AN INFORMAL REVIEW REGARDING THE ABC METHOD IN THE COST ENGINEERING DISCIPLINE

Corneliu NEAGU [1]
Valentina ZAHARIA[2]

Rezumat. *Prezentul articol prezintă o scurtă trecere în revistă a metodei ABC în ingineria costurilor. Deşi a fost abandonată pentru un timp, în ultimul an metoda ABC s-a dovedit a fi destul de eficientă în cazul companiilor mici care fabrică produse care nu sunt foarte complexe. O descriere a metodei şi o scurtă analiză a unei companii XYZ.AB sunt prezentate în lucrare. ABC (Activity-Based Costing) este o metodologie de inginerie a costurilor dezvoltată la începutul anilor 1970. Obiectivul principal al ABC a fost acela de a evalua eficiența unui proces de fabricație din perspectiva costurilor şi de a transforma costurile indirecte în costuri directe. O revizuire extensivă a metodei ABC se face în lucrarea de față pentru a identifica şi a optimiza eficiența metodologiei. ABC a fost aplicată pentru patru furnizori diferiți din Regatul Unit, SUA, Italia şi Malaysia pentru acelaşi produs, dar cu costuri diferite de inginerie. Ancheta a fost efectuată în cinci etape. Deşi costurile principale de inginerie au fost comparabile pentru toți furnizorii, în Malaezia s-a observat o diferență semnificativă în ceea ce priveşte manipularea, depozitarea şi transportul maritim.*

Abstract. *The present paper presents a very brief review of the ABC method in cost engineering discipline. Although it was abandoned for a while, in the last year the ABC method was proven to be quite efficient in the case of small companies which are manufacturing not very complex products. A description of the method and a brief analysis of an XYZ.AB Company are presented in the paper. ABC (Activity-Based Costing) is a cost engineering methodology developed in the early 1970s. The ABC's main goal was to evaluate the efficiency of a manufacturing process from the cost perspective and convert indirect costs (overhead) to direct cost. An extensive review of the ABC method is done in the present paper to identify and to optimize the efficiency of the methodology. The ABC was applied to four different suppliers from UK, USA, Italy and Malaysia for the same product but different engineering costs. The investigation was conducted in five stages. Although the main engineering costs were comparable for all suppliers, in Malaysia was noticed a significant difference as to handling, storage and shipping.*

Keywords: ABC, method, costs, overhead, efficiency.

[1]Professor, Faculty of Engineering and Management of Technological Systems, Politehnica University of Bucharest; Academy of Romanian Scientists.
[2]PhD student, Faculty of Engineering and Management of Technological Systems, Politehnica University of Bucharest.

1. Introduction

Cost engineering is the science of cost finding by analysing the processes and expenses of the production and, charging of particularizing expense factors, through process unit rates, in the exact ratio of utilization[1-4, 6, 7].

The possibility to increase the profit will come not that much by increasing prices, but by revealing the week points in the making and selling effort, so that special attention may be paid to strengthen them, decreasing existent unseen loses which absorb part of all the normal profits [8-10].

One of the most important issues of the company is to identify and estimate the final cost of a product. Usually the final product cost includes costs for activities and services divided in direct costs and indirect costs. A significant percent from the indirect cost is represented by the overhead cost. In that sense the cost of the product is an unknown for the most of fabricators because either they don't know to determine correctly the final cost, or they didn't applied their knowledge [11].

One of the great mysteries of the business is the so called «Overhead expenses» or «Burden» for Cost Accounting. Thousands of pages are written with the subject «Distribution of the overhead burden», thousands of authors spent valuable time and efforts to apply a certain formula, but in the minds of manufacturers and accountants, the point where expenses end and profit begins was still a mystery.

In the early 1970s, cost engineers traditionally and arbitrarily included a broad percentage of analysis into indirect costs. Moreover, activities include actions that are performed by both people and machine [12-14]. However an increase of the overhead costs started to be noticed and a need for more precisely and accurate method was necessary. Among other methodologies, the developing of the ABC method seemed to be very promising [1-15]. The present paper demonstrates that the ABC method is suited even today to anticipate the correct costs in the case of a reduced complexity product.

2. The ABC method

2.1. Implementation of the ABC method

Activity-based costing was first clearly defined in 1987 by Robert S. Kaplan and W. Bruns as a chapter in their book *Accounting and Management: A Field Study Perspective* and detailed further in [9, 10, 11, 17]. The focus was mainly directed

on the manufacturing industry where increasing technology and productivity improvements have reduced the relative proportion of the direct costs.

