is determined by calculating the difference between the price, set according to the logic outlined above, and expected profit and it constitutes the largest value of resources that can be used by the company to obtain the product.
The problem of choosing a costing model (Kee, 2010: 204-211) relates to the second stage of the target costing process, which consists in setting and achieving the target cost and relates to the industrialization and *manufacturing preparation phase.* This stage consists of two steps:
1- calculating the difference between the allowable cost and the currently achievable one;
2- cost reduction, driven by this difference analysis.
The current cost is the one sustainable with the current level of capacity utilization, methods of production and distribution and is called *"drifting cost"* because it aligns the acceptable cost through successive modifications of the design.
The definitions of acceptable cost and initial cost should be based on the total cost of the entire product lifecycle and includes components consistent with the cost objective. In particular:
- the full product cost should be used because profit planning and price are determined by considering the product as a whole. This means that the allowable cost shall include the costs of research and development, manufacturing, sales, distribution, servicing, and service and property. Owing to an emphasis on product design, many companies focus the target costing process on the manufacturing and purchasing cost of components while disregarding the cost of support activities;
- the costs incurred throughout the life cycle of the product should be analysed in order to consider both the producer and consumer perspective. Target cost should be determined considering the costs of warranty, repair and servicing that constitute the consumer *cost of ownership for* and costs incurred by the producer from research and development up to the abandonment of the product. The target cost can then refer to costs incurred by the producer (cost of planning, design, development, production, and disposal) or it can also refer to the costs incurred by the customer (operating, maintenance and disposal costs of the product) .
Cost reduction is led by analysing how product design affects all costs associated with the product from its birth to its elimination, using different tools such as value engineering, functional analysis and tables of costs (Ansari, Bell and The CAM-I Target Cost Core Group 1997: Ch. 10). The planning cost process is dynamic and iterative. At each stage of the product development cycle, cost is continually reduced until the allowable cost and the achievable cost are aligned.
Each company develops models to estimate the costs suitable for their needs. In particular, the variables used in the estimation must be related with the technical attributes of the product or process. As attributes are the focus of design, cost estimation models must make clear to the engineers how changes to these attributes can affect the cost of the product.

3. The ABC in the *target costing* process

Activity-Based Costing (ABC) was introduced (Johnson and Kaplan, 1987: 183-208) in response to the need for a costing tool based on the factors that give rise to indirect costs as well as one able to express more objectively the causal relationship between products and costs. The method is based on the assumption that production costs are incurred for the implementation of activities which are performed in order to produce and sell products. Therefore, ABC correlates costs to activities, then to products, through a two-stage imputation methodology. The strength of ABC is due to its recognition that the consumption of resources in the production process is related not only to the volume of production, but largely to activities related to transactions that occur within the organization (Cooper and Kaplan, 1988: 20-27). The innovative contribution of ABC is twofold: on the one hand, through considering a wide variety of cost drivers, it provides the analytical causal-functional determination of the product cost of multi-product or multi-service companies. These have differentiated outputs depending on their varied complexity; on the other, it is a tool to guide management decisions because, by ordering activities by hierarchical logic, ABC highlights relevant costs and makes it possible to determine the actual cost of a decision. The Target Costing process would be effectively supported, by structuring the model in order to keep - within the activities costs - the separation of costs according to their dynamic in relation to changes in output (Woods, 1992: 53-57; Christensen and Sharpe, 1993: 38-42; Kee, 2001: 1-7, Moisello, 2008: 107-119), in order to enlighten the effect of different solution on product cost structure and on capacity utilization both in the short and the long term. Woods (1992: 53-57) proposes a partition of costs between variable and fixed, while Christensen and Sharpe (1993: 38-42) suggest a more detailed classification of the activity costs: variable costs in the short run, fixed costs and fixed costs in the short term, which I assume in the model. The distinction between short-term variable costs, fixed costs and fixed costs in the short-term depends on the time horizon in which management can change the costs. The variable costs in the short-term change in direct proportion to changes in cost drivers and are therefore related to the volume of the driver. Decisions involving activities related to the units or batches have a short-term impact. Decisions that affect the fixed costs in the short term, which is normally one year, involve cost drivers in the batch or product-support level. The fixed costs in the short term, for example, vary with the number of batches, but not in relation to the number of units in the batch. Decisions that affect the fixed costs imply a long-term time horizon. These costs are normally linked to activities in support of the product, to support the industrial structure or the business. Since both fixed costs and fixed costs in the short term have the problem of unused capacity that must be properly highlighted, the costing rates must be calculated on the basis of the offered capacity but charged in relation to the used one. From an operational standpoint the ABC model is flexible processing information on capacity because, through the comparison of variable cost capacity and the capacity of the factors that result in short and long-term fixed costs, it shows:

