

THE INTEGRATED ACTIVITY-BASED COSTING AND ECONOMIC VALUE ADDED INFORMATION SYSTEM

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Abstract

This paper examines the implementation of an integrated Activity-Based Costing and Economic Value Added system, using a database approach. The proposed database approach allows the creation of a costing and performance measure system which provides decision-makers with up-to-date, complete, and reliable cost information. The steps for designing and implementing this integrated information system are illustrated with data from a real company. The advantages for calculating product cost information are investigated when a database is used to collect, store, retrieve, and analyze data. Improvements in quality of product cost information, resulting from this proposed methodology, are presented. Finally, the impact of this integrated information system on a company's decision-making and long-term business performance is discussed.

Keywords

Activity-Based Costing, Costing System, Decision Support Systems, Economic Value Added, Information System, Management Information System

Introduction

The main motivation for a company to implement and use Activity-Based Costing (ABC) is the need for reliable cost information. Reliable product cost information is considered to be a powerful tool in increasing a company's profitability and competitiveness. The ABC system alone, however, lacks the ability to support direct managerial decisions.

In most cases, the ABC analysis terminates after the operating cost (overhead) is traced to the cost objects and added to the direct cost (Roztock & Needy, 1999b). These results are called "profit before interest and taxes" (Hicks, 1992) or "operating profit" (Cooper & Kaplan, 1992). However, since these results of ABC analysis disregard costs for capital needed to produce a product or provide a service, they may lead managers to make poor decisions. For example, in many companies, even a high operating profit for a particular product line does not necessarily indicate its generation of wealth for shareholders. If the actual capital cost is higher than the operating profit, the company's capital is eroded rather than built.

To remove the inherent deficiency of ABC, due to disregarding capital cost, many authors have proposed that ABC should be combined with the Economic Value Added performance measure (Hubbell, 1996a; Hubbell, 1996b; Cooper & Slagmulder, 1999; Roztock & Needy, 1999c). The ABC component of this integrated system deals with operating costs, while the Economic Value Added component focuses on capital costs.

While some authors have already proposed a model for an ABC based Information System (IS) (Sundaram, 1999), a published, widely-known conceptual model of an Integrated ABC-and-EVA Information System still does not exist. The objective of this paper is, therefore, to propose a conceptual model of the Integrated ABC-and-EVA Information System, and to provide an example of how such a system may lead to improvements in the reliability of cost information.

Methodology

According to the Integrated ABC-and-EVA System, a cost object (product, job, customer, or service) is economically profitable when it is able to be sold above its total costs (Roztocki & Needy, 1999c). In other words, for a cost object to be economically profitable, it must recover all of its costs: direct cost (material and direct labor), operating cost (overhead expenses, such as administration, and rent), and capital cost (cost needed for using capital). This relationship can be shown mathematically as follows:

$$ABC\text{-and-EVA Profit} = Sales - Direct Cost - Operating Cost - Capital Cost \quad (1)$$

A *positive* ABC-and-EVA Profit indicates that a particular cost object creates shareholder value for a company, while a *negative* ABC-and-EVA Profit indicates that it destroys shareholders' wealth.

In most cases, tracing sales (revenues) and direct costs to the cost objects is perhaps the simplest task. Tracing operating expenses (or overhead) can be done using the traditional ABC approach. On the other hand, tracing capital costs perhaps represents the greatest challenge.

Total capital cost for a company, also called capital charge, can be estimated by multiplying its Capital (*C*) by its Capital Cost Rate (*CCR*) (Roztocki & Needy, 1999a). Mathematically, this relationship can be illustrated as follows:

