THE ENABLING ROLE OF ABC SYSTEMS IN OPERATIONS MANAGEMENT
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# THE ENABLING ROLE OF ABC SYSTEMS IN OPERATIONS MANAGEMENT

**This article provides an overview of activity-based accounting systems and develops a spreadsheet-based ABCM model of a hypothetical company. It also discusses real world applications of ABC in various areas of the operations functions.**

MAHESH GUPTA AND SIDNEY BAXENDALE

Cost accounting measurements and information help management assess the profitability, effectiveness, and efficiency of sub-segments of a company such as products, processes, and departments.[1] Accurate cost information is critical for every aspect of a business, from its product designs to its pricing policies to its performance reviews.

Over the last few decades, there has been growing doubt about the efficacy of managing modern manufacturing operations with traditional cost accounting systems. In today's technologically advanced organizations, overhead costs tend to vary on the basis of product diversity, product volume, and complexity of operations. Traditional cost accounting systems focus on uni-dimensional overhead application, which rarely reflect the product diversity or complexity of operations. Johnson and Kaplan were perhaps among the first researchers to discuss the mismatch of traditional cost accounting measures with new manufacturing practices.[2, 3, 4, 5] Cooper and Kaplan proposed activity-based costing (ABC) as an alternative to support the emerging management programs (e.g., total quality management) and especially to deal with the impact of overhead on true cost information.[6] During the past decade, many U.S. companies such as Tektronix, John Deere, Schrader Bellows, and others have adopted ABC as a strategic tool that can help them understand and improve their business processes.

Activity-based costing is an accounting information system that traces the cost of each activity such as purchasing, receiving, engineering, production, inspection, marketing, and distribution to the products that benefit from the activity. Activity-based cost management (ABCM) systems use ABC information to improve products and processes by correctly identifying product costs, possibly revising product prices, eliminating non-value-added activities, reducing cycle time and, above all, improving overall profitability of the companies.[7]

The purpose of this article is to demonstrate that an ABCM system enables managers to make operational decisions and improve business processes by providing an integrated view of the organization. More specifically, a generic conceptual framework is used to synthesize activity-

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**Exhibit 1** The Product-Process Flow Chart

based cost accounting literature (real-world applications) published in the last decade or so on various operations decisions such as product planning, management and control of quality, process selection, capacity planning and scheduling, inventory management, and work force management. A spreadsheet-based ABCM model for a hypothetical company is developed, which then is used throughout our discussion along with real-world applications of the ABCM system in the operations function.

**A hypothetical case study:** The PQ company. Goldratt describes a hypothetical company that consists of four operations and produces two products.[8] The goal of this company is to maximize profits. We will use this case study first to illustrate the basic concepts of activity-based accounting system and then to illustrate the usefulness of the ABCM system in the operations decision-making process.

The process flow chart is shown in Exhibit 1. Each week, there is a maximum demand for 100 units of product P and fifty units of product Q. Product P is assembled at process D by assembling one part that is purchased at the cost of $5, and two parts that are manufactured in-house. Each of the manufactured parts for product P is processed from purchased raw materials, RMI and RM2 (each at a cost of $20 per unit), and each undergoes distinct processes before they are assembled at activity D. For example, one unit of RMI is processed by an activity A for fifteen minutes and then it is processed by activity C for ten minutes. Exhibit 1 also shows that activities are used interchangeably in order to manufacture P and Q products. For example, one unit of product Q consumes ten minutes of activity A, thirty minutes of activity B (fifteen minutes on RM2 and fifteen minutes on RM3), five minutes of activity C, and five minutes of activity D.

In addition to the cost of raw materials and purchased parts, it takes $6,000 each week to operate this system. Goldratt states that the operating expense of $6,000 includes the salaries of the



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foremen, the company's salespeople, management, and the money that is paid to the utilities for energy and to the banks for interest.

