

# **How to Design and Implement an Integrated Activity-Based Costing and Economic Value Added System**

**Narcyz Roztocki / Kim LaScola Needy**  
**University of Pittsburgh**  
**Department of Industrial Engineering**  
**1040 Benedum Hall**  
**Pittsburgh, PA 15261, USA**  
**412-624-9830 (ofc) / 412-624-9831 (fax)**  
**[roztocki@pitt.edu](mailto:roztocki@pitt.edu) / [kneedy@engrng.pitt.edu](mailto:kneedy@engrng.pitt.edu)**

## **Abstract**

This paper describes how to design and implement an integrated the Activity-Based Costing method with the Economic Value Added performance measurement system to determine costs as well as measure performance. Motivation for switching to an integrated ABC-and-EVA system is presented. Pre-implementation and implementation steps are illustrated using data from an actual implementation of the system at a small design and manufacturing firm. Changes to product costs resulting from the inclusion of full capital cost are demonstrated. The impact of the increased reliability of cost information on the company's decision-making, potential long-term business performance, and expected shareholder wealth creation is discussed.

## **Keywords**

Activity-Based Costing, Economic Value Added, Performance Measure, Costing System

## **1. Introduction**

The main motivation for investors who are looking for new business opportunities is expected returns on their investment. In most cases, investors will not be eager to put their money into a company until they see acceptable future returns. If expected future returns for a company are low, they will probably look for other investment alternatives. The rate of return on invested capital depends on many factors such as a company's business, the current interest rate, risk factors, and alternative investment opportunities.

The management of a for-profit organization is obliged to create value for their shareholders. In other words, they have to generate enough value to recover capital cost. If a company's returns are below its capital costs, the company is destroying shareholder value, and the management needs to take corrective action.

Complete cost information is needed to make smart business decisions. Cost information delivered by a modern system should include all costs necessary to create products, jobs, or services, i.e., cost objects. Total costs include not only tangible costs, but also include capital cost expected by investors and creditors. Based on both historical and current data, as well as future expectations, management can learn which products, jobs, services, and customers help to contribute to the company's business success.

For many companies, today's costing systems are inadequate [1]. Traditional Cost Accounting (TCA) arbitrarily allocates a company's overhead to its cost objects, usually based on some volume-based measure such as direct labor hours. Activity-Based Costing (ABC) which is able to accurately trace overhead expenses (operating expenses) [2], however, stops short of taking into account the full capital cost associated with the cost objects. ABC focuses only on operating costs included in a company's income statement while ignoring balance sheet data [3,4,5]. When management uses ABC cost information alone, they have difficulty fully recovering capital costs and, therefore, meeting investors' expectations. Some authors have recently proposed combining the ABC method with the Economic Value Added performance measurement system in order to consider the operating and capital costs associated with cost objects, thereby addressing the shortcomings of TCA and ABC systems [3,4,5].

The proposed integrated ABC-and-EVA system is more than a costing system. Besides providing accurate cost information consistent with the corporate objective of shareholder wealth creation, this system is able to measure the business performance of specific cost objects. It shows which cost objects are not only able to recover operating costs, but also satisfy investors' expectations in the form of a reasonable rate of return on the company's capital. In addition, the integrated ABC-and-EVA system can identify value drivers. After implementing this system, the management will be able to recognize which factors, components, processes, or operations are the real value drivers, greatly impacting a company's value creation potential. Even small improvements in these areas can result in a notably higher business performance.

## 2. Methodology

### 2.1 Motivation for Implementing an Integrated ABC-and-EVA System

An integrated ABC-and-EVA system is especially valuable for companies having high capital costs. In order to help companies decide if an Integrated ABC-and-EVA System has the potential to improve their cost information, the ratio of capital charges to operating expenses (overhead) should be examined. The Capital to Operating ratio, *CO-ratio*, can be shown mathematically as follows:

$$CO\text{-ratio} = \text{Capital Charges} / \text{Operating Expenses} \quad (1)$$

If the ratio of capital charges to operating expenses is high, higher than 0.1, the company should consider implementing an Integrated ABC-and-EVA System. The value of 0.1 was derived based upon the authors' experience working with several small manufacturing firms. This value will be examined over time and potentially adjusted as we gain more experience working with additional companies.