the size of the unused capacity in accordance with the following relations:

short-term fixed cost capacity – variable cost capacity = [1]
= short-term fixed cost available capacity – utilized variable cost capacity =
= non utilized capacity that can be managed in the short-term

fixed cost capacity – variable cost capacity = [2]
= fixed cost available capacity – utilized fixed cost capacity =
= non-utilized capacity that can be managed in the long term

the presence of constraints in the short term if :

short term fixed cost available capacity = variable cost capacity=
[3]
= short-term fixed cost utilized capacity
the presence of constraints in the long term if :
fixed cost available capacity = variable cost capacity = [4]
= fixed cost utilized capacity

[1] measures the unused capacity manageable in the short as the difference between the capacity of fixed costs in the short and the capacity of the variable costs, since the first indicates the maximum available capacity taking into account that capacity constraints can not be eliminated in the short term and the second expresses the short run used capacity as the acquisition and, therefore, the availability of variable factors is modulated by the planned use of their capacity.
[2] detects idle capacity that can be managed in the long run as the difference between the capacity of fixed costs and variable costs capacity as the first expresses the long term available capacity that is not constrained by capacity limits of short term fixed costs.
When the capacity of the short-term variable cost is equal to the capacity of short term fixed costs [3] shows the presence of capacity constraints in the short period because on the base of [1] production capacity is fully used. Similarly, [4] shows a capacity constraint in the long run when the capacity of the variable costs completely absorbs the available capacity of fixed costs.
The flexible model shows the extent of available resources and possible areas of intervention, to optimise the management of production capacity through capacity reductions or reallocation of resources to activities whose capacity is at saturation level. This pattern is also designed as compromise in the wider discussion around ABC absorption versus direct costing that stresses the importance of highlighting the costs of idle capacity (Aranoff, 2011: 6-10; Baxendale and Foster, 2010: 5-14; Sopariwala, 2009: 41-46).
The example below shows a possible structure of flexible ABC model. Table 1 summarizes the data related to three hypothetic productions: X, Y and Z. Table 2 records the unit costs of activities in the three distinct classes of cost determined on the basis of practical capacity and it highlights the non-utilized capacity costs manageable in the short and in the long term. Table 2 shows the unit costs of activities that are subsequently used in Table 3 to allocate activity costs to products on the base of the used capacity. Table 3 presents the calculation of the average unit cost of the three productions. The cost of production is the sum of operating costs directly attributable to the production and variable costs, fixed and fixed in the short term incurred to carry out the activities required by the productions.

Table 1. Values of drivers and direct costs

	X	**Y**	**Z**
Volume of production	1.000	15.000	8.400
Unit direct costs	180	100	90
Hours of dir. labour per unit	8	1	2
Number of components per unit	105	20	40
Volume of components	100.000	300.000	325.000
Machine hours	7	1	3
Number of Batches	50	50	100
Batch size	20	300	84

Controlled units per batch	2	2	2
Number of shipment orders	550	750	800
Order average size	2	20	11

Table 2 - Unit cost of activities and non-utilized capacity cost manageable in the short and in the long