## An overview of accounting systems

In the mid-1980s, ABCM systems were viewed as a supplement to the standard cost system. At that time the emphasis was on the cost assignment view. Such ABCM systems were designed primarily to lead to modifications in the *external* marketing strategy of the firm by more accurately determining product costs.[9, 10]

The cost accuracy problems were particularly acute where there was capital intensity as a result of automation and technology, as well as a large number of products making diverse demands upon the support services represented by the overhead costs. Activity-based costing, after tracing the costs of resources to activities and then attributing the activity costs to products or other cost objects such as customers, revealed that the traditional product costing systems tended to over-cost the standard, high-volume products and under-cost the specialized, low volume products. Activity-based costing remedied that situation by attributing the costs of activities to specific products based on the varying degree to which those products used the activities.[11, 12] The more accurate cost information associated with activity-based costing permitted improved understanding of product profitability, which was essential to develop sensible marketing strategies. Activity-based costing was used to aid in making product pricing, product promotion, and product retention decisions.

Although product costs are more reliable under this ABCM system compared to the traditional (i.e., standard) costing approach, the main problem with this early ABCM approach is that product costs fluctuate with changes in the number of units produced. The system allocates activity costs to the product costs based on the actual number of units produced and thus, the costs of unused capacity are also allocated to the product costs. Cooper and Kaplan[13] and Cooper and Slagmulder[14] suggested a variation to this approach that isolates the costs of unused capacity from the product costs and thereby more accurately measures the costs of resources used in the organization's processes to produce the products.

## The process improvement view: A capacity-adjusted ABCM system

In recent years, the emphasis has shifted from the use of activity-based information for more accurate product costing to its use for the improvement of processes. With the advent of the need for continuous improvement, the information about activities and their costs can play an important role in focusing attention on improvements in activities (a process is merely a chain of activities). The activity view permits the identification and elimination of non-value-added activities.[15, 16, 17]

Cooper and Kaplan stated that unused capacity costs should not be included in the product costs.[18] If the practical capacity of the activity can be specified, then a planning model can be created. The planning model then reveals the product cost for each product as well as the unused capacity costs for each activity. Although most of the activity costs are fixed costs, changing the number of units of a product does not result in a change in the per-unit product cost. However, a change in the number of units produced does change the unused capacity costs associated with each activity in the production process and thus, provides a focus for further improvement of processes. This capacity-adjusted ABCM system provides much more complete and stable cost information about the manufacturing environment and the products manufactured.[19] Exhibit 2 shows this capacity-adjusted ABCM model for the PQ Company; and the model development process is discussed in the following section.

## ABCM model for the PQ company

In the PQ Company, operating expenses of $6000 are given and it is possible to

**THE EMPHASIS HAS SHIFTED FROM THE USE OF ACTIVITY-BASED INFORMATION FOR MORE ACCURATE PRODUCT COSTING TO ITS USE FOR THE IMPROVEMENT OF PROCESSES.**



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**Exhibit 2** ABCM System for the PQ Company

***Panel 1: Activity Costs, Capacity and Charging Rates***

| Activities | Weekly Costs ($) | Practical Capacity (Minutes) | Charging Rates ($) |
|---|---|---|---|
| Activity A | $300.00 | 2400 | $0.1250 |
| Activity B | $4,800.00 | 2400 | $2.0000 |
| Activity C | $400.00 | 2400 | $0.1667 |
| Activity D | $500.00 | 2400 | $0.2083 |

***Panel 2: Processing Times***

| Particulars | Product P | Product Q |
|---|---|---|
| | Min/Unit | Min/Unit |
| Factor for activity A | 15 | 10 |
| Factor for activity B | 15 | 30 |
| Factor for activity C | 15 | 5 |
| Factor for activity D | 15 | 5 |

***Panel 3: Per Unit Product Profitability***

| Particulars | Product P | Product Q |
|---|---|---|
| Sales revenue per Unit | **$90.00** | **$100.00** |
| Purchased parts | $5.00 | $0.00 |
| Raw material 1 | $20.00 | $0.00 |
| Raw material 2 | $20.00 | $20.00 |
| Raw material 3 | $0.00 | $20.00 |
| **Total Material costs** | **$45.00** | **$40.00** |
| Activity A Cost (Charging rate* minutes per unit) | $1.88 | $1.25 |
| Activity B Cost (Charging rate* minutes per unit) | $30.00 | $60.00 |
| Activity C Cost (Charging rate* minutes per unit) | $2.50 | $0.83 |
| Activity D Cost (Charging rate* minutes per unit) | $3.13 | $1.04 |
| **Total Activity costs per unit** | **$37.50** | **$63.13** |
| Product Cost (Material + Activity) | $82.50 | $103.13 |
| Profit per unit | $7.50 | ($3.13) |