### 2.2 Pre-implementation stage

As with any new system, the most important step is to obtain top management support. The implementation of an Integrated ABC-and-EVA System is no exception in that it must be initiated from the top. To help show their commitment to the new system, management must first assemble a high-powered, dedicated implementation team. In addition, they must decide in

advance what the system's desired level of accuracy will need to be so that the system can be utilized for its intended purpose.

### **2.3 Implementation Methodology**

The implementation methodology described next has been developed by researchers from the University of Pittsburgh [5]. The main difference in this methodology as compared to others lies in the procedure for tracing capital charges to specific cost objects. While some authors propose that capital charges should first be added to activities and then traced to the cost objects using capital drivers [3,4,5], the proposed method traces capital charges directly to cost objects. This methodology can be broken down into six steps. Steps 1 through 5 are identical to those for a traditional ABC system. The main extension from an ABC to an ABC-and-EVA System lies in Step 6. Thus, Steps 1 through 5 will be overviewed briefly, while Step 6 will be discussed in greater detail.

#### ***Step 1: Review the company's financial information***

Almost all of the information needed to perform the analysis can be obtained from the company's financial statements and balance sheet. The income statement is primarily needed to estimate the operating cost, while the balance sheet is mainly needed to calculate the capital charges. Some of the information needed to make adjustments for the Economic Value Added calculation may appear in the notes to financial statement [6].

#### ***Step 2: Identify main activities***

The main activities that describe how the company's manufacturing and business operations consume operating resources are identified.

#### ***Step 3: Determine the operating cost for each activity***

Operating costs are calculated for each activity as they would be for the implementation of a traditional ABC System.

#### ***Step 4: Select cost drivers***

Selection of cost drivers is also performed in a manner similar for the implementation of a traditional ABC System.

#### ***Step 5: Calculate operating costs for cost objects***

Once the cost drivers have been selected, operating costs are traced to the cost objects in the same way as for the implementation of a traditional ABC System. In most cases the traditional ABC analysis ends after operating costs are calculated and added to the direct cost. Some authors call this result "profit before interest and taxes" [7], others "operating profit" [8]. This method disregards information appearing on the company's balance sheet [3,4,5] and income statement, for example, interest payments to the banks for borrowed money and tax payments, i.e., capital charges. What is typically done then is to arbitrarily allocate these costs to cost objects. This leads to cost distortions and inequitable assignment of expenses. Therefore, a refinement to the traditional ABC System would be an integrated ABC-and-EVA System, which also manages capital charges. This refinement is depicted in Step 6 of the methodology.

### ***Step 6: Calculate capital charges for cost objects***

The main objective of this step is to distribute the company's capital charges to the appropriate cost objects. In other words, the capital cost of assets used to produce a particular cost object needs to be traced to that cost object. For example, let us assume that a company manufactures two products: one product is paid for by the customers at delivery, while the second product is delivered and then billed. In this example, the company incurs expenses for the second product related to the account receivable transaction. Assuming that the company has a receivable of \$100,000 and a capital cost of 10 percent, then capital charge of \$10,000 can be traced to the second product.

### **3. Illustration**

In this section, the results of a field study which examined the development of an integrated ABC-and-EVA System for small manufacturing firms are presented to illustrate the implementation procedure. A small manufacturing company located in the Pittsburgh region with approximately 30 employees was chosen to participate in this study. This company's main products are commercial offset, screen printing, electronic, and membrane switches. One year ago, the company was bought by a group of investors from the previous owner-manager. The company is currently being managed by its former vice-president who is supported by a management group of three people. Investors primarily perform a control function. The management group was very eager to participate in the field study conducted by the University of Pittsburgh for several reasons. First, the management group was under pressure from the new investors to increase the return on existing product lines, and second, they were asked to identify in which product line a marketing campaign would potentially have the biggest impact on increasing sales and ultimately profits. Finally, the management group felt that the traditional costing system that they were currently using was not able to provide sufficient cost information. They were hopeful that an integrated ABC-and-EVA System would help them to manage their company better. To preserve its anonymity, this company will be referred to as ScreenPrint from this point forward.