The main principles of the methodology include the following costs:

- Cost allocation
- Fixed cost
- Variable cost
- Cost driver
- Cost driver rate

To avoid assigning arbitrary percentage into the total costs ABC tries to identify the cause and effect relationships to objectively assign costs. Once the costs of the activities have been identified, the cost of each activity is ascribed to each product to the extent in which the product uses the activity. Later they are divided in direct and indirect costs (where the overhead cost percentage is accurately defined). In this way ABC often identifies areas of high overhead costs per unit and so directs attention to finding ways to reduce the costs or to charge more for costly products [12-20]. In order to understand the concepts a GAD (dictionary) was developed. The concepts along with the database are used in a calculation program (see chapter 3.2) to complete the final cost. A few concepts are explained below.

The data involved in the ABC process are classified into three domains: product domain, activity domain and resource domain. The essence the ABC is to develop qualitative (what) and quantitative (how many) relationships among them. To integrate the data from these three domains a method called GAD – The attributes include operation, object, sub –object, parent activity driver and resource set [12].

- Operation is the key attribute to describe an activity which represents the action required to do an activity.
- Activity driver forms the linkage between activity and cost object. The usage of activity driver is calculated with the data of production record like production orders, etc.
- Object Activity object is defined as physical target for an operation. In linguistic activity description operation and its object are often combined together as a whole concept of activity. This probably brings redundancy in the activity database.
- Sub-object Activity sub object is defined as an item which is physically related to the activity object.
- Parent is a subassembly or an end product, which consist of at least two components referred to as activity object and sub-object.

- Resource set. Resource set represents the resource pools required to do an activity. It includes two kinds of data related to the resource pools required to do an activity.

2.2. Drawbacks

The primary drawback hindering the implementation of ABC is the difficulty to carry out comprehensive analyses for activities in terms of activities driver and the consumption of the related source pools. This drawback results in complexity explosion when enterprises carry out ABC in mass customization environment [21-22].

The academic research on activity database is quite limited. Guidance on activity database modelling must be provided to the enterprise which plans to develop the ABC system independently [9-12].

3. Selected case study company XYZ.AB

3.1. The problem issued and approach

The XYZ.AB Company (the managers of the company wished that the name of their company remained anonymous in the study) has been established in Norway in the beginning of the 1970s.

XYZ is a designing-manufacturing company with subsidiaries and suppliers in Italy, Malaysia, UK and USA and an increasing number of customers.

The XYZ Company noticed that most of the suppliers were using a traditional cost system, where overhead was allocated to products based on direct labour hours. This cost information was then used mainly for cost controlling, profit planning and manufacturing decisions.

The XYZ Company decided to implement ABC methodologies principles for the suppliers by working on a make-to-order basis where customer orders trigger the production, reducing set up and lead time, holding around zero-level inventory of finished goods and producing one batch size of every product.

Most of the managers of the companies were interested in determining reliable cost information for their major product lines. They welcomed some researchers' idea to carry out an investigation to determine reliable cost information for their main products to enhance product mix decision and other relevant decisions. The first step was to collect relevant data from the suppliers.

The data collection process included several interviews with different top management, shop floor supervisors, controller and accounting team of different suppliers. The best practice and machine data were chosen for the study of different fabricators.

The ABC method was applied by a data collecting process followed by the numerical simulation of the final cost in the case of each supplier/subsidiary of the XYZ.AB Company.

3.2. Results

The XYZ Company has manufacturing for a long time the product A. The ABC method was applied to each subsidiary in USA, UK, Italy and Malaysia.

The overhead cost representing such activities like profits, research and development, sales, management is exhibited in Table 1.

Table 1. Overhead costs in various countries for the XYZ company subsidiaries

Countries (subsidiaries.)	*Overhead costs[Euros]*
USA	223.14
UK	236.281
Malaysia	206
Italy	273.746

A significant difference can be noticed already from overhead costs. Such

The final costs are calculated using formulas integrated in a database code, in the Excel platform. For the subsidiaries of the XYZ Company from each country, the total cost was calculated including the overhead costs. The output of the program is presented in Figures 1-4.