***Panel 4: Income Statement***

| Particulars | Product P | Product Q | Unused Capacity | Total |
|---|---|---|---|---|
| **Unit Sales** | **100** | **50** | | |
| Sales Revenue | $9,000.0 | $5,000.0 | n/a | $14,000.0 |
| Total Material costs | $4,500.0 | $2,000.0 | n/a | $6,500.0 |
| Activity A costs (per unit cost*unit sales) | $187.5 | $62.5 | $50.0 | $300.0 |
| Activity B costs (per unit cost*unit sales) | $3,000.0 | $3,000.0 | ($1,200.0) | $4,800.0 |
| Activity C costs (per unit cost*unit sales) | $250.0 | $41.7 | $108.3 | $400.0 |
| Activity D costs (per unit cost*unit sales) | $312.5 | $52.1 | $135.4 | $500.0 |
| Total Operating Costs (Activity costs) | $3,750.00 | $3,156.3 | ($906.3) | $6,000.00 |
| Total Product Costs (Material+Activity) | $8,250.00 | $5,156.25 | | $12,500.00 |
| Total Profit (Revenue - Product Costs) | $750.00 | ($156.25) | $906.25 | $1,500.00 |

***Panel 5: Capacity Analysis (minutes per Week)***

| Particulars | Product P | Product Q | Unused Capacity | Total |
|---|---|---|---|---|
| Activity A | 1500 | 500 | 400 | 2400 |
| Activity B | 1500 | 1500 | (600) | 2400 |
| Activity C | 1500 | 250 | 650 | 2400 |
| Activity D | 1500 | 250 | 650 | 2400 |



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trace the operating expenses (or overheads) of $6,000 to the four activities (A, B, C, and D) by using account analysis techniques and interviewing operating employees. It is also assumed that the practical capacity of each of the four activities is 2,400 minutes per week. A charging rate for each activity is calculated by dividing the operating expenses of each activity by the practical capacity of each activity (see Exhibit 2, Panel 1). This information on the charging rate along with the information regarding he processing time requirements on various activities (see Exhibit 2, Panel 2) is then used to attribute the overhead costs to the products to determine product costs. Panel 3 shows the composition of per unit product costs in terms of material costs and activity costs. Raw material costs are extracted from Exhibit 1 whereas per-unit activity costs are calculated by multiplying charging rates (Panel 1) by the processing times (Panel 2) of activities. Panel 3 also calculates per-unit profit of each product by subtracting the product cost from the unit selling-price. Because the charging rates were based on the practical capacities of the various activities, the cost per unit will not change with a change in the number of units produced. Thus, this ABCM system provides the capability to capture the cost of the unused capacity in each of the activities (see Panels 4 and 5).

Panel 4 provides an income statement if the production of 100 units of product P and fifty units of product Q is assumed. If this product mix can be produced, the company will realize a total profit of $1500. However, notice that activity B has a negative unused capacity of $1,200 (Panel 4) or 600 minutes (Panel 5). The negative unused capacity indicates that the current product-mix is not feasible.

However, ninety units of product P and twenty-five units of product Q would require only 2,100 minutes (15*90 + 30*25) of the 2,400 available minutes for Activity B. The unused capacity in Activity B would have been 300 minutes. Therefore, the cost of those unused capacity minutes would then be 300 minutes multiplied by the charging rate per hour of Activity B ($2.00 per minute per Panel 4) for a total of $600 for the week. This same approach could be used to reveal the unused capacity costs associated with each of the activities. In the following section, the PQ Company and the associated capacity-adjusted ABCM model is used to demonstrate the model's applicability to many areas of operations management.

## ABCM system: An enabler of operations management

*Operations management* is the study of decision making in the operations function. The major decision responsibilities of operations managers include designing products and services, assuring quality, planning the production processes, designing the facility layout, managing inventories, and tailoring jobs to effectively manage human resources.[20] The next section discusses the enabling role played by the activity-based accounting system in each of these major operations management decisions is discussed using the real world examples as well as the ABCM model of the hypothetical company (i.e., the PQ Company).