	Total cost	Driver	Variable	Fixed in the short	Fixed
Logistics	690.000	No of components	210.000	400.000	80.000
Capacity			740.000	750.000	800.000
Unit cost of activity			0,28	0,53	0,10
Non-utilized capacity in the short				10.000	
Cost of Non-utilized capacity in the short				5.300	
Non-utilized capacity in the long					50.000
Cost of Non-utilized capacity in the long					5.000
Setup	740.000	Batch size	200.000	190.000	350.000
Capacity			200	200	200
Unit cost of activity			1.000	950	1.750
Non-utilized capacity in the short				0	
Cost of Non-utilized capacity in the short				0	
Non-utilized capacity in the long					0
Cost of Non-utilized capacity in the long					0
Automatic machining	2.200.000	Machine hours	0	950.000	1.250.000
Capacity			46.700	70.000	70.000
Unit cost of activity			0	13,57	17,86
Non-utilized capacity in the short				23.300	
Cost of Non-utilized capacity in the short				316181	
Non-utilized capacity in the long					0
Cost of Non-utilized capacity in the long					0
Finishing	1.550.000	Hours of dir. labour	590.000	600.000	360.000
Capacity			39.800	60.000	60.000
Unit cost of activity			14,82	10,00	6,00
Non-utilized capacity in the short				20.200	
Cost of Non-utilized capacity in the short				202.000	
Non-utilized capacity in the long					0

Cost of Non-utilized capacity in the long					0
Quality control	3.700	No of Controls	1.500	1.000	1.200
Capacity			400	400	400
Unit cost of activity			3,75	2,5	3
Non-utilized capacity in the short				0	
Cost of Non-utilized capacity in the short				0	
Non-utilized capacity in the long					0
Cost of Non-utilized capacity in the long					0
Packing and shipping	85.000	No of Orders	36.000	35.000	14.000
Capacity			2.100	2.300	2.500
Unit cost of activity			17,14	15,22	5,6
Non-utilized capacity in the short				200	
Cost of Non-utilized capacity in the short				3.044	
Non-utilized capacity in the long					200
Cost of Non-utilized capacity in the long					1.120

Table 3 – Product average unit cost

	X	Y	Z
Direct Costs	180	100	90
Variable costs			
Logistics	29,40	5,60	11,20
Setup	50,00	3,33	11,90
Automatic machining	0,00	0,00	0,00
Finishing	118,56	14,82	29,64
Quality Control	0,38	0,03	0,09
Packing Shipping	8,57	0,86	1,56
Fixed costs in the short			
Logistics	55,65	10,60	21,20
Setup	47,50	3,17	11,31
Automatic machining	94,99	13,57	40,71
Finishing	80,00	10,00	20,00
Quality Control	0,25	0,02	0,06
Packing Shipping	7,61	0,76	1,38
Fixed costs			
Logistics	10,50	2,00	4,00
Setup	87,50	5,83	20,83

Automatic machining	125,02	17,86	53,58
Finishing	48,00	6,00	12,00
Quality Control	0,30	0,02	0,07
Packing Shipping	2,80	0,28	0,51
Unit Cost	947,03	194,75	330,04

With regard to the use of ABC in the design phase, it should be noted that the model performs to its maximum potential when the products are characterized by different levels of complexity since the cause-effect relationship between product-activities-resources leads to undistorted determinations of cost. When, as commonly happens in the manufacturing industry, the cost of materials and labour play a dominant role, industrial cost is the most appropriate cost configuration to use because it is characterized by the certainty of the calculation. The ABC model is, therefore, unsuitable as it determines a full product cost that covers all stages of the value chain. Environments with product differentiation are characterized by high product development costs and considerable Flexible Manufacturing Systems (FMS) costs for assembly services of complex logistics transactions with suppliers and customers and for information systems; in such circumstances the ABC model, as it highlights the role of support activities in the absorption of resources, allows a more accurate determination of the achievable cost and can be usefully integrated with target costing.