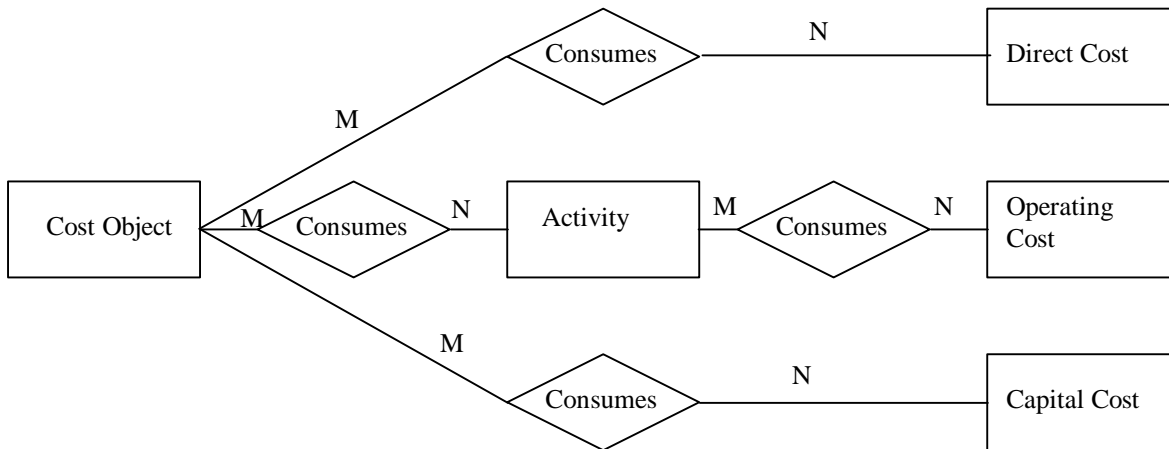
$$Capital Cost = C \times CCR \quad (2)$$

C is defined as all money invested in a company. According to this definition, a company's capital is "all the cash that has been invested ... as if the company were a savings account" (Stewart, 1991). *CCR* depends on many factors, such as interest level, business risks, a company's financial structure, and the investors' expectations.

Using a software system to collect, store, and retrieve data needed for cost analysis simplifies work and increases efficiency. For example, tracing all of the costs needed for Equation 1 can be done using a database approach. To meet a company's specific requirements and provide maximum information, this Integrated ABC-and-EVA Information System must, however, be properly designed. Because the purpose of this paper is to focus more on methodology than programming, conceptual database design is discussed in greater detail, while the remaining steps of design are only briefly described.

In general, the database design process begins with identifying all requirements for this system. After requirements for a costing system are determined, the next step is to develop a conceptual model for a database. During this major step, also called conceptual database design, an Entity-Relationship (ER) Model is created (Elmasri & Navathe, 1994). Figure 1 presents an ER diagram for the Integrated ABC-and-EVA Information System.

Figure 1 ER Diagram for Integrated ABC-and-EVA Database



The ER diagram displays data as entities, relationships, and attributes. Cost objects, for example, are entities. A cost object may be tangible (a product or a customer) or intangible (a service). For most companies, cost objects are groups of entities having similar attributes. A company, for example, may wish to examine the returns from its customers. In this profitability analysis, customers are cost objects. All of the company's customers have the attributes of name, address, and phone number. Because they possess the same attributes, the customers can be defined as an Entity Type.

The costs needed to manufacture a product or provide a service may also be considered entities. Usually, the three cost types (direct, operating, and capital costs) represent three different Entity Types. In most cases, all direct costs possess the same attributes. Contrary to operating and capital costs, direct costs possess an attribute which associates them with a cost object. For example, raw material may be associated with the product it will go on to be used in the manufacturing of. Capital costs are also different from both direct and operating costs. For example, capital costs may have attributes which are specific to capital investments, such as business risks and cash flow factors.

In addition to the *Cost Object* Entity Type and the three Entity Types for each cost category (*Direct Cost*, *Operating Cost*, and *Capital Cost*) the ER diagram for the Integrated ABC-and-EVA Information System requires a fifth Entity Type, *Activity*. As in a traditional ABC System, activities are used as a means by which operating expenses may be traced to the cost objects.

All of the five Entity Types are related. The Relationships provide information about resource consumption by cost objects. For example, cost objects consume direct resources, such as material or direct labor. In addition, a cost object also requires capital investments, such as the purchase of equipment and inventory. In other words, a cost object consumes direct and capital resources. Furthermore, a cost object requires operating expenses for activities such as production planning, materials purchasing, supervision, administration, and final product shipment. In most cases, the Relationship between operating costs and cost objects is indirect. The incurred operating costs (costs for consumed overhead resources) are traced to the cost object, according to the ABC approach, in two steps: tracing operating costs to activities and then to cost objects. In other words, within the proposed conceptual model there is one Relationship between activities and operating costs and another between activities and cost objects.