**Product pricing and mix decisions.** One opportunity for operations management to use ABCM systems as a strategic tool is the accurate identification of the demand variation between product offerings and their related profitability. Activity-based systems can help management reduce costs and improve profits in the short or medium term by altering the product mix. Profitability can be improved by correctly pricing the products and eliminating products which use an unusually high amount of cost drivers associated with constrained resources, or through redesigning complex products so they use less costly drivers in the manufacturing process. Additionally, an optimal product mix may be determined by optimizing the available resources and given market demand for the products.

The PQ Company can be used to demonstrate product pricing and mix decisions. The information provided concerning the PQ Company is capable of being optimized by establishing mar-

**ACTIVITY-BASED SYSTEMS CAN HELP MANAGEMENT REDUCE COSTS AND IMPROVE PROFITS IN THE SHORT OR MEDIUM TERM BY ALTERING THE PRODUCT MIX.**



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**AN ABCM SYSTEM PROVIDES OPPORTUNITIES FOR CLEARER COMMUNICATION BETWEEN FUNCTIONAL AREAS ON THE ISSUES OF PRODUCT DESIGN.**

ket constraints on the quantity of product demanded. If we assume that the maximum weekly demand for Products P and Q were 100 and 50 units respectively (see Exhibit 1), it is possible to optimize the ABCM model and determine the product mix that will yield the greatest total weekly profit given the market demand and given that none of the activities may use more than 2,400 minutes per week.

That optimal product mix is 100 units of Product P and thirty units of Product Q. At that product mix, the total company profit is $300/week. The optimal solution is obtained by using Microsoft Excel's Solver feature, which performs the optimization of the PQ Company on the computer model. The optimal solution results in Activity B having no unused capacity. Thus, 100 units of P and thirty units of Q use all of the capacity of Activity B. The other activities have some unused capacity at the optimal solution.

In an organization with complex product offerings, cost assignments are more involved because product complexity often results in high overhead costs incurred for activities such as supervision, quality control, equipment maintenance, and production control. Activity-based systems can better identify the costs arising from product complexity, and managers can use that improved cost information to influence alternative product design choices.

In the PQ Company, the ABCM model provided more accurate product costs because the overhead costs were allocated more systematically (see Panel 5 of Exhibit 2), providing information for more effective pricing strategies. These benefits are even greater as the product complexity and incurred overhead costs increase.

Christensen and Sharp suggest that the ABCM system can also be used successfully for short-term product pricing decisions.[21] Not all product pricing decisions are long term strategic decisions. Some examples are negotiating prices for special orders, pricing an existing product which has lost value in its original market, and pricing a product in the declining stage of its product life cycle.

**New product development and design.** Product design should be a group process with input from all functional areas, including marketing, operations, and finance. Traditionally, each of these areas tends to view product design from its own perspective. The ABCM system assists the process of synthesizing these different perspectives by identifying specific cost drivers. For example, setup times may be a significant cost driver not recognized by cost accounting. However, the setup changes might only be required for a relatively minor feature that marketing added as a "bonus" or afterthought, but does not have a significant impact on the product's desirability. Once this driver is recognized, product design can be modified with the goal of lowering costs and providing better value through reducing or eliminating unnecessary setup changes.

In this way, an ABCM system provides opportunities for clearer communication between functional areas on the issues of product design. A product engineer described the impact of ABCM on Hewlett Packard's Roseville Network Division's new product development process as follows:

> We created a lot of tighter relationships among accounting, research and development, manufacturing, and marketing. We were all learning about the business. We have broken the back of the cost system design problem and are now refining it and our intuitions about the economics of product design. Overall, the whole experience forced us to understand our design process.[22]

In the PQ Company, the information regarding unused capacities is a significant piece of information as management seeks to meet customer needs at the lowest possible cost. In the optimal solution, activities A, C, and D have unused capacity. Because Activity B has no unused capacity, any design revision to either product that would reduce the demands on Activity B would increase the unused capacity of Activity B. With unused capacity in all activities, marketing would be better prepared to meet the demand for new or existing products. Because of the unused capacities, the incremental cost of production would be minimal.