ScreenPrint's management decided to use gross profit as a percentage of sales as shown in Table 1 as a decision criterion for sales expansion. Although Product Line 1 had the highest gross profit as a percentage of sales, management believed that this product line was mature and had a limited customer base. Product Lines 2 and 4 each showed the next highest percentage profit. Product Line 4 was not chosen for expansion in sales, because management believed that it had limited market growth potential. Thus, Product Line 2 was targeted for sales expansion.

In the initial meeting, the implementation methodology for the integrated ABC-and-EVA System was described to ScreenPrint's management. Next, ScreenPrint established a project team consisting of three managers: the president, the production manager, and the financial manager. Two researchers from the University of Pittsburgh supported the project team. The production manager was chosen to collect data and be the main contact person with the University of Pittsburgh researchers.

Table 1. ScreenPrint's Traditional Cost Information in Thousands of Dollars

	Product Line						<b>Total</b>
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	
Sales	1,041	393	356	102	35	28	1,955
Direct Cost	-503	-258	-273	-67	-25	-24	-1,250
Gross Profit	538	135	83	35	10	4	705
<b>Gross Profit as Percentage of Sales</b>	<b>52%</b>	<b>34%</b>	<b>23%</b>	<b>34%</b>	<b>29%</b>	<b>14%</b>	<b>36%</b>

The project was scheduled to be completed in three months. Project meetings were held once a week. Phone calls and e-mail messages provided additional communication outside of the meetings. The objective of the project was to determine in which of the six product lines to expand sales based upon the cost and profitability profile as determined by the proposed ABC-and-EVA System.

After the pre-implementation stage of the project, the first implementation step was to analyze the company's most recent income statements and balance sheets. Table 2 and Table 3 depict ScreenPrint's income statement and balance sheet respectively.

Overhead included selling expenses, administrative expenses, and expenditures such as shop floor supervision, rent, utilities, and factory maintenance. A portion of the operating expenses were included in the cost of goods sold category on the income statement. After subtracting out direct labor and direct material expenses from cost of goods sold, we were left with a total of \$100,000 in overhead. The complete overhead calculation is shown in Table 4.

In order to calculate the amount of ScreenPrint's capital, we considered all money invested in the company, regardless of the sources (bank debts or equity). Using this approach, ScreenPrint's capital was determined to be \$2,000,000 as shown in Table 5.

Table 2. ScreenPrint's Income Statement in Thousands of Dollars

Net Sales	1,955
Cost of Goods Sold	-1,250
SG&A Expenses	-523
<b>Earnings Before Interest and Taxes</b>	<b>182</b>
Interest Expenses	-90
<b>Income Before Tax</b>	<b>92</b>
Income Tax (40%)	-36.8
<b>Net Income</b>	<b>55.2</b>

Table 3. ScreenPrint's Balance Sheet in Thousands of Dollars

ASSETS		LIABILITIES	
<b>Current Assets</b>		<b>Current Liabilities</b>	
Cash	56	Accounts Payable	196
Receivable	540	Accrued Expenses	149
Inventory	497	Short-term Debt	250
Other Current Assets	42	<b>Total Current Liabilities</b>	<b>595</b>
<b>Total Current Assets</b>	<b>1,135</b>		
		<b>Long-term Liabilities</b>	
		Long-term Debt	750
<b>Fixed Assets</b>		<b>Total Long-term Liabilities</b>	<b>750</b>
Property, Land	649		
Equipment	411		
Other Fixed Assets	150	<b>Owners' Equity</b>	
<b>Total Fixed Assets</b>	<b>1,210</b>	Common Stock	500
		Retained Earnings	500
		<b>Total Owner's Equity</b>	<b>1,000</b>
<b>TOTAL ASSETS</b>	<b>2,345</b>	<b>TOTAL LIABILITIES</b>	<b>2,345</b>

Table 4. ScreenPrint's Operating Cost Calculation in Thousands of Dollars

Cost of Goods Sold (operating expenses)	100
SG&A Expenses	523
<b>Operating costs</b>	<b>623</b>

Table 5. ScreenPrint's Capital in Thousands of Dollars

Total Assets	2,345
Accounts Payable	-194
Accrued Expenses	<u>-151</u>
<b>Capital</b>	<b>2,000</b>

Once the capital was determined, we selected a value of 10 percent to be used as the Capital Cost Rate (*CCR*). This resulted in total capital charges of \$200,000. In addition, we calculated a tax shield associated with the operating expenses. Using Equation 1, the *CO-ratio* was calculated as follows:

$$\begin{aligned} CO\text{-ratio} &= \text{Capital Charge} / \text{Operating Expenses} \\ &= 200,000 / [623,000(1-0.4)] = .54 \end{aligned} \tag{1}$$

A relatively high *CO-ratio* ( $> 0.1$ ) suggests that including Economic Value Added elements in ScreenPrint's costing system will have potential to increase its competitiveness.

