Using the Integrated Activity-Based Costing and Economic Value Added Information System for Project Management

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Abstract

This paper examines the use of the Integrated ABC-and-EVA Information System for the management of new technology projects. The advantages of integrating the Activity-Based Costing system with the Economic Value Added financial performance measure and the positive impacts of this integration on project costing are presented. The effect of the Integrated Information System on overall project performance is discussed. Finally, building on the preliminary findings of its worth and effectiveness, suggestions for future research in using the Integrated ABC-and-EVA Information System for project management are made.

Keywords: Activity-Based Costing, Costing System, Economic Value Added, Information System, Project Management

Introduction

Today, information systems are used in virtually all areas of business. These systems are extremely important because of their ability to accelerate the design and production process while increasing a company's overall efficiency. An information system's components for collection, storage, and retrieval of data, when working together, provide desired information in a specific format and timeframe (Simon, 2001). The "specific format" of this information may be reports, graphs, or charts, which are dispersed to managers who are then able to make more informed decisions about pricing, production, and new product development. Often, the quality and design of the information systems used in an organization decide its level of competitiveness and prosperity.

Usually, a company uses several information systems concurrently. A Human Resources Information System, for example, handles issues related to employees, such as compensation, benefits, work evaluation, and job training. While the Human Resources Information System manages employee records, a Marketing and Sales Information System handles issues related to product marketing, and is often used to track customer buying trends. These two systems are relatively commonplace in today's business environment. Companies which work primarily on "unique" tasks, however, use another information system which is more specifically tailored to their shifting needs.

A company which works primarily on projects (or unique rather than routine tasks), needs a Project Management Information System. This system is used in project planning and scheduling. In addition, a Project Management Information System also aids in project control and serves to answer questions about whether or not a given project is progressing on-time and on budget, and whether or not corrective action is needed (Cleland, 1994).

Cost control is extremely important for project management. If a project's cost runs over its assigned budget, the venture often fails. However, many Project Management Information Systems use a traditional volume-based costing approach to estimate the cost of projects. This approach has a reputation for providing rather unreliable cost estimates and is known to lead to distortions in product cost. Traditional costing is detrimental to the management of technology projects because in a traditional system, overhead consumption is regarded as being proportional to volume. In reality, this is seldom the case.

Given the apparent inefficiency of traditional volume-based costing, the question that arises is why was this system implemented in the first place and what would cause project managers to be drawn to its continued use? The answer is simply that the traditional volume-based approach is the most familiar method of costing and is relatively easy to implement. It is also important to note that traditional volume-based costing was not always a model of inefficiency. When projects were direct labor intensive, and characterized by high material costs and low overhead, the traditional volume-based approach functioned with reasonable accuracy. Now, however, as unique technology projects have become more commonplace, the implementation of a new costing system is necessary to meet the specific needs of these high overhead and high capital cost endeavors.

Activity-Based Costing (ABC), which is designed to more accurately trace overhead costs, is just such a system. Because ABC outperforms traditional volume-based methods in terms of its reliability, some authors have proposed using ABC to trace overhead costs, specifically for projects (Raz & Elnathan, 1999). The ABC system has one major limitation however, which brings its reliability into question.

Though ABC is highly efficient in tracing overhead, it fully disregards capital cost. This is significant, as capital costs can be very high for certain projects, for reasons such as capital demand and level of perceived risk. (The level of risk for a project depends on the uniqueness of the task, resource availability, whether or not a company has had experience with similar projects, and overall project feasibility.) To account for capital cost, some authors have proposed that ABC be combined with Economic Value Added (Hubbell, 1996a; Hubbell, 1996b; Cooper & Slagmulder, 1999; Roztocki & Needy, 1999). Economic Value Added is a performance measure which focuses primarily on capital and capital costs (Stewart, 1991). As a result of this proposal, the Integrated ABC-and-EVA Information System was devised (Roztocki, 2000a). The ABC component of this integrated Information System traces overhead cost, while the Economic Value Added component focuses on capital costs. Because of the integrated nature of this costing system, it is able to account for all types of costs: capital, overhead, and direct. This integrated system has been in use in small manufacturing companies, resulting in more informed pricing policies and more reliable identification of customer profitability (Roztocki, 2000b; Roztocki & Needy, 2000). Its potential in the area of project management has never been fully explored however.