Part 1 US supplier	Currency: EUR			1 316,525
|--- Machining quotation		Tier 1	0	
|--- 01.01 Set up part/machine		Tier 1	1	160,301
|--- 01.02 Machining Time		Tier 1	1	913,860
|--- 01.02.01 Marking		Tier 1	1	41,539
|--- 01.03 MT Control		Tier 1	0	
|--- 01.03.01 MT Control Test		Tier 1	1	38,264
|--- 01.04 QC		Tier 1	0	
|--- 01.04.01 Hardness Test		Tier 1	1	47,336
|--- 01.04.02 Wet Magnetic Test		Tier 1	1	44,135
|--- 01.05 Documentation		Tier 1	1	38,264
|--- 01.06 Handling, Storage and Shipping		Tier 1	1	32,825

Fig. 1. Total cost for the XYZ Company in the case of product A, American subsidiary

	UK Part 1	Currency: EUR			1 413,044
X	|--- Machining		Tier 1	0	
X	|--- 01.01 Set up part/machine		Tier 1	1	173,895
X	|--- 01.02 Machining Time		Tier 1	1	963,704
X	|--- 01.02.01 Marking		Tier 1	1	43,805
X	|--- 01.03 MT Control		Tier 1	0	
X	|--- 01.03.01 MT Control Test		Tier 1	1	45,516
X	|--- 01.04 QC		Tier 1	0	
X	|--- 01.04.01 Hardness Test		Tier 1	1	54,586
X	|--- 01.04.02 Wet Magnetic Test		Tier 1	1	51,385
X	|--- 01.05 Documentation		Tier 1	1	45,516
X	|--- 01.06 Handling, Storage and Shipping		Tier 1	1	34,638

Fig. 2. Total cost for the XYZ Company in the case of product A, English subsidiary

	Part 1 Italian supplier	Currency: EUR			1 557,455
-	Machining Quotation		Tier 1	0	
	|--- 01.01 Set up part/machine		Tier 1	1	187,488
	|--- 01.02 Machining Time		Tier 1	1	1 037,873
	|--- 01.02.01 Marking		Tier 1	1	46,070
	|--- 01.03 MT Control		Tier 1	0	
	|--- 01.03.01 MT Control Test		Tier 1	1	58,206
	|--- 01.04 QC		Tier 1	0	
	|--- 01.04.01 Hardness Test		Tier 1	1	67,274
	|--- 01.04.02 Wet Magnetic Test		Tier 1	1	64,072
	|--- 01.05 Documentation		Tier 1	1	58,206
	|--- 01.06 Handling, Storage and Shipping		Tier 1	1	38,264

Fig. 3. Total cost for the XYZ Company in the case of product A, Italian subsidiary

	EUR Malaysia Part 1	Currency: EUR			1 173,667
X	|--- Machining		Tier 1	0	
X	|--- 01.01 Set up part/machine		Tier 1	1	143,309
X	|--- 01.02 Machining Time		Tier 1	1	851,556
X	|--- 01.02.01 Marking		Tier 1	1	38,707
X	|--- 01.03 MT Control		Tier 1	0	
X	|--- 01.03.01 MT Control Test		Tier 1	1	29,199
X	|--- 01.04 QC		Tier 1	0	
X	|--- 01.04.01 Hardness Test		Tier 1	1	38,274
X	|--- 01.04.02 Wet Magnetic Test		Tier 1	1	35,072
X	|--- 01.05 Documentation		Tier 1	1	29,199
X	|--- 01.06 Handling, Storage and Shipping		Tier 1	1	8,350

Fig. 4. Total cost for the XYZ Company in the case of product A, Malaysian subsidiary

A brief analysis is presented in Fig. 6-7 below. In Fig. 6 the total cost for the product A is presented for all subsidiaries. The red colour shows all the costs before the overhead costs while the blue colour shows the overhead costs.