The vision of the product as a set of activities, and product cost as the sum of the costs of activities to attain it, allows an evaluation of the effects of possible interventions on existing products and an evaluation of the cost of new interventions. The information obtained with the application of the model permits an appraisal of the impact that the various design variants have on the costs of activities and, consequently, on product cost. ABC can determine the effect of planning and design proposals on the product cost (Cokins, 2002: 13-22). Costs related to the design and product development phase can be determined with greater accuracy than the traditional methods and therefore they can be more effectively controlled (Ben-Arieh and Qian, 2003: 169-183). In the case of new products, the model, together with a functional analysis, shows the impact of different combinations of technical and aesthetic characteristics on the cost of production as it measures related activity consumption and, therefore, the different solutions' absorption of costs. Moreover, with the separation of variable costs in the short term, fixed cost in the short and fixed, it highlights the effects in terms of capacity utilization and capacity constraints of the various activities.

Further, as noted above, a definition of the target cost should take into account the cost of the product lifecycle, which can be effectively determined by the ABC model (Moisello, 2008: 188-193) because it allows for the measurement of operating, warranty, repair and service costs incurred by the customer and the costs incurred by the producer from research and development to the abandonment of the product, taking into account the complexity of the product in terms of type and intensity of activities required.

In the case of existing products, if the achievement of the target cost means, for example, the evaluation of the opportunity to produce a component that is purchased on the market, the flexible model gives an immediate test of the incremental costs related to the hypothesis of internal production. The model identifies the costs that vary (variables) and those that may have a relevance in the decision in the case where the existing capacity should be changed (fixed costs in the short). Moreover, from the point of view of fixed costs, the model renders apparent the available capacity for internal production because it is based on the distinction between used capacity and available capacity.

The focus on process, which characterizes the activity based costing model, provides useful information for effective process redesign or re-engineering. Activity-based costing highlights

weak processes, characterized by a complicated set of activities that do not create value and by long response times. It provides adequate information on which to base redesigning interventions aimed at streamlining and speeding up processes. It highlights the *drivers* - which, being the cause of the costs - constitute the key variables to control for the achievement of efficiency targets respecting quality and time standards. ABC is also useful for predicting the decrease in activity frequency resulting from the redefinition of processes or products. If the reduction in the frequency of activities frees capacity of resources which are not constrained, it can translate into a contraction in medium to long-term costs. If the released capacity is related to constrained resources, depending on whether the firm has the possibility to expand or not, it can be used to reduce costs or to support a suitable production. Stand-alone ABC provides guidance on costs, without taking into account consumer preferences. The integration of ABC and Target Costing usefully supports the decisions related to changes in the product use of standardized components, the choice of distribution channel, the sizing of the production lot and the possibility of outsourcing, as well as the management of the delicate trade-off between the product cost structure cost and the attributes and characteristics required by the market. Target Costing produces information on market demands and cost goals, while ABC shows the changes in cost structure resulting from the various design alternatives of the product. The connection between activity-based costing and target costing also encourages designers to contribute to cost control but designing products involving the use of common and standardized components (Taylor, 2000: 3-19).
The ABC methodology provides a useful contribution in the application of the target costing model in determining the drifting cost and provides guidance on possible areas of cost containment in the operational phase of target cost alignment. On the one hand the creation of the activities map helps identify those activities that produce value-added and whose rationalization allows a more efficient cost management; on the other hand it is useful for the selection of the vendor and highlights the actions required to achieve a reduction of the purchase price and cost control in the internal management of purchase orders. Supply management plays a crucial role in the target costing process, and ABC can provide support at this stage of the process when externally purchased components are used.

4. The ABC in supply choices and in supply management

The target costing process requires careful management of the supply process and the decisions concerning purchases require two basic types of information. On the one hand, they require a store of information that allows the company to evaluate the price of goods and services not internally produced, and thus to determine the factors that can be used to obtain cost reductions from suppliers. On the other hand, they require information that effectively supports the planning of purchases and the definition of orders so as to contain the cost of those activities that must be carried out internally in order to manage supplies.