In most cases, the Relationships are "many-to-many." For example, manufacturing a product may require many operating activities such as contacting customers, purchasing materials, planning production, and final distribution. Also, materials may be bought for many of a company's product lines. Therefore, the Relationship between the *Cost Object* Entity Type and the *Activity* Entity Type can be defined as many-to-many.

After the conceptual model of the Integrated ABC-and-EVA Information System for a company is designed and refined, the next step, called “logical database design” or “data model mapping,” follows (Elmasri & Navathe, 1994). This step is the actual implementation of the database, preferably using a commercial database management system (DBMS).

Finally, the design and implementation process of the Integrated ABC-and-EVA Information System ends with the “physical data design” step. During this final phase, internal storage structures and file organization for the system are created (Elmasri & Navathe, 1994).

Illustration

In this section, the advantages of using the Integrated ABC-and-EVA Information System are presented through an example. The focus of this example is also to illustrate its impact on a company’s decision-making and business performance.

A small manufacturing company in Western Pennsylvania was chosen to participate in this study. The company’s financial data has been simplified to better focus the reader’s attention on the methodology rather than on accounting details. Furthermore, to preserve its anonymity, the company will be referred to as Company X from here on.

Company X, employing more than 40 people, is owned and managed by three owner-managers who bought the company from a large corporation several years ago. The majority of this company’s business is in the area of manufacturing electrical devices, such as motors, generators and electrical industrial equipment. Company X sells its products in both domestic markets and abroad. Most customers are manufacturers or electrical companies looking to replace their out-dated or damaged equipment. A portion of the company’s output is sold directly to customers, while the remainder is sold through independent distributors.

Before this field study, Company X was using a traditional cost analysis system. Company X’s overhead was allocated to products based on direct labor hours. This cost information was used mainly for cost control and profit planning. Management at Company X was interested in expanding sales of their existing product lines, which were divided into the following: Motors and Motor Parts, Breakers, Control Products, and Miscellaneous Parts. They were concerned that the cost and profitability information provided by their traditional cost system was inaccurate limiting informed decision-making.

Company X’s product line of Motors and Motor Parts consisted of electrical motors needed for different industrial applications. The motors differed in size, power output and other specifications and required a great deal of engineering effort. Two engineers were assigned to this product line full-time. Inventory levels were minimal, while machining and direct labor demands were moderate. Most of the machining operations were done on lathes.

Company X’s Breakers were mainly used by power-distribution companies. Machining and direct labor demand in this product line were moderate. Furthermore, the Breakers product line was also characterized by relatively long lead times and a moderate inventory investment. One full-time engineer was assigned to this product line.

The Control Parts were mainly push-buttons and small releases. One engineer devoted half of his time to this product line, while the rest was devoted to the production of Miscellaneous Parts. The main engineer’s responsibility was to prepare job specifications, create manufacturing plans, and supervise production. This product line demanded special equipment, such as assembly fixtures and output testing devices. Inventory levels were substantial for this product line.

Company X’s remaining products, such as small electrical devices and filter paper, were in the Miscellaneous Parts product line. One engineer, preparing design specifications, spent half of his time on this product line. The Miscellaneous Parts product line required unique tooling and special fixtures.

The cost and value creation analysis was performed twice: once with the proposed Integrated ABC-and-EVA Information System and once without, in order to trace capital cost. Most of the financial information needed for the analysis was obtained from Company X's income statement and balance sheet. Table 1 and Table 2 present Company X's income statement and balance sheet respectively.