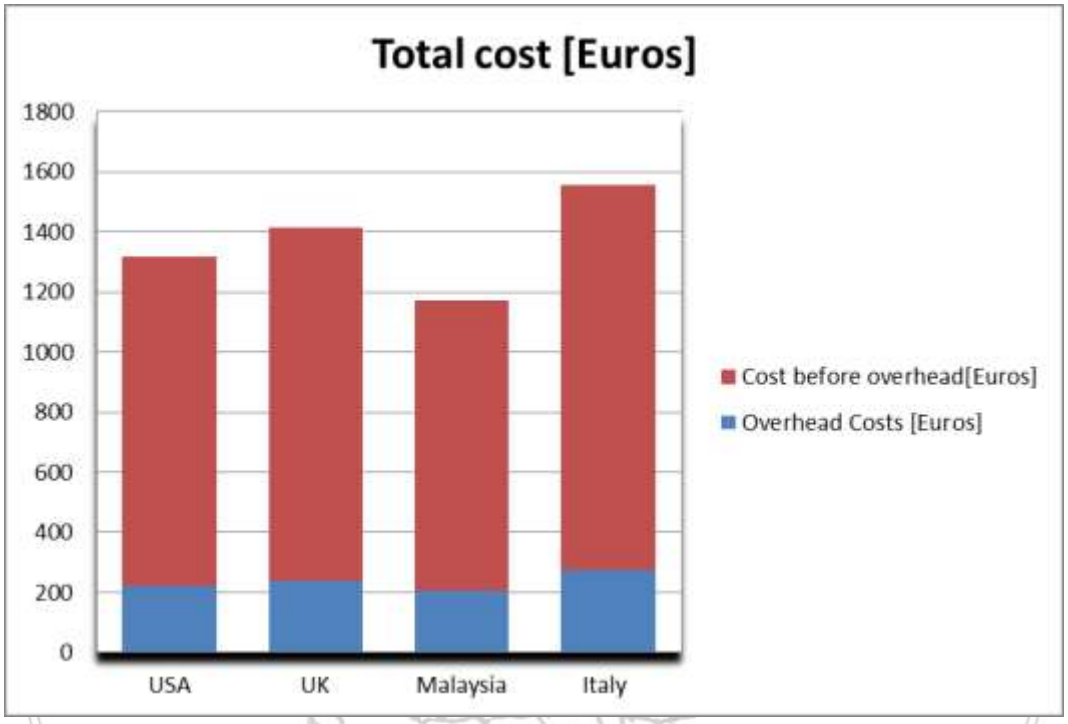

Fig. 5. Total cost for the XYZ Company in the case of product A, all subsidiaries

Fig. 6 shows the weighting of the overhead costs in the final product.

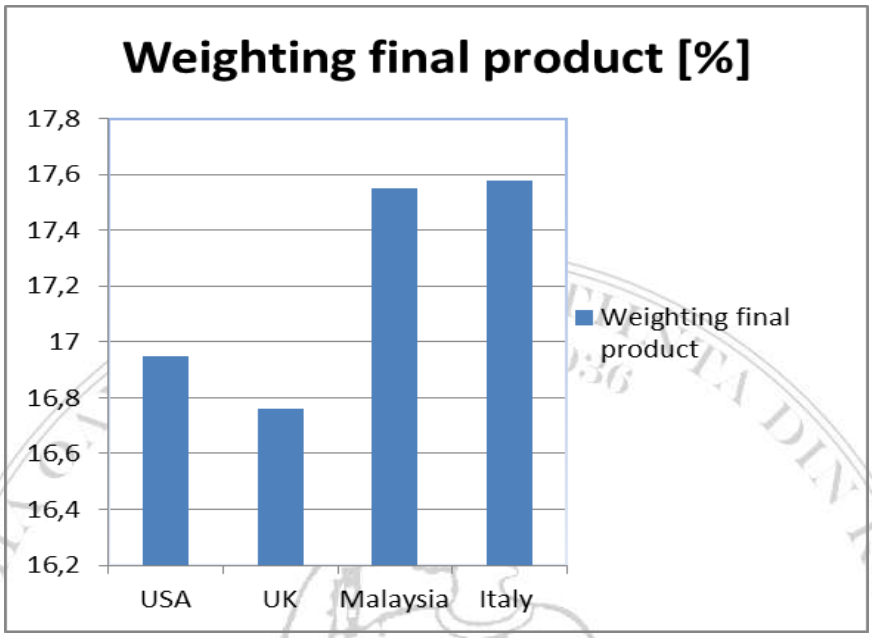

Fig. 6. Overhead costs weighting for the XYZ Company in the case of product A, all subsidiaries

Analyzing the results from Figures 6-7 certain aspects stand out. The costs of the product A is much higher in Italy compared with the other countries. The overhead costs weighting is nearly the same for all subsidiaries. Although in Malaysia product A costs significantly less compared with Italy, the highest difference in the final costs comes from all the other activities (shipping, machining time and so on). In that way the overhead costs are much easier to be assigned to the other costs in Malaysia. The most efficient in terms of overhead costs is the subsidiary from the UK. The ABC method shows the real costs of product A in the manufacturing processes from all subsidiaries and even points out which activities can be reassigned between countries.