In this context activity based costing can provide important information regarding the reduction of the purchase price as well as costs concerning the management of purchase orders, since it highlights the direct relation between complexity and cost and allows the company to identify those activities without value added that can be reduced or eliminated.
The purchaser can get a reduction in price-cost through a reduction in the number, intensity and unit cost of activities (Lere and Saraph, 1995: 25-31). When the supplier, faced with a long-term or exclusive supply arrangement, is willing to provide information on the costs sustained for the product/service, in order to justify the unit prices quoted, ABC allows the purchaser to have information that is decidedly superior to that available from traditional cost accounting techniques. The purchaser can obtain a flow chart of the supplier's activities during the entire process; that is, from when the order is received to when it is shipped out, which highlights in

particular those activities without value added that can eventually be reduced and the waste that must be eliminated. As regards the activities specifically undertaken for the supply product, the purchaser can have a clear idea of the indirect cost allocation per unit, batch and product, and thus of the cost determinants used in the allocation. For the supplier cost drivers represent the variables that explain the complexity of the product and of the client; for the client they represent the lever to use to obtain a reduction in the purchase price by lowering the supply cost. The supply cost varies as a function of the technical characteristics of the product and of the order. The technical characteristics of the product translate into a request for a certain number of production support activities involving varying levels of intensity; for example, planning and quality control activities. On the other hand, the level of complexity of the order determines the level of intensity of support activities such as shipping, shipment planning, the preparation of documents necessary for shipping, and obtaining the required certifications for international supplies.
The activity point of view and the awareness of the cost drivers make it easier to identify waste, which is advantageous for both the purchaser and the supplier as well as providing important information for assessing the opportunity for reorganizing the complexity of supply by reducing the use and/or cost of activities that have no effect on the quality and functionality of the product.
The activity based method provides valuable information also with regard to the control of costs incurred internally in the management of purchase orders, since it represents an effective model for the analysis of the purchase department.
The complexity of the internal and external variables facing companies make it appropriate to extend cost analysis to the entire chain of value, paying proper attention to links with organizations both up and down the production line .

So Roodhooft and Konings (Roodhooft and Konings, 1996: 97-102), base the choice of supplier on the total cost of ownership (TCO) – which is the set of costs associated with the purchase, use or maintenance of a product or service – which is determined by means of activity based costing, whose merits were underscored and whose adoption favored in Ellram's studies (Ellram, 1995: 22-30).
This approach bases the choice on identifying the supplier with the lowest value of the following indicator:

$$S_i^B = \left(p_i - p^{\min}\right) \times q + \sum_j c_j^B \times D_{ij}^B \qquad [5]$$

where:

S_i^B = score for supplier i

$p^{\min}$ = unit sales price for most economical supplier

q = number of units purchased

c_j^B = estimated unit cost of activity j, whose use is measure by cost driver j

D_{ij}^B = estimated units of cost driver j, which is consumed by supplier i

The indicator is thus constructed taking into account both the price differential applied by the supplier with respect to the lowest market price and the costs of the activities of the same supplier. The evaluation thus considers the costs relating to the various levels of quality of the purchased factor, as well as shipping and service costs.
The model is proposed for both the selection as well as the subsequent evaluation of the supplier, which can lead to a review of the choice. In the second case, the values estimated in [5] are replaced with the actual values obtained from the following equation:

$$S_i^A = \left(p_i - p^{\min}\right) \times q + \sum_j c_j^A \times D_{ij}^A \qquad [6]$$

[5] is subtracted from [6] to obtain:

$$S_i^A - S_i^B = \sum_j c_j^A \times D_{ij}^A - \sum_j c_j^B \times D_{ij}^B = \overbrace{\sum_j \left(c_j^A - c_j^B\right) \times D_{ij}^B}^{\text{purchaser-effect}} + \overbrace{\sum_j \left(D_{ij}^A - D_{ij}^B\right) \times c_j^B}^{\text{supplier-effect}} + \overbrace{\sum_j \left(c_j^A - c_j^B\right)\left(D_{ij}^A - D_{ij}^B\right)}^{\text{combined-effect}} \qquad [7]$$