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Due to competitive pressures, corporations add more features and design more complex products which results in high manufacturing overhead costs incurred for such activities as quality control, inspection, machine and tool maintenance, and production control. ABCM systems can also be used to inform the product designers about the cost implications of alternative designs. Banker et al. described an innovative enhancement to ABCM system development process which analyzes the determinants of activities in terms of product and process design features.[23] They investigated a division of a leading automobile manufacturer that produces a variety of rear, park, signal, and other lamps for a wider variety of automobiles and trucks. Their analysis focuses on the complexity factors (e.g., number of moving parts, length of components, multicolor molding, and number of rejects) that drive costs in the current manufacturing environment—i.e., as processes and product mix change, these factors may also change. Thus, this enhancement can be used to determine product costs and other implications for the operations function if the company is introducing product and process designs. They concluded that efforts to reduce the support service costs should start at the new product design phase.

**Make-buy decisions.** The ABCM systems calculate the value of not only those costs or activities incurred to produce a product, but also those that would be saved if a product or component were obtained elsewhere. Because the product cost is more accurately known, when an ABCM system is used, management is in a better position to emphasize a reduction in the total product cost through improved arrangements with the suppliers, leading to strengthened supplier relationships. The activity-based system provides operations managers with relevant internal data needed to decide whether to make or buy various parts/components, strengthening the sourcing policy of a firm.

Such systems also provide information regarding the availability of effective production capacity and regarding any technological restrictions. For example, a vertically integrated plumbing fixture manufacturing company used the activity-based system, among other things, to review its sourcing policy. The ABCM-based insight helped the company decide to outsource some low-volume parts and high-cost activities, thus freeing capacity to meet increased demands for existing or new products.[24] Banker et al. also demonstrated how their enhancement to ABCM system (as discussed earlier) helped operations managers in "make-buy decisions" i.e., they found that non-complex and simple products were over-costed by existing accounting systems; and competitive analysis would unduly penalize in-house production.

**Quality management and control.** The ABCM system, which is compatible with the continuous improvement philosophy, provides information about each process or activity (through which a product moves) as a potential area for improvement, attention, and control. Since quality can only be improved by identifying causes and reducing variations, ABCM necessitates input from all levels of workers, and it breaks down the barriers between them. The ABCM system has been recognized as the most powerful tool in assessing the cost of not doing things right the first time (which may account for between five percent and thirty-five percent of profits). The ABCM system highlights this area by attaching costs to activities to quantify the quality costs through quality measurement systems that are comprised of: i) prevention costs (e.g., unreliable supplier related costs); ii) appraisal costs (e.g., inspection); iii) internal failure costs (e.g., scrap and rework); and iv) external failure costs (e.g., correcting errors and complaints after delivery).

A large telecommunication company provides an example of how the ABCM system can help managers improve quality and efficiency. After performing an activity analysis of all the positions in the company, it was determined that approximately thirty percent of personnel time was spent on rework. This activity had not been identified on the

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**ABC DATA CAN ASSIST IN EVALUATING COMPETING PROPOSALS IN ADDITION TO PROVIDING MORE ACCURATE COST JUSTIFICATION INFORMATION.**

customary reports using traditional accounting data and was thus never questioned. Following the analysis, the causes were traced and eliminated. After that, almost one fourth of the shop's workers became available for other activities.[25] ABCM simplified the determination of the cost of quality by revealing such activities and their costs-information that could then be used to detect and correct costly activities.[26]

In the PQ Company, the optimization of the model revealed that 100 units of Product P and thirty units of product Q would be the optimal product mix. With that product mix, activity B had no remaining unused capacity. All of the other activities still had some unused capacity. The process view of the ABCM system might suggest that activity B be reexamined in terms of the tasks that are linked together in activity B. A reexamination might reveal that the cost of activity B is so high because much rework happens in that activity. ABCM provides previously unavailable accounting information to permit focusing on those activities that have costly quality problems. Often, if management knows the cost of an activity, the fact that the activity is a constraining activity and contains a high proportion of non-value-added tasks, would be sufficient impetus to act swiftly.