The main purpose of this paper is therefore to present a conceptual model of the Integrated ABC-and-EVA Information System for project management, using a database approach, and to focus the reader’s attention primarily on practical concepts rather than technical details. For that reason, conceptual database design is discussed in greater detail than database management system (DBMS) programming techniques. In addition, the design details in the methodology section have been simplified. Design specific issues about the different types of attributes (stored vs. derived, single-valued vs. multi-valued and the establishment of key attributes, for example), are not discussed. The intention of this paper is to present the essentials of database application for the Integrated ABC-and-EVA Information System in general and applicable terms, while avoiding oversimplification.

Furthermore, the intention of the hypothetical example in the Illustration section is to demonstrate the potential benefits of the Integrated ABC-and-EVA Information System for project management. This paper does not make use of extended case studies, as this system is still a new addition to the field of project management. A current field study would have been inadequately short term, and the inclusion of it, premature. This paper therefore lays a kind of ground-work for those interested in future research, who would ideally examine and test the system through long-term field studies of established companies.

Methodology

The purpose of the Integrated ABC-and-EVA Information System for project management is to trace the three major kinds of costs associated with a project: direct, overhead, and capital. The ABC component of the Integrated Information System is used to trace overhead costs, while the Economic Value Added component is used to trace capital costs. Direct costs are traced directly to a specific project.

Usually, in order to provide good cost estimates for a project-in-progress, a significant amount of data must be collected. One efficient way to collect, store and retrieve data needed for an ABC-and-EVA Information System is by the use of database technology. There are several persuasive reasons for using the database application for cost analysis: high processing speed, data integrity, the ability to share data among many applications, relatively high security, and user-tailored input and output interfaces. A commercial database management system (DBMS) may be used to create and maintain an ABC-and-EVA database. The accuracy of the cost estimates provided by the system, in addition to the quality of the raw data, depends greatly on the nature of the system’s design. The proper design of the Integrated ABC-and-EVA Information System for Project Management is therefore essential.

The process of designing a database for the Integrated ABC-and-EVA Information System, as with those designed for other information systems, begins with an evaluation of the database’s purpose. An understanding of purpose allows for a list of specific requirements to be determined. The database designers may interview prospective users, such as managers, accountants, and engineers, to complete this list. Through these interviews, designers are able to identify technical parameters, such as the demand on user interface, the required level of accuracy, and the degree of security desired. After the requirements for the costing system are determined, the next step is to develop a conceptual model of the database. During this major step (also called "conceptual database design"), an Entity-Relationship (ER) Model is created (Elmasri & Navathe, 2000).

An ER model (also called an ER diagram) graphically illustrates the relationships between various entities. An entity is an item of particular interest in a database. For example, incurring expenses (or costs) could be defined as entities in an ER-model. Projects, too, could also be defined as entities. Figure 1 presents an ER diagram for the Integrated ABC-and-EVA Information System for Project Management.

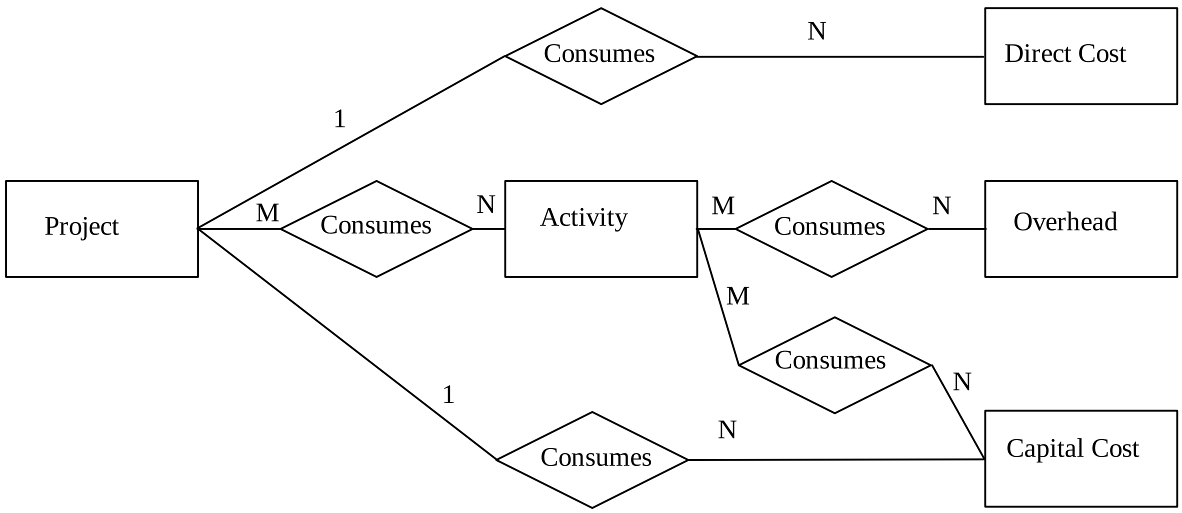

Figure 1. ER Diagram for the Integrated ABC-and-EVA Information System for Project Management