In Step 2, ScreenPrint's main activities were identified. These activities were named, according to Johnson's recommendation, with a phrase containing a verb and a noun [9]. In all, there were twenty-one activities as depicted in Table 6.

Table 6. ScreenPrint's Activity Categories and Activities

<b>Activity Category</b>	<b>Activities</b>
Customer Management	Making Calls and Travelling Service Customer Coordinate and Support Sales People Prepare Quotes Invoice Jobs Collect Money
Production Planning and Preparation	Purchase Inventory Enter Order Schedule Jobs
Production Management	Handle Materials Inventory Coordinate and Supervise Jobs in Progress Do Paper Work Manage Accounts Payable
Product Distribution	Handle and Store Final Product Ship Final Product
Enterprise Management and Development	Manage Business Perform Human Resource Duties Represent Business Perform Administrative Duties Perform Research on Products

In Step 3, operating costs for each activity were determined. These results are displayed in Table 7.

In Step 4, cost drivers, were selected so that the operating costs could be traced to the product lines [10].

In Step 5, operating costs were traced to each product lines. Table 8 presents these results.

In a traditional ABC analysis, management would stop with Step 5 and use these "final" results to make decisions. The managers at ScreenPrint were uncomfortable with stopping the cost analysis at this point. They were interested in including the costs associated with interest payments and tax expenses in the product cost to gain a clearer understanding of how value was created.

Table 7. ScreenPrint's Operating Activity Cost in Thousands of Dollars

Activities	Operating Cost
Making Calls and Travelling	160
Service Customer	14
Coordinate and Support Sales People	49
Prepare Quotes	46
Invoice Jobs	51
Collect Money	20
Purchase Inventory	14
Enter Order	26
Schedule Jobs	18
Handle Materials	21
Inventory	6
Coordinate and Supervise Jobs in Progress	18
Do Paper Work	10
Manage Accounts Payable	28
Handle and Store Final Product	20
Ship Final Product	9
Manage Business	46
Perform Human Resource Duties	28
Represent Business	14
Perform Administrative Duties	21
Perform Research on Products	5
<b>Total Operating Cost</b>	<b>623</b>

Table 8. ScreenPrint's ABC Cost Information in Thousands of Dollars

	Product Line						Total
	1	2	3	4	5	6	
Sales	1,041	393	356	102	35	28	1,955
Direct Cost	-503	-258	-273	-67	-25	-24	-1,150
Operating Cost	-306	-105	-62	-67	-52	-31	-623
Operating Profit (EBIT)	<b>232</b>	<b>30</b>	<b>21</b>	<b>-32</b>	<b>-42</b>	<b>-27</b>	<b>182</b>

In Step 6, the capital charges were determined for each product line. In other words, the main objective of this step was to trace the total capital charge (\$200,000) amongst the six product lines. These capital charges can be traced to the product lines using the Product-Capital Dependence (PCD) Analysis. For example, as previously shown in

Table 3, ScreenPrint's balance sheet showed receivables of \$540,000. Assuming a *CCR* of 10 percent, a capital charge of \$54,000 had to be distributed between the six product lines. A review of ScreenPrint's receivable accounting category showed that Product Line 1 was responsible for \$240,000 of receivables. In this case, a capital charge of \$24,000 has to be traced to Product Line 1. This amount was placed at the intersection of the Receivable column and the Product Line 1 row as shown in Table 9. In a similar manner, capital charges associated with each accounting category were placed in the PCD matrix. By summing the charges across each row of Table 9 we are left with the total capital charge for each product line.

