INTEGRATING ACTIVITY-BASED COSTING AND ECONOMIC VALUE ADDED IN MANUFACTURING*

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Abstract
This article presents a cost and performance measurement system that integrates activity-based costing (ABC) with the economic value added financial performance measure. This proposed ABC-and-EVA system is a management support tool for managing cost and capital. The integrated ABC-and-EVA system includes the rate of resource consumption (as in a traditional ABC system), but it also includes capital demand. A traditional ABC system is compared with an ABC-and-EVA system by examining the cost for each activity at the first stage. A firm's capital information is then transformed into transparent capital charges using a newly developed method called Activity-Capital Dependence (ACD) Analysis. Changes to the end-product costs and possible changes to corporate strategies and business performance in the proposed ABC-and-EVA system are discussed.

Introduction
The main objective of most privately held for-profit companies is to make money in the present and over the long run. If a company is not able to generate enough economic profit over time, its survival is questionable. Moreover, companies making little or no profit are not very attractive for potential investors looking for returns. Management interested in investors' satisfaction has to manage cost and economic value while maintaining at least some minimum profitability level. There needs to be a move towards real improvement and value creation as opposed to clever manipulation of financial data for short-term performance gains.

Activity-Based Costing (ABC), a costing system that has gained popularity in the last decade is based on a simple idea: in an enterprise, overhead (or operating) expenses are generated by a number of activities needed to successfully perform manufacturing and business processes. Since activities consume overhead resources, and products (or projects or processes) demand activities, the cost of products is related to the cost of resources (Cooper, 1988a; 1988b; 1989a; 1989b). By design, ABC provides not only relatively accurate cost data, but also information about the origin of the cost (Cooper and Kaplan, 1988). In other words, ABC makes overhead costs traceable (Tippett and Hoekstra, 1993).

The literature reports of numerous implementations of ABC, although as noted by Benjamin, Siriwardane and Laney (1994), these implementations have occurred primarily in large companies. In many cases, ABC has been used in conjunction with other process improvement tools, such as just-in-time (JIT) or total quality management (TQM), to affirm improvement initiatives and to track cost improvement. In these ABC implementations, managers familiar with the ABC method were able to manage costs more successfully. Costs were kept in-line through the removal of non-value-added activities, process improvement, or outsourcing. Even the most impressive cost reductions, however, do not automatically imply an improvement in value creation; often the shareholder value remained unchanged or was reduced. This results from the fact that the ABC method, however sufficient in the calculation of operating costs, is deficient in the handling of full capital costs (Hubbell, 1996a; Hubbell, 1996b). While the depreciation (a part of capital cost) is considered in the ABC calculation, the interest charges for capital invested in a company are not taken into account.

In contrast, value-based performance measures, such as Economic Value Added (EVA) and Residual Income (RI), focus on capital cost and shareholder value. EVA, a registered trademark of Stern Stewart & Company, has been implemented in numerous large companies to motivate managers to create shareholder value (Dodd and Chen, 1996). If the EVA is positive, the company creates shareholder wealth. Negative EVA indicates that shareholder wealth is destroyed (Stewart 1991). De facto, EVA is the same as RI that has been in existence for several decades. The only significant difference between the two lies in the handling of accounting distortions (Dodd and Chen, 1997). EVA removes existing distortions by using up to 164 adjustments to traditional accounting data (Stewart, 1991; Blair, 1997). These distortions are disregarded in the RI calculation.

Enterprise leaders need a tool to help them manage both cost and capital. This paper presents an integrated ABC-and-EVA system that can be utilized to create shareholder value through cost structure improvement.

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Methodology

Value-based performance measures help to determine the minimum profitability level that a company has to maintain in order to satisfy their current investors and attract new one. This minimum profitability level, or capital charge (*CC*), can be calculated as follows:

$$CC = C \times CCR \quad (1)$$

In this equation, *C* represents the company's capital and *CCR* refers to the capital cost rate. The *CCR* is dependent on the current interest level, the company's business field, the capital structure and the investors' expectations. A good estimator for the *CCR* can be obtained by adding to the long-term interest rate of government bonds (a practically risk free investment) a premium associated with the investment in the given company (Reimann, 1988; Dodd and Chen, 1996). For example, suppose that the interest for a 30 year government bond is 5 percent and the company business is considered stable. In this case, investors may be satisfied with an additional 5 percent return above the government bond rate return for a *CCR* of 10 percent.