An ER diagram displays data as entities, relationships, and attributes. Entities, sometimes called "things" or "items," are basic elements of an ER diagram. Projects, direct costs, overhead costs, capital costs, and activities are examples of entities in the ER model designed for an Integrated ABC-and-EVA Information System for project management.

Attributes are characteristics which describe entities. Entities which have the same attributes are classified as members of an Entity Type. Since all projects have the same attributes, they are defined as being members of the same Entity Type. For example, each project entity has the same attributes, such as project leader, location, and expected completion time. Because all project entities usually have the same attributes, they can be defined as a *Project* Entity Type.

Usually, the three cost types related to a project (direct, operating, and capital) represent three different Entity Types. All direct costs possess an attribute which associates them directly with a project. For example, direct labor expenses may be associated with software installation for a particular project. Overhead costs do not possess an attribute which associates them with a specific project however. Capital costs are different from either direct or overhead costs as they may have attributes which are specific to capital investments, such as business risks and cash flow factors.

In addition to the *Project* Entity Type and the three Entity Types for each cost category (*Direct Cost*, *Overhead*, and *Capital Cost*), the ER diagram for the Integrated ABC-and-EVA Information System requires a fifth Entity Type: *Activity*. Activities are used as a means by which overhead is traced to projects. In addition, sometimes activities are used to trace capital costs.

All of the five Entity Types are related. The relationships provide information about resource consumption by a particular project. For example, a project may consume direct resources, such as material or direct labor. Therefore, the ER diagram displays a direct relationship between the *Project* Entity Type and the *Direct Cost* Entity Type.

A project also requires overhead expenses for activities, for example, project planning, purchasing, supervision, administration, and final project assessment. In most cases, the relationship between overhead costs and projects is indirect. The incurred overhead costs (those associated with consumed overhead resources) are traced to the projects, according to the ABC approach, in two steps. First, overhead is traced to activities. Then, it is traced to the projects. In other words, within the proposed ER conceptual model, there is one relationship between the *Project* Entity Type and the *Activity* Entity Type, and another between the *Activity* Entity Type and the *Overhead* Entity Type.

In addition to consuming direct and overhead resources, a project also requires the dedication of capital in the purchase of equipment and the keeping of inventory. This capital dedication causes capital costs. A portion of this capital cost is defined as "direct dedicated capital" (Cooper & Slagmulder, 1999) and can be directly traced to a project. For example, capital expenses from acquiring special equipment for a project, or interest paid for receivables dedicated to a particular project, are examples of direct dedicated capital costs. Therefore, in the case of capital costs incurred from using direct dedicated capital, there is a direct relationship between the *Project* Entity Type and the *Capital Cost* Entity Type.

In contrast to direct dedicated capital costs, which can be directly traced to a project, there often exists capital costs which can not be directly traced. The capital, called "indirect dedicated capital" (Cooper & Slagmulder, 1999), results in capital costs that are incurred by many projects collectively. Capital cost for equipment shared by many projects is one example of indirect dedicated capital cost. One way of assigning these costs is to use activities as a medium to trace them. Let us assume that a vehicle is used by a manager who is supervising two or more projects. The activity of traveling to a projects' location can then be used as a means of tracing capital cost associated with financing the vehicle. Indirect dedicated capital costs can then be traced to the project using a capital cost driver, such as the distance from the manager's office to the projects' location. Therefore, in the case of capital costs resulting from "indirect dedicated capital," there is one relationship between the *Project* Entity Type and the *Activity* Entity Type, and another between the *Activity* Entity Type and the *Capital Cost* Entity Type.

Most of the relationships between Entity Types are characterized as being "many-to-many" (M:N). For example, the project of preparing to manufacture a new product may require many activities, such as contacting customers, supervising projects, and purchasing, installing, and testing new equipment. Also, one person may supervise several of a company's projects. Therefore, the relationship between the *Project* Entity Type and the *Activity* Entity Type can be defined as "many-to-many" (M:N). Since one project may consume many direct expenses, and since a specific direct expense is related to only one project, the relationship between the *Project* Entity Type and the *Direct Cost* Entity Type is "one-to-many" (1:N).