ABCM scholars and practitioners have noted that ABCM systems should be viewed primarily as a powerful support system to implement *total quality management* (TQM) and to strengthen the operations strategy of a company by measuring its process improvements and customer satisfaction efforts.[27]

**Capacity planning and scheduling.** ABCM systems supply a critical link in capacity decision making, because decision variables are often significantly different from those of the traditional standard product costing perspective. Long-term capacity decisions involve choices between alternate uses of resources. Bottlenecks caused by inadequate or outdated equipment can be identified using ABC data. New technologies are often expensive, and many companies require detailed justification proposals. ABC data can assist in evaluating competing proposals in addition to providing more accurate cost justification information.

Furthermore, activity-based systems estimate the costs of various resources used to perform the activities producing the products/services and systematically show how activity usage varies with the demands made over a period of time.[28] Operations management teams, therefore, can make informed capacity-related decisions either to use the available capacity to support a higher volume of business (i.e., by processing more throughput) or to reduce spending on resources (i.e., by eliminating the unused capacity). Additional capacity can also be created by reducing the length of time required by activities, which can then either be diverted to other products (to increase throughput) or eliminated. Cooper and Kaplan also noted that unless a firm redeploys or eliminates unused capacity, profits are not likely to increase. Information on the capacity unlocked through reengineering efforts can also be valuable at the planning and budgeting stage.[29]

In the PQ Company, activity B was identified as the constraining activity when the product mix was optimal and also the extent of unused capacity in the other activities was revealed. Once the processes in activity B have been improved as fully as possible, it might be useful to consider increasing the capacity of activity B by acquiring more capacity. The ABCM model can provide the information necessary to evaluate the economic feasibility of acquiring more capacity for activity B.

**Inventory management.** Due to capital and customer delivery aspects, inventory management is an important operations management function. The objectives of these two aspects often conflict, because the cost of carrying inventory must be balanced against the maintenance of comfortable levels of operational efficiency and customer-service capacity. The ABCM system can help identify some of the reasons for inventory buildup (e.g., if purchasing is rewarded on getting better discounts or if units are evaluated based on production volume). The ABCM system supports measures that place empha-



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sis on the whole firm, not the individual units or departments, and thus making it more feasible (from a unit/department's viewpoint) to lower inventory levels. For example, in an ABCM pilot study carried out at Lord Corporation, numerous revealing insights were found in the company's cost structure and recognition system. "It only made sense that a ten cents per part should take a penny's worth of overhead, as our standard cost system used to show." What ABCM system revealed was that even those inexpensive parts were being purchased, received, inspected, and stocked in a manner that created significant costs.

Particularly hard hit were low-cost, low-volume parts.[30] In another case study, Western Zirconium—the Commercial Nuclear Fuel Division of Westinghouse (the 1988 Baldridge awardee)—used activity-based systems for understanding and analyzing the various activities and their related costs. As a result, the company was able to reduce its work-in-process inventory from $12.3 million to $4.2 million, increase its first-time product acceptance from thirty-four percent to ninety-two percent, and reduce its production elapsed time from forty-five days to ten days.[31]

In the PQ Company, there is no inventory to use as a basis of explanation. However, using an ABCM system, operations managers would be in a better position to isolate the costs of managing the inventory. Once those costs have been isolated, it would be possible to analyze the various tasks that are associated with inventory management. The assignment of costs to the tasks, the categorization of tasks as non-value-added or value-added, and the calculation of the cost-per-performance measure for each of the tasks are specific means of focusing the process improvement efforts of the company. Through benchmarking and focusing on the cost-per performance measure, one could identify those tasks or series of tasks that might benefit from re-engineering.

**Material requirement planning.** Information about cost drivers can be an effective and efficient way to differentiate product costs. If the company already maintains a material requirement planning (MRP) system, most cost driver information is probably already available. Output from ABCM systems provides a bill of activities, materials and routing information indicating the raw materials, the number of required setups, and the number of material moves. Therefore, implementation of an ABCM system would facilitate the addition of an MRP system (or vice versa) since both utilize much of the same information.[32]

In the July 1995 issue of *Industrial Engineering* magazine, a comprehensive listing of MRP software packages and specifications was presented along with the complete addresses of the vendors. It is interesting to note that out of approximately 107 MRP software vendors listed, more than ninety percent of the vendors stated that their software provides an interface with accounting functions in general, and about fifty percent of their software has a direct interface with activity-based costing concepts and principles.