If a company is not able to show an economic profit at least as high as the capital charge, shareholder wealth is decreased. As management considers particular investment opportunities in specific projects, products or processes, a reasonable approach would be to divide the total capital charge among the activities while calculating cost information. If this allocation of capital charges to activities is done arbitrarily, costs could be distorted, especially in the case where capital costs are not proportional to operating costs.

ABC emerged due to a similar deficiency with the arbitrary allocation of overhead costs to products. Hubbell (1996a; 1996b) proposes combining the ABC method with a value-based performance measure that includes capital costs with ABC system calculated costs. These capital costs, according to Hubbell, may have positive or negative values. In contrast, the integrated ABC-and-EVA system proposed in this paper distinguishes two different activity costs: operating cost and capital charge. Operating costs mirror resource consumption in a company, while capital charges describe the company's capital investment cost. Operating costs and capital charges have only non-negative values.

Implementation Procedure

The implementation steps for the ABC-and-EVA system are similar to those for a traditional ABC system. The main difference lies in the determination of the total cost for each activity (Step 4). This step will be discussed in greater detail, while remaining steps of the implementation procedure will be discussed briefly.

Step 1: Review the company's financial information

Nearly all of the needed financial information can be obtained from the company's income statement and balance sheet.

Step 2: Identify main activities

Identify the main activities describing the manufacturing and business processes of the company that consume operating resources or are responsible for capital investments.

Step 3: Determine operating cost for each activity

Calculate the operating cost for each activity in the same way as would be done for a traditional ABC implementation. Costs should mirror overhead resource consumption by each activity.

Step 4: Determine capital charge for each activity using Activity-Capital Dependence Analysis

This step does not exist in a traditional ABC calculation. Since many activities consume not only resources but also capital investment, the full cost for many activities is higher than the cost calculated in an ABC system. As a result, ABC tends to underestimate the object cost. The integrated ABC-and-EVA system calculates the capital charge for activities demanding capital investments or tithing capital. This information is obtained by converting data on the company's balance sheet into capital costs or charges. These capital charges are then added to the cost for each activity previously calculated by the ABC system.

Step 5: Select cost drivers

This step is similar for a traditional ABC implementation. Cost drivers are used to trace the cost of activities to products based on their consumption rate. Thus, operating cost drivers can trace operating costs and capital cost drivers can trace capital charges to the products.

Step 6: Calculate product cost

Operating costs and capital costs are traced to the products.

Application Example

In this section, the proposed integrated ABC-and-EVA methodology is illustrated. The data used for this illustration implementation are based on the actual data of a small design and manufacturing firm with which we have worked. For purposes of this tutorial, the data has been disguised to protect confidentially of the firm. Furthermore, the data has been simplified to focus attention on the demonstrated methodology rather than on accounting details.

Some authors suggest that some items in the company's income statement, such as research and development costs, marketing outlays, and restructuring charges, should be treated as capital investments, rather than as expenses. Furthermore, equity equivalents, such as

deferred income tax reserve, LIFO inventory valuation reserve, and depreciated items that represent economic book value, should be added to the company's capital (Stewart, 1991). Although this removal of accounting and financing distortions will increase system accuracy, some authors argue that this marginal gain in accuracy does not justify the additional effort (Dodd and Chen, 1996). In any event, neither inclusion nor removal of the accounting distortions changes the proposed procedure. Hence, accounting adjustments were not performed in this tutorial.

The following calculation was performed for a one year time period. Adjustments to the *CCR* can easily be made for different time periods. For example, a rate of 2.5 percent can be used for a 3 month period to approximate the annual rate of 10 percent. And finally, this illustration makes a simplifying assumption that the data on the balance sheet remains unchanged throughout the year. A preferred method is to use a yearly average value for each category on the balance sheet.