After the conceptual ER model of the company's Integrated ABC-and-EVA Information System is designed and refined, the next step, called "logical database design" or "data model mapping," is carried out (Elmasri & Navathe, 2000). This step is the actual implementation of the database, preferably using a commercial DBMS.

Finally, the design process of the Integrated ABC-and-EVA Information System is completed with the "physical database design" step. During this final phase, internal storage structures and file organization for the system are created (Elmasri & Navathe, 2000). After the database design process is completed, the actual implementation of the system follows.

Illustration

In this section, the advantages of using the Integrated ABC-and-EVA Information System are presented. The focus of the following illustration is to show the systems' impact on a company's decision-making process and overall business performance. The data used in the following illustration is drawn from that gathered during several field studies with manufacturing and technology companies. Though simplified for the purposes of this illustration, the data accurately reflects the financial information for the companies' large and small scale technology projects.

For the purposes of this illustration, let us imagine a company which has completed two projects in the past year: Project X and Project Y. These hypothetical projects are similar in purpose and financial data to those of the studied companies. Project X was to implement an information system in a small manufacturing company with less than 50 employees and approximately 5 million dollars in sales per year. This information system was a multi-use information system covering customer management, inventory handling, job scheduling, and accounting functions. The second project, Project Y, was the implementation of a Human Resources Information System in a medium-sized company with approximately 2000 employees and 200 million dollars in sales per year. This information system included the personal data, insurance and benefits information, salary and pay records, and vacation and sick leave times for all employees. Records of each employee's skills and work evaluations were also stored.

The company (let us call them the "NP Technology Group") was very interested in implementing a costing system whose purpose was to perform a post-project evaluation of the financial benefits of Project X and Project Y. The requirements of their system would be to store, retrieve, and process historical data needed for the analysis. Top management would use the system, the demands of which would be only a modest level of accuracy, since the system would provide only a general idea of project profitability.

After the determination of these requirements, a specific conceptual model was designed. In this model, six major business activities were used in order to trace overhead. Table 1 presents these activities. In reality, the "reasonable" number of activities for highly accurate system might be twenty to fifty. However, the need for only a modest level of accuracy in this analysis determined that a reasonable number of activities for the system was six. To learn more about the details of the ABC analysis, interested readers are directed to existing publications on the topic (Cooper, 1988a; Cooper, 1988b; Roztocki, Valenzuela, Porter, Monk, & Needy, 1999).

Table 1. Main Business Activities

Activity	Activity Cost	Project X	Project Y
Acquisition of Hardware	$25,000.00	$15,000.00	$10,000.00
Acquisition of Software	$25,000.00	$15,000.00	$10,000.00
Project Planning	$30,000.00	$15,000.00	$15,000.00
Project Control	$100,000.00	$60,000.00	$40,000.00
Document Preparation	$20,000.00	$10,000.00	$10,000.00
Customer Support	$100,000.00	$35,000.00	$65,000.00
Total	**$300,000.00**	**$150,000.00**	**$150,000.00**

After tracing overhead costs to Projects X and Y, direct costs and overhead (traced by ABC) were subtracted from customer payment, also called revenues. Table 2 summarizes the results of this calculation.

Table 2. Operating Profits

	Project X	Project Y
Revenues	$400,000.00	$400,000.00
Direct Cost	-$200,000.00	-$200,000.00
Overhead Cost	-$150,000.00	-$150,000.00
Operating Profit	**$ 50,000.00**	**$ 50,000.00**

The ABC analysis showed the same operating profits for both projects. Therefore, based on the ABC analysis, it could be assumed that both projects were similarly profitable. However, the ABC analysis, as mentioned before, did not take into account the use of capital to support these two projects.

In order to calculate the average capital usage by both projects, positive and negative cash flows at the end of each month were calculated. Generally, to increase accuracy, a company should consider calculating capital costs on a daily basis. Table 3 presents the calculation of average capital usage for Project X and Project Y.