So the model can explain the variance between the ex-ante and ex-post scores by determining the purchaser effect, the supplier effect and the combined effect. The purchaser effect depends on the company's ability to reduce the unit cost of driver j; thus the variations in the score that depend on this driver should not affect the assessment of the supplier. The supplier effect depends on the variance between the estimated and actual consumption of the driver; it is caused by variations in the volume of the activities of the supplier and has an impact on the seller's performance measure. The combined effect refers to variations in those costs not attributable solely to the purchaser or the supplier. The logic of the model is useful in different context. The criterion of choice based on the minimum total cost of ownership determined by ABC is employed in the model by Degraeve and Roodhooft (Degraeve and Roodhooft, 1998: 781-789; Degraeve and Roodhooft, 2000: 69-98), who treat the problem of selecting a supplier in situations where the supply is more complex.

Roodhooft and Konings' model for choosing an outside supplier can also be utilized, with appropriate adjustments, in the choice between one or more outside suppliers and an internal one. In the case of the make or buy choice, we propose to replace [5] with the following equation:

$$S_n^B = \left(p_n - c^{abc}\right) \times q + \sum_j c_j^B \times D_{nj}^B \qquad [8]$$

Where:

S_n^B = value of the indicator for the nth supplier

p_n = unit sales price applied to supplier n

c^{abc} = cost of self-production

The cost of self-production corresponds to the average unit cost of production, determined using the flexible ABC model that maintains the separation between variable and fixed costs in the activity costs. The flexible model enables us to develop an average unit cost of production that is appropriate to the specific situation; that is, the model is made up only of incremental costs with respect to the "make" decision, however this is interpreted: as autonomous production in the country of origin, in a foreign country, in a partnership in the country of origin, or in a partnership in a foreign country.

The different values that [8] can have take on the following significance:

$S_i^B > 0$ indicates the advantage of self-production with respect to purchasing from outside;

$S_i^B = 0$ shows that the two alternatives are different from the economic point of view;

$S_i^B < 0$ signals the convenience of the *buy* choice as opposed to the *make* choice

If for $\forall n$ with $n = 1,...,N$, $S_i^B > 0$, the model indicates the advantage of self-production with respect to outside purchasing.

If for some n $S_i^B < 0$, the model leads to choosing the *buy* option and selecting the supplier with the lowest value of the indicator.

The methodology proposed by Roodhooft and Konings, which is based on the systematic determination of a quantitative measure, overcomes the problem of subjectivity that characterizes models, which base their choice on specific criteria and evaluations that can considerably differ depending on who does the assessment.

The determination of TCO provides important information for decisions when the purchase price of the factor represents only a small part of the purchase cost and of the use of productive factors. TCO clearly brings out the difference between low-price and low-cost suppliers. A low-price supplier can have high costs; for example, because it is unreliable regarding delivery times, in carrying out orders, and from the point of view of quality, thereby forcing the company to keep higher stocks than they would like to protect against uncertainty. The supplier is chosen on the basis of a gradual and systematic management and reduction of the ownership cost of productive factors.

The analysis of the model brings out the potential contribution of TCO to the control of costs since it underscores, on the one hand, the variables influenced by the supplier's performance, and on the other those variables that depend on internal efficiency and which affect the company's economic efficiency; thus TCO allows the company to positively assess the choice to accept purchase prices which are higher due to higher quality and overall supply management costs which are more moderate in the long run. TCO enables companies to analyze the economic effects of relations with suppliers in terms of the amount and trends in the internal and external costs of selection, evaluation and management, the internal costs for the utilization of purchased goods, and the internal and external costs associated with the distribution or the damage/defect of the good or service, while also allowing the purchase function to be carried out on the basis of value.