In Step 1 the company's income statement and balance sheet were obtained. These are shown in Exhibits 1 and 2.

Exhibit 1. Income Statement in Thousands of Dollars

Net Sales	2,470
Cost of Goods Sold	-1,050
SG&A Expenses	-450
Depreciation	-250
Other Operating Expenses	-100
Interest Expenses	-120
Income before Tax	**500**
Income Tax (40%)	-200
Net Profit after Tax	**300**

In Step 2 the main activities are identified as shown in Exhibit 3.

Exhibit 3. Activity Categories and Activities

Activity Categories	Activities
Customer Management	Contact Customers Prepare Quotes Invoice and Collect Money
Production Planning and Preparation	Perform Engineering Work Plan Production Purchase Materials
Production Management	Receive and Handle Materials Manage Production
Product Distribution	Store Final Product Ship Final Product
Enterprise Management	Develop Employees Manage Business

Operating costs are calculated for each activity in Step 3. To determine the operating cost, the company's income statement was analyzed to identify operating expenses. Exhibit 4 shows this calculation. In this example, the cost of goods sold item represents direct expenses, such as materials, supplies, and direct labor that can be traced directly to the products.

Exhibit 4. Operating Cost Calculation in Thousands of Dollars

SG&A Expenses	450
Depreciation	250
Other Operating Expenses	100
Total Operating Cost	**800**

Based on the data given in the income statement the company's total operating cost was determined to be $800,000 and was traced to the activities using a traditional ABC approach. Exhibit 5 shows the operational cost of each activity. Note that the sum of the cost of all activities is equal to the total operating cost.

Exhibit 5. Operating Activity Cost in Thousands of Dollars

Activities	Operating Cost
Contact Customers	90
Prepare Quotes	80
Invoice and Collect Money	15
Perform Engineering Work	75
Plan Production	28
Purchase Materials	47
Receive and Handle Materials	100
Manage Production	150
Store Final Product	43
Ship Final Product	112
Develop Employees	17
Manage Business	43
Total Operating Cost	**800**

Exhibit 2. Balance Sheet in Thousands of Dollars

ASSETS	
Current Assets	
Cash	50
Receivable	600
Inventory	300
Others Current Assets	150
Total Current Assets	**1,100**
Fixed Assets	
Property, Land	1,000
Equipment	200
Others Long-term Assets	100
Total Fixed Assets	**1,300**
TOTAL ASSETS	**2,400**

LIABILITIES	
Current Liabilities	
Accounts Payable	300
Accrued Expenses	100
Short-term Debt	400
Total Current Liabilities	**800**
Long-term Liabilities	
Long-term Debt	800
Total Long-term Liabilities	**800**
Owner Equity (Common Equity)	
Capital Stock	100
Retained Earnings	400
Total Owner Equity	**500**
Year to Date Profit/Loss	**300**
TOTAL LIABILITIES	**2,400**

The next step is to determine the capital charge for each activity using Activity-Capital Dependence Analysis. Since the company is in business to make money, the owners expect a reasonable rate of return, i.e., *CCR*, for their investment. Investors' expectations, management's financial objectives, as well as the company's financial structure are factors used to establish the *CCR*. Determining a company's desired *CCR* is very critical. In this illustration, *CCR* is assumed, for simplicity, to be 10 percent. Next, the company's capital, *C*, has to be identified from the balance sheet. The company's capital is equal to total liabilities or total asset minus all non-interest-bearing categories. In our example, non-interest-bearing current liabilities are accounts payable and accrued expenses. In this context, capital includes both equity and debt. This approach defines capital as all money invested in a company regardless of the source (we own it – equity or we borrowed it – debt). Exhibit 6 shows the company's *C* calculation. The total capital is equal to $2,000,000.