Table 1 Company X's Income Statement for 1999 (in thousands of dollars)

Net sales	6,020
Cost of goods sold	-3,713
SG&A expenses	-1,893
Earnings before interest and taxes	404
Interest expenses	-136
Income before tax	268
Income tax	-107
Net Income	161

Table 2 Company X's Balance Sheet (in thousands of dollars)

ASSETS	1998	1999	LIABILITIES	1998	1999
Current assets			Current liabilities		
Cash	32	34	Accounts payable	537	613
Receivables	682	883	Accrued expenses	136	146
Inventory	903	993	Short-term debt	412	556
Other current assets	4	5	Total current liabilities	1,077	1,315
Total current assets	1,621	1,915	Long-term liabilities		
Fixed assets			Long-term debt	800	800
Property, land	0	0	Total long-term liabilities	800	800
Equipment	1,504	1,550	Owners' Equity		
Other fixed assets	109	110	Common stock	300	300
Total fixed assets	1,613	1,660	Retained earnings	1,057	1,160
			Total owner's equity	1,357	1,460
TOTAL ASSETS	3,234	3,575	TOTAL LIABILITIES	3,234	3,575
			AND OWNERS' EQUITY		

Company X's operating expenses included marketing expenses, administrative costs, and outlays such as transportation, rent, utilities, and maintenance. The largest portion of the operating expenses is included in the SG&A expense category on the income statement. In addition, operating expenses, such as indirect labor for facility supervision, are included in the cost of goods sold. The complete calculation is shown in Table 3.

Table 3 Company X's Operating Cost (in thousands of dollars)

Cost of goods sold	220
SG&A expenses	+1,893
Operating cost (Overhead)	2,113

Company X's *C* (Capital) consisted of all money invested in the enterprise. Company X's *C*, assuming all book values were reliable estimators of market values, was estimated by subtracting all non-interest-bearing liabilities (Accounts Payable and Accrued Expenses) from total liabilities. The complete calculation using the financing approach is shown in Table 4.

Table 4 Financing Approach: Company X's Capital (in thousands of dollars)

Total Assets	3,234
Accounts Payable	-537
Accrued Expenses	-136
Capital	2,561

Company X's *C* may also be calculated using the operating approach as shown in Table 5.

Table 5 Operating Approach: Company X's Capital (in thousands of dollars)

Cash	32
Receivables	+682
Inventory	+903
Other current assets	+4
Property, land	+0
Equipment	+1,504
Other fixed assets	+109
Accounts payable	-537
Accrued expenses	-136
Capital	2,561

As recommended by some authors (Stewart, 1991), both the financing approach and the operating approach used the previous year's data in estimating Company X's *C*. Estimating *CCR* (Capital Cost Rate) based on cost of interest paid for debt and the owners' expectations. A *CCR* of 15 percent (before tax) was applied to all of Company X's accounting categories and product lines. Total capital charges (before tax) were estimated, according to Equation 2, by multiplying Company X's *C* by the *CCR*.

Next, all costs needed for Equation 1 were traced to Company X's four product lines, beginning with direct and capital costs. Next, operating costs for each product line were determined by using the traditional ABC analysis method. The complete ABC-and-EVA cost information was obtained by adding all of these traced costs. Table 6 shows these results.

Table 6 ABC-and-EVA Product Cost Information (in thousands of dollars)

Product line	Direct Cost	Operating Cost	Capital Charges	ABC-and-EVA
Motors and Motor Parts	1,481	885	154	2,520
Breakers	697	657	103	1,457
Control Parts	696	209	70	975
Miscellaneous Parts	619	362	57	1,038
Total	3,493	2,113	384	5,990

As previously mentioned, *C* and capital charges for particular product lines were estimated using the starting capital of the 1999 fiscal year, which was derived from the ending capital of 1998. This approach, however, does not show the fluctuations in Company X's capital during the given period, but is more of a snapshot of the starting capital from the beginning of 1999. During the 1999 fiscal year, Company X's capital changed substantially on a daily basis. Fluctuation in capital was related to

fluctuation in sales. For example, when sales increased, receivables also increased. To finance this, Company X's management experienced short-term debt in their credit line. After receiving payments from customers, the short-term debts were paid back. Company X had, however, to pay interest for this additional short-term debt. This additional interest cost would not be captured without using the Integrated ABC-and-EVA Information System.

In order to more accurately measure fluctuation in capital and so more accurately determine capital charges, Company X's capital was monitored using the Integrated ABC-and-EVA Information System. Table 7 summarizes Company X's fluctuation in capital over the course of the 1999 fiscal year.