Conclusions

In the present paper an informal review of the ABC method is presented. Although the method was developed in the earlier 1970s and was later discarded, for small companies manufacturing not very complex products, it is still quite efficient. A successful situation is the case of the NEVS AB from Sweden where the ABC cost engineering method was applied for the first time.

Acknowledgment

The guidance of Professor Neagu as well as the financial support of NEVS and UPB are gratefully acknowledged.

R E F E R E N C E S

[1] http://web.aacei.org The Authority for Total cost Management.
[2] https://coresolutions.ca Price vis Cost – What's the Difference, Lawn Barney.
[3] Anonymous, The many Faces of ABC. Management Accounting (London) **70**, 32, 1992.
[4] Alex Hill, How to Organize Operations: Focusing or Splitting? International Journal of Production Economics, **112**, 646–654, 2008.
[5] T.Bjørnenak and F.Mitchell, The Development of Activity-based Costing Journal Literature, European Accounting Review, **11**, 481, 1987-2000.
[6] S.Börjesson, What Kind of Activity Based Information Does Your Purpose Require? Two Case Studies, International Journal of Operations &Production management**, 14,** 79-99, 1994.
[7] H. Bouquin, Comptabilité de gestion, 3e édition, Ed. Economica, Paris, 2004.
[8] R. Cooper, The Role of Activity Based Systems in Supporting the Transition to the Lean Enterprise, Advances in Management Accounting **3**, 1-24,1994.
[9] R. Cooper and Kaplan, Measure Costs Right: Make the Right Decisions, Harvard Business Review, September-October, 96-103, 1988.
[10] R.Cooper, R. and Kaplan, Activity-based Systems: Measuring the Costs of Resource Usage, Accounting Horizons, September, 1-13, 1992.
[11] R. Cooper and R.S. Kaplan, Cost and Effect Using Integrated Cost Systems to Drive Profitability and Performance, Harvard Business School Press, Boston,1997.
[12] R. Cooper, Cost Classification in Unit Based and Activity-based Manufacturing Cost Systems, Journal of Cost Management, **3**, 41-48, 1990.
[13] R. Cooper R, Slagmulder, Develop Profitable New Products, Sloan Management Review, Summer, 23-33, 1999.
[14] R. Cooper, R The Rise of Activity-based Costing, Part 11, Journal of Cost Management, Vol. **2**, pp. 41-8, 1988.
[15] S. Cooray – Target Cost Management in Japanese Companies, Management Accounting Research, 1994.
[16] Construction Industry Institute (1986), Constructability Primer Publication 3-1 Austin, TX, University of Texas (1986).

[17] R.S. Kaplan and R. Cooper, Profit Priorities from Activity-Based Costing, Harvard Business Review (May-June 1991); 130-135.
[18] Creese, R.C. Adithan, M.&Pabla Estimating and Costing for Metal Manufacturing Industries New York: Marcel Dekker, USA, 1992.
[19] A. Hagqvist, F Andersson, E. Sundin, and M. Björkman M. (2014), Design for the Manufacturing of Composite Structures for Commercial Aircraft - the Development of a DFM Strategy at SAAB Aerostructures, Procedia CIRP, Vol. **17**, pp. 362-367, 2014.
[20] M. Gosselin. and P. Mévellec (2003), Development of a Cladogram of Cost Management Systems, 6th manufacturing Accounting Research Conference, Twente, Netherlands.
[21] P. Mevellec (2003). Les paramètres de conception des systèmes de coût, étude comparative, Comptabilité, contrôle et audit, France, 2003.
[22] P. Mévellec, Outils de gestion. La pertinence retrouvée. Edition Comptables Malesherbes, Paris 121-134, France, 1990.
[23] S. Nilsson, J. Jensen, M. Björkman. and E. Sundin, 11 Dfm Rules for cfrp Components – An Application at SAAB Aerostructures, SAE 2016, Aerospace Manufacturing and Automated Fastening (AMAF), 4-6 October, Bremen, Germany, 2016.
[24] S. Robert Dunham, Fundamentals of Cost and Profit Calculation, Cleveland, US, 1919.
[25] E. Sundin and M. Björkman, Development of a Design for Manufacturing and Assembly (DFM/A) Methodology Concerning Products and Components Made in Composites of Carbon Fiber Reinforced Plastics (CFRP) Used in the Aerospace Industry, Swedish Production Symposium, October 25-27, Lund, Sweden, 2016.