Table 9. ScreenPrint's Product-Capital Dependence (PCD) Analysis in Thousands of Dollar

<b>Product Line</b>	<b>Accounting Category</b>								<b>Product Line Capital Charge</b>	
	Cash	Receivable	Inventory	Other current assets	Property, land	Equipment	Other long-term assets	Accounts payable		
1	2	24	24	1	26	20	10	-2	-7	98
2	2	24	20	1	30	17	5	-17	-6	76
3	1	2	2	1	4	1		-1	-2	8
4	1	2	2	1	1	1				8
5		1	1		3	1				7
6			1		1	1				3
<b>Total Capital Charges</b>	<b>6</b>	<b>54</b>	<b>50</b>	<b>4</b>	<b>65</b>	<b>41</b>	<b>15</b>	<b>-20</b>	<b>-15</b>	<b>200</b>

The tax on the *EBIT* can be calculated as shown in Table 10.

Table 10. ScreenPrint's Tax on EBIT in Thousands of Dollars

Income Tax Provision	36.8
Tax Shield on Interest Expenses (90 x 0.4)	36.0
<b>Tax on EBIT</b>	<b>72.8</b>

An alternative way of calculating the taxes on the EBIT would be to multiply the EBIT times the tax rate. We will assume an effective tax rate of 40 percent. In other words, taxes on the EBIT would be applied in the event that ScreenPrint will be financed by 100 percent of owners' equity. The complete Economic Value Added calculation for all six product lines is summarized in Table 11.

We exercised two simplifying assumptions in the analysis: (1) Full resource usage, and (2) Economic Value Added adjustments. Full resource utilization is only seldom the case. Resource

utilization will vary because of variation in production and sales. In many cases, companies may even decide to keep idle resource in order to increase their ability to quickly respond to customer demand [11]. For further discussion of this issue refer to any of the following publications [8,12,13,14,15].

Table 11. ScreenPrint's ABC-and-EVA Cost Information in Thousands of Dollars

	Product Line						<b>Total</b>
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	
Sales	1,041	393	356	102	35	28	1,955
Direct Cost	-503	-258	-273	-67	-25	-24	-1,150
Operating Cost	-306	-105	-62	-67	-52	-31	-623
<b>EBIT (Operating Profit)</b>	<b>232</b>	<b>30</b>	<b>21</b>	<b>-32</b>	<b>-42</b>	<b>-27</b>	<b>182</b>
Tax on EBIT	-92.8	-12	-8.4	12.8	16.8	10.8	-72.8
<b>NOPAT</b>	<b>139.2</b>	<b>18</b>	<b>12.6</b>	<b>-19.2</b>	<b>-25.2</b>	<b>-16.2</b>	<b>109.2</b>
Capital Charge	-98	-76	-8	-8	-7	-3	-200
<b>Economic Value Added</b>	<b>41.2</b>	<b>-58</b>	<b>4.6</b>	<b>-27.2</b>	<b>-32.2</b>	<b>-19.2</b>	<b>-90.8</b>

In addition to the full resource utilization assumption, we did not perform any “adjustments” accordingly to the Economic Value Added method. Some authors suggest that various items on the company’s financial statement, such as research and product development costs, software development, marketing outlays, distribution improvement, employee training, and restructuring charges, should be treated as capital investments as opposed to expenses [6]. Moreover, these cash outlays often have more benefit to future business rather than to the existing business and its associated product mix. Some argue, if these cash outlays are accounted for in the time period when they occur, that the true product cost will be distorted [1]. A company, therefore must weigh the benefit of improved product cost accuracy against the additional effort to make the various adjustments.

#### 4. Results

Table 12 summarizes the findings from the analysis. By looking at gross profit alone (in the traditional costing approach), it appears as though Product Line 1 is the most profitable. The ABC analysis shows operating profits for Product Lines 1, 2, and 3. On the other hand, ABC-and-EVA analysis shows that only Product Lines 1 and 3 create economic profit for ScreenPrint.

#### 5. Conclusions

Looking at the operating profit derived by ABC alone, management can obtain a distorted impression of profitability for particular cost objects. This distortion may lead to poor decisions. An integrated ABC-and-EVA system has the potential to help managers improve the business performance of their companies by giving them a better understanding of their true costs.