**Just-in-time (JIT) philosophy.** Firms using JIT manufacturing also question the wisdom of traditional cost methods, which have a neutralizing effect on JIT benefits, e.g., the allocation solely on the basis of machine time encourages overproduction. Such inefficiencies may lead to items produced earlier than required, long lead times, inspection programs, and resistance to improvement. These objections can be addressed through ABC's tracing of activities. JIT philosophy also uses non-financial information available from the activity-based systems to identify the causes of inventory buildup and to accelerate rectification.[33]

Hedin and Russell found that the degree of JIT implementation in production is related to the extent to which JIT and the accounting system are integrated.[34] Before a JIT program is implemented, both the production system and the accounting system should be analyzed for compatibility. Thomas and Mackey reported an innovative cost management system implementation at Ditch Witch, a company where an activity-based accounting system was applied to the production activities within a JIT manufacturing cell (i.e., focused fac-

**INFORMATION ABOUT COST DRIVERS CAN BE AN EFFECTIVE AND EFFICIENT WAY TO DIFFERENTIATE PRODUCT COSTS.**



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**ABC INFORMATION CAN BE USED TO DETERMINE HOW BEST TO STRUCTURE PROCESSES.**

tory).[35] Ditch Witch used socio-technical systems analysis (STSA) techniques to identify resources consumed within each production activity and to design the cost accounting system that provides activity-based source cause cost variances at the shop floor level.

O'Guin also found that implementing ABCM systems drives a company toward JIT philosophy and toward operations streamlining.[36] Activity-based costing justifies product-line reductions and manufacturing configuration changes. This, in turn, provides support for a "focused factory strategy," which is critical to the competitiveness of U.S. companies. O'Guin noted that without activity-based costing, the author could never have convinced the client (Super Faucet) of this dependency.

**Process structure and design.** ABC information can be used to determine how best to structure processes. Using the data reports about every activity and material in the production chain, managers can determine how best to structure line-flow processes to realize the ultimate profit before implementation. The availability of information often spurs awareness and interest in improving processes and eliminating non-value-added activities. The implications do not stop at the management level, since lower-tier workers are the ones who benefit most through seeing how their work relates, intangible form, to other value adding activities in the chain. The broader picture and the significance of work done at each station are made clear, and the ownership of processes is established.

Applications of ABCM are not, however, generic. A different set of decision parameters evolves to suit each unique situation within the general guidelines. This, in turn, enables management to make better product and customer rationalization decisions and understand process economics and model production volume changes. A well-managed operation is characterized by factors such as dependability, flexibility, and efficiency. Identifying redundancies, reducing non value-added activities, and decreasing setup time and activities of products are some aspects of the process restructuring facilitated by ABC-generated information. The delivery time to customers is also often reduced after a firm adapts ABC, as a result of its better management of activities and its reduction or elimination of time spent on non-value-added activities.[37]

The PQ Company provides an ABCM model that is useful to evaluate the unused capacity impact of various scenarios. Because activity B is the constraining activity when 100 units of P and thirty units of Q are produced, it should be the focus of any process improvement efforts to free up capacity for increased sales. If the processing time for Product Q in activity B were reduced from thirty minutes to twenty-five minutes, the thirty units of Product Q would require 750 minutes rather than the 900 minutes currently required.

The freed-up capacity would permit the manufacture of five more units of Product Q or ten more units of Product P (Product P requires fifteen minutes at activity B). If one assumes that sales could be increased to those higher levels at some cost in advertising and promotion, one could evaluate the incremental profit potential of that process improvement. Traditional product costing approaches would not have revealed the impact of the process improvement so clearly. Instead, the total cost of $6,000 per week would have been spread over fewer minutes (assuming no change in unit sales) and the cost per unit of product would have increased. Using the ABCM system, the process improvement in activity B would cause the cost of Product Q to decline and the unused capacity of activity B to increase. As can be seen in this example, ABCM information is far more useful in coordinating operations and marketing management decisions than traditional cost accounting.

**Process design.** The activity-based system is a superior method because it develops cost drivers and uses much of the information in a manufacturing environment. Many software systems are being created to help the detailed process become less complicated. ABCM systems can