Table 3. Capital Usage Calculation

	Project X			Project Y		
Month	Expenses	Payments	Balance	Expenses	Payments	Balance
1	-$90,000.00		-$90,000.00	-$55,000.00	$100,000.00	$45,000.00
2	-$100,000.00		-$190,000.00	-$30,000.00		$15,000.00
3	-$30,000.00		-$220,000.00	-$25,000.00		$5,000.00
4	-$30,000.00		-$250,000.00	-$10,000.00		-$5,000.00
5	-$20,000.00		-$270,000.00	-$30,000.00		-$35,000.00
6	-$20,000.00		-$290,000.00	-$30,000.00	$100,000.00	$35,000.00
7	-$10,000.00		-$300,000.00	-$20,000.00		$15,000.00
8	-$10,000.00		-$310,000.00	-$20,000.00		-$5,000.00
9	-$10,000.00		-$320,000.00	-$20,000.00		-$25,000.00
10	-$10,000.00		$330,000.00	-$20,000.00		-$45,000.00
11	-$10,000.00		$340,000.00	-$50,000.00		-$95,000.00
12	-$10,000.00	$400,000.00	$50,000.00	-$55,000.00	$200,000.00	$50,000.00
	Average		**-$238,300.00**			**-$3,750.00**

The average capital usage by Project X and Project Y showed substantial differences. This was the result of differences in capital consumption at the beginning of each project, and differences in the schedule by which payments were received. After the average capital usage was traced to each project, capital costs were calculated using 25% as the interest rate, a rate based on the expectations of NP Technology Group's investors. Table 4 presents the calculation of capital costs for both projects.

Table 4. Calculation of Capital Cost

	Project X	Project Y
Average Capital	$238,300.00	$3,750.00
Capital Cost Rate	25 %	25%
Capital Cost	**$59,570.00**	**$937.50**

In order to calculate the Economic Value Added for both projects, capital cost was subtracted from operating profit. Table 5 presents the Economic Value Added calculation for both projects.

Table 5. Economic Value Added Calculation

	Project X	**Project Y**
Operating Profit	$50,000.00	$50,000.00
Capital Cost	-$59,570.00	-$937.50
Economic Value Added	**-$9,570.00**	**$ 49,062.50**

The Integrated ABC-and-EVA Information System revealed that the Economic Value Added for Project X was negative, while the Economic Value Added for Project Y was positive. The main reason for this difference was the relatively high capital cost associated with Project X. The information provided by the Integrated Information System was also different from that provided by the ABC analysis alone, which suggested that both projects had the same operating profit.

There are several messages delivered by the ABC-and-EVA analysis that could be useful to NP Technology Group's project management, which, when transformed into action, could improve their overall business performance. First, the managers could actively employ the results of the ABC analysis to investigate opportunities for improvement. The business activities "Project Control" and "Customer Support" (See Table 1) consumed a substantial amount of overhead resources, which was mirrored in the costs of those activities. Project management might, for example, examine what caused this significant consumption of overhead resources. A thorough examination of these activities might reveal opportunities for future cost reduction.

Second, the managers could derive further use from the capital cost information (See Table 4 and Table 5). The profitability analysis revealed a negative Economic Value Added for Project X, which was a direct result of delayed customer payments. For future projects and customers, project management might therefore consider introducing more incentives (either positive or negative) to pay on time.

The most important realization, however, is that even a well-designed Integrated ABC-and-EVA Information System, delivering the most reliable cost information, will not carry out improvements by itself. Rather, project managers, once armed with the System's reliable cost information, are challenged to interpret it correctly and act decisively.

Conclusions and Recommendations for Future Research

As shown in the previous example, using the output of the ABC-and-EVA database is advantageous in tracing both overhead and capital costs. This potential is wasted, however, if the database designers use a traditional volume-based approach. Therefore, database designers who intend to create a costing information system for project management would benefit from using a modern and more comprehensive approach, such as the Integrated ABC-and-EVA Information System.

Overall, the proposed system appears especially useful for projects experiencing high overhead and high capital cost. If a company is working with projects where direct costs are relatively low, for example, managers should seriously consider implementing the system. This highly accurate costing and performance measure would provide management with the reliable cost information needed to guide the course of a project. Armed with this information, project managers would be better able to act decisively on their companies' behalf.

Looking toward the future of the Integrated ABC-and-EVA Information System, there are many opportunities for further research related to the preliminary explorations in this paper. One possibility would be to implement the system in a company engaged with multiple technology projects, monitoring its performance over a longer period of time. This would provide researchers with the opportunity to gain practical findings about long-term use of the system. Another possibility would be to track the use of this system in a greater number of technology companies. During this extended field study, an extensive amount of data could be collected, allowing statistical tests to identify particular project characteristics (and therefore particular companies) for which the proposed system could be especially advantageous. These are just two of the many suggestions available for interested researchers, options which would ideally build upon the ideas and proposals presented in this paper.

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