Table 7 Company X's Capital over Time (in thousands of dollars)

	1998 4 Q	1999 1 Q	1999 2 Q	1999 3 Q	1999 4 Q	Average for 1999
Cash	32	35	34	33	34	34
Receivables	+682	+950	+1,226	+972	+883	+943
Inventory	+903	+1,007	+1,125	+1,063	+993	+1,018
Other current assets	+4	+4	+5	+4	+5	+4
Property, land	+0	+0	+0	+0	+0	+0
Equipment	+1,504	+1,504	+1,504	+1,550	+1,550	+1,522
Other fixed assets	+109	+114	+119	+119	+110	+114
Accounts payable	-537	-643	-783	-701	-613	-655
Accrued expenses	-136	-148	-155	-149	-146	-147
Capital	2,561	2,823	3,075	2,891	2,816	2,833

Results

Applying the database approach to trace capital cost showed that since the average capital was higher than the starting capital, the total capital cost was also higher than previously assumed. Using the previously established *CCR* of 15 percent, the total capital cost increased by \$41,000.00. The highest increase in capital cost of \$23,000.00 was registered in the Control Parts product line. One of the reasons for this increase in capital cost, was a relatively high capital investment in additional inventory needed to manufacture this product line. Table 8 summarizes the findings from this analysis.

Table 8 Comparison of Product Cost Information for Company X (in thousands of dollars)

Product line	ABC-and- EVA	ABC-and- EVA IS System
Motors and Motor Parts	2,520	2,526
Breakers	1,457	1,467
Control Parts	975	998
Miscellaneous Parts	1,038	1,040
Total	5,990	6,031

In order to obtain information about economic value creation in Company X's product lines, the previously calculated product costs were subtracted from the amount of sales. Table 9 summarizes economic value creation for Company X's major product lines.

Table 9 Comparison of Value Creation for Company X in (thousands of dollars)

Product line	ABC-and-EVA Profit	ABC-and-EVA Profit IS System
Motors and Motor Parts	18	12
Breakers	124	114
Control Parts	21	-2
Miscellaneous Parts	-133	-135
Total	30	-11

The improved reliability of cost information obtained from the Integrated ABC-and-EVA Information System provided managers with more insight into their cost structure. The Control Parts product line, for example, previously regarded as a value creator, was, in reality, not able to recover its full cost (capital cost included) and as a result, destroyed shareholders' wealth. Company X's management, armed with the improved cost information, sought different options in their corporate strategy. The possibilities of a slight increase in price, reduction in inventory, or improvements in productivity were discussed. Finally, a slight increase in price was chosen as the most promising strategy toward better business performance.

Conclusions

As shown by the previous example, using a database approach is especially advantageous in tracing capital cost. Therefore, the proposed Integrated ABC-and-EVA Information System appears especially useful for companies experiencing high capital cost.

Furthermore, the previous example and the author's own experience suggest that the proposed Integrated ABC-and-EVA Information System is extremely promising in increasing reliability of product cost information when there is a substantial variance in materials, product volume, technology, lead times, or product distribution methods. In all these cases, the proposed method outperforms traditional approaches. For example, some materials needed to manufacture a particular product line may be relatively expensive, yet companies are forced to purchase them in large quantities. For another product line, materials may be ordered, processed, and paid after the final products have already been shipped to the customers. In such a case, the first product line would require a capital investment for purchasing and storing materials, while such an investment for the second product would not be needed. Therefore, a homogenous allocation of capital cost for these product lines would lead to distortions in costing information.

In addition, high fluctuation in capital usage may justify implementation of the Integrated ABC-and-EVA Information System. For example, companies producing very cyclical products may need short-term additional capital. In such a case, the proposed Integrated ABC-and-EVA Information System would better account for this additional interest expense.

In all companies which decide to implement and use the proposed Integrated ABC-and-EVA Information System as a tool for on-going cost and performance analysis, an increase in efficiency in the direct, operating, and capital resources will be experienced. In other words, this system will potentially lead companies toward greater competitiveness and better business performance overall.

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