Table 12. ScreenPrint's Cost Information Comparison in Thousands of Dollars

	Product Line						<b>Total</b>
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	
Sales	1,041	393	356	102	35	28	1,955
Direct Cost	-603	-258	-273	-67	-25	-24	-1,250
Gross Profit	438	135	83	35	10	4	705
Traditional Gross Profit in Percent	42%	34%	23%	34%	29%	14%	36%
ABC Operating Profit	232	30	21	-32	-42	-27	182
ABC-and-EVA Economic Value Added	41.2	-58	4.6	-27.2	-32.2	-19.2	-90.8

## References

1. Johnson, H. T. and Kaplan, R. S., 1987, *Relevance Lost: The Rise and Fall of Management Accounting*, Harvard Business School Press, Boston.
2. Cooper, R., 1988, "The Rise of Activity-Based Costing - Part One: What Is an Activity-Based Cost System?," *Journal of Cost Management*, Vol. 2, No. 2, pp. 45-54.
3. Hubbell, W. W., 1996, "Combining Economic Value Added and Activities-Based Management," *Journal of Cost Management*, Vol. 1, No. 10, pp. 18-29.
4. Hubbell, W. W., 1996, "A Case Study in Economic Value Added and Activities-Based Management," *Journal of Cost Management*, Vol. 2, No. 10, pp. 20-29.
5. Roztocki, N. and Needy, K. L., (forthcoming), "Integrating Activity-Based Costing and Economic Value Added in Manufacturing," *Engineering Management Journal*.
6. Stewart, G. B., 1991, *The Quest for Value: A Guide for Senior Managers*, Harper Business, New York, NY.
7. Hicks, D. T., 1992, *Activity-Based Costing for Small and Mid-Sized Businesses: An Implementation Guide*, John Wiley & Sons, New York, NY.
8. Cooper, R. and Kaplan, R. S., 1992, "Activity-Based Systems: Measuring the Costs of Resource Usage," *Accounting Horizons*, Vol. 6, No. 3, pp. 1-13.
9. Johnson, H. T., 1991, "Activity-Based Management: Past, Present, and Future," *The Engineering Economist*, Vol. 36, No. 3, pp. 219-38.
10. Cooper, R., 1989, "The Rise of Activity-Based Costing - Part Three: How Many Cost Drivers Do You Need, and How Do You Select Them?," *Journal of Cost Management*, Vol. 2, No. 4, pp. 34-46.
11. Johnson, H. T., 1992, *Relevance Regained*, The Free Press, New York, NJ.
12. Kaplan, R. S., 1994, "Flexible Budgeting in Activity-Based Costing Framework," *Accounting Horizons*, Vol. 8, No. 2, pp. 104-9.
13. Brausch, J. and Taylor, T. C., 1997, "Who Is Accounting for the Cost of Capacity?," *Management Accounting*, Vol. 78, No. 8, pp. 44-50.
14. Mak, Y. T. and Roush, M. L., 1994, "Flexible Budgeting and Variance Analysis in an Activity-Based Costing Environment," *Accounting Horizons*, Vol. 8, No. 2, pp. 93-103.
15. Mak, Y. T. and Roush, M. L., 1996, "Managing Activity Costs With Flexible Budgeting and Variance Analysis," *Accounting Horizons*, Vol. 10, No. 3, pp. 141-46.

## **Bibliographical Sketches**

Narcyz Roztocki is currently a Ph.D. candidate in the Industrial Engineering Department at the University of Pittsburgh. He received his MS degree in Mechanical Engineering from the Technical University Hamburg-Harburg, Germany. His research interests include Strategic Engineering Management, Activity Based Costing, Economic Value Added, TQM and Performance Measurement Systems. He is a member of ASEM and IIE.

Kim LaScola Needy is an Assistant Professor of the Industrial Engineering at the University of Pittsburgh. She received her BS and MS degrees in Industrial Engineering from the University of Pittsburgh, and her Ph.D. in Industrial Engineering from Wichita State University. She has obtained nine years of industrial experience at PPG Industries and The Boeing Company. Her research interests include Activity Based Costing, TQM, Engineering Management and Integrated Resource Management. Dr. Needy is a Senior Member IIE as well as a member of ASEE, ASEM, APICS, IEEE, SME and SWE. She is a licensed PE in Kansas.