Exhibit 6. Company's Capital in Thousands of Dollars

Total Assets	2,400
Accounts Payable	-300
Accrued Expenses	-100
Capital	**2,000**

Total capital charges can now be calculated using Equation 1 as follows:

$$CC = C \times CCR = \$\ 2{,}000{,}000 \times 0.10 = \$\ 200{,}000$$

Next, total capital charges must be traced to all activities. Each activity that demands capital investment should generate a return that recovers its share of capital costs. The capital consumption rate of each activity determines the cost of the capital charge assigned to it.

The cost of capital can be traced to each activity using the Activity-Capital Dependence (ACD) Analysis. The ACD Analysis is shown in Exhibit 7. The rows in the ACD matrix are activities while the columns are the accounting categories from the balance sheet. To systematically recognize the relationship between capital and activities, a checkmark at the *i,j* entry denotes that activity *i* uses capital from the given capital category *j*. For example, the activity receive and handle materials demands capital investment in inventory, other current assets, land, and other current assets. The accounts payable and accrued expenses can be considered as savings in capital requirement, because of the delayed payments in the amount of accounts payable and accrued expenses, the raising of additional capital can be offset.

Next, all checkmarks in the ACD Analysis matrix are replaced with values between 0 and 1 representing the percentage of capital demanded for each activity. For instance, it was determined that only two activities, perform engineering work and manage production, require investments in equipment. Furthermore, it was determined that the activity perform engineering work is responsible for 40 percent of the investments in the company's equipment and the activity manage production for the remaining 60 percent. Based on this information, the corresponding checkmarks were replaced by 0.40 and 0.60 respectively, as shown in Exhibit 8.

Exhibit 7. Activity-Capital Dependence (ACD) Analysis

Activity	Accounting Category								
	Cash	Receivable	Inventory	Other Current Assets	Property, Land	Equipment	Other Long-term Assets	Accounts Payable	Accrued Expenses
Contact Customer	✓				✓				
Prepare Quotes					✓				
Invoice and Collect Money		✓			✓				
Perform Engineering Work					✓	✓			
Plan Production					✓				
Purchase Materials	✓				✓				
Receive and Handle Materials			✓	✓	✓		✓	✓	✓
Manage Production			✓	✓	✓	✓	✓	✓	✓
Store Final Products			✓	✓	✓		✓		
Ship Final Products					✓				
Develop Employees					✓				
Manage Business	✓				✓				

Exhibit 8. Activity-Capital Dependence (ACD) Analysis in Thousands of Dollar

Activity	Accounting Category									Activity Capital Charge
	Cash	Receivable	Inventory	Other Current Assets	Property, Land	Equipment	Other Long-term Assets	Accounts Payable	Accrued Expenses	
Contact Customer	.20				.01					2
Prepare Quotes					.01					1
Invoice and Collect Money		1.00			.01					61
Perform Engineering Work					.01	.40				9
Plan Production					.01					1
Purchase Materials	.20				.01					2
Receive and Handle Materials			.60	.60	.05		.20	.80	.80	2
Manage Production			.20	.20	.80	.60	.60	.20	.20	99
Store Final Products			.20	.20	.05		.20			16
Ship Final Products					.01					1
Develop Employees					.01					1
Manage Business	.60				.02					5
Total Capital Charges	**5**	**60**	**30**	**15**	**100**	**20**	**10**	**-30**	**-10**	**200**

The total capital charges (the last row in Exhibit 8) were calculated by multiplying the particular balance sheet item by *CCR*. For example, the charge of $ 5,000 for cash was obtained by multiplying the cash entry in the balance sheet of 50,000 by a *CCR* of 10 percent.

Subsequently, capital charges (the last column in Exhibit 8) for all activities were calculated by adding all row entries multiplied by their respective capital charges. For example, the capital charge for the row labeled manage business was obtained by multiplying the capital charge for cash, 5, by 0.60 plus the capital charge for land and property, 100, times 0.02 for a total of 5.

To obtain the total cost for each activity the operating cost and capital charge must be summed. Exhibit 9 shows activities with operating costs and capital charges. Some of the activities became significantly more expensive.

Cost drivers are selected in Step 5. For example, the operating cost driver for the activity receive and handle materials was the number of receipts. An appropriate capital cost driver for this activity may be a combination of the dollar value of received material and the time materials spend waiting to be processed.

Product costs are calculated in Step 6. Exhibit 10 shows the resulting product costs when using only the ABC method, while Exhibit 11 presents the product cost calculated using the proposed integrated ABC-and-EVA system.

Results

Although, the ABC method provides accurate operating product costs, it does not identify which products are economic value added creators and so contribute to stockholders' wealth. On the first look, including capital charges in product cost information increase their cost, in some cases significantly. On the other hand, the managers obtain a powerful tool. For example, the illustration shows that if management uses the product costs obtained using the ABC system, they will conclude that Product 1 is much less profitable that Products 2 and 3. If, however, they use the product costs obtained using the integrated ABC-and-EVA system, management can see which products create value. In the illustration, Product 1, which under the ABC system was regarded as creating only minor value for the company, yields higher levels of economic profit due to its limited use of capital. In contrast, Product 3, while consuming a small portion of the company's operating cost resources, demands high capital investments. This capital demand results in a relatively high capital charge. The needed capital investments are in production equipment, storing before shipment, invoicing and money collection.

More accurate product cost information alone, however, does not automatically lead to improvements in business performance. Once product cost information is obtained from the integrated ABC-and-EVA system, management is challenged to take action. For example, some possible strategies regarding Product 3 include:

- Increase the selling price
- Decrease its capital demand by reducing lead times
- Reduce the operating costs
- Increase the output with only minimal additional capital investments, keeping operational cost in line
- Search for a replacement product having a better potential to be a value creator
- Drop it

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Exhibit 9. Operating Costs and Capital Charges in Thousands of Dollar

Activities	Operating Cost	Capital Charge	Total Cost
Contact Customers	90	2	92
Prepare Quotes	50	1	51
Invoice and Collect Money	45	61	106
Perform Engineering Work	75	9	84
Plan Production	28	1	29
Purchase Materials	47	2	49
Receive and Handle Materials	100	2	102
Manage Production	150	99	249
Store Final Product	43	16	59
Ship Final Product	112	1	113
Develop Employees	17	1	18
Manage Business	43	5	48
Total	**800**	**200**	**1,000**

Exhibit 10. Product cost calculation using ABC system in Thousands of Dollars

ABC				
Product	**1**	**2**	**3**	**Total**
Revenues	1,000	800	670	2,470
Direct Costs	500	300	250	1,050
Operating Costs	400	200	200	800
Interest	40	40	40	120
Profit before Tax	60	260	180	500
Tax (40 Percent)	24	104	72	200
Profit after Tax	**36**	**156**	**108**	**300**

Exhibit 11. Product cost calculation using ABC-and-EVA system in Thousands of Dollars

ABC-and-EVA System				
Product	**1**	**2**	**3**	**Total**
Revenues	1,000	800	670	2,470
Direct Costs	500	300	250	1,050
Operating Costs	400	200	200	800
Operating Income	100	300	220	620
Tax	32	97	71	200
Net Operating Profit After Tax	68	203	149	420
Capital Charge	10	38	152	200
Economic Profit	**58**	**165**	**-3**	**220**

In addition, management may need to reconsider its attitude toward Product 1, which appears to be more attractive under the ABC-and-EVA system. For example, management may wish to increase marketing efforts for Product 1.

Conclusions

The proposed integrated ABC-and-EVA system will help managers in companies understand that the capital invested in their company is a precious resource that has to be used effectively. The proposed capital charge added to activities and traced to the products attempts to account for the capital use and helps management understand the capital cost associated with the manufacturing process. Management can obtain a distorted impression of *profitability* if they look only at profit after tax in the traditional sense as opposed to economic profit as calculated in the ABC-and-EVA system. Once implemented, the integrated ABC-and-EVA system can be used as an engineering management tool to protect company leaders from making short-term decisions based on profit alone, that may destroy economic value over the long-term.

The proposed integrated ABC-and-EVA system by itself will not make improvements in the business process, but rather will provide management with information that can direct improvement efforts. Management should be committed to make these necessary improvement steps.

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