The TCO method shows how supply costs do not depend solely on the volume of production but on the conditions and circumstances linked to supplier performance: each supplier has a different degree of complexity in the supply process which translates into a difference in the type and intensity of activities. This brings out the third advantage in the model we have presented: the reconstruction of total cost ownership through activity based costing. In the studies on the application of TCO to supply decisions, some writers have interpreted the model as a special application of ABC – used to quantify purchase costs and the use of the products/services acquired – that extends its concepts and tools to an interorganizational context (Wouters, Anderson and Wynstra, 2005: 167-191).

The costs that are included in TCO models (Ellram, 1995: 22-30), though different depending on the company that uses the model, are divided into four categories: quality, delivery, customer service and price/cost. In traditional costing systems most of these costs – for example, the cost associated with machine downtime or quality control – are hidden in the accumulation of manufacturing costs. Internationalized firms meet with two further costs categories (Table 4): international delivery solution costs and financial costs related to the international payment and to the exchange rate risk management (Moisello, Gorbunova and Gottardo, 2008: 70-72). In traditional costing systems a relevant amount of these costs too are hidden in the accumulation of administrative costs. The ABC method traces costs correctly to the cost object that generated them, but the amount of detail usually found in ABC models is not sufficient to adequately support supply decisions; the cost object must be traced to the supplier and the individual purchase item. The ABC model allows us to use the costing system to directly derive the analyses necessary for TCO, thereby increasing the accuracy and efficiency of the TCO model.

Table 4 – Cost categories for TCO in internationalized firm (Moisello, Gorbunova and Gottardo, 2008: 72).

Costs connected to quality	Inspection cost Cost of returned goods Cost of equipment downtime Cost of remanufacturing
Delivery	Cost of orders not carried out on time Transport cost *Lead time* related costs Cost of reminders Cost of reopening orders due to partial supply
Customer service	Cost of delays due to slowness in solving problems Cost of adapting a system to that of the suppliers Cost related to time employed for problems with orders
International delivery solution cost	Eventual cost for agents Insurance Clearing for export and import (licenses, authorization and formalities)
Financial costs	International payment transfer cost Exchange rate risk management: Commission costs Personnel, information systems and supports, other costs of administration
Price/cost	Price Quantity discounts Price reductions linked to product/process improvements

5. Conclusions

Activity based costing, due to its ability to model the relationship between complexity, use of activities and the indirect costs dynamic, can adequately support the target costing process, both for the design of the product and for the redesign and re-engineering process, when indirect costs have a significant impact on the cost structure of the product that is the object of the process. ABC performs to its maximum potential if structured flexibly, with the separation of variable costs, fixed and fixed in the short because it makes evident the effects of changes in the product or in the processes in terms of capacity utilization and capacity constraints of the various activities. It also highlights the time horizon to which excess capacity is related. The ABC methodology effectively supports target costing both in determining the drifting cost and in the operational phase of target cost alignment because the creation of activities maps and the identification of value-added and non value-added activities highlights those on which cost containment should be focused. Supply management has a very strong impact in the target costing process, and ABC can also provide support at this stage of the process.

The ABC model is useful in managing the supply process both as a model of cost measurement applicable to the choice of supplier and as a support for supply cost management. The ABC model provides the correct determination of both the internal cost of producing the factor as well as the costs of the activities necessary to use productive factors

purchased externally. This information allows a firm to optimize the choice of supply alternative by following the method of minimizing the total cost of ownership (TCO). ABC clearly evidences the direct link between the complexity of the activities and the incurrence of costs, revealing the opportunities for rationalizing the activities and containing costs. An awareness of the internal activities costs related to managing the supply process guides the planning process for the purchase and management of orders and this leads to the containment of the costs of such activities. Moreover, when the supply relationship is such as to induce the supplier to provide information on the costs sustained to produce the product/service, ABC allows the purchaser the chance to evaluate the impact, in terms of cost, of the activities requested of the supplier and, as a result, to rationalize these activities by reducing their number or intensity and enable the effective involvement of the supplier in the process of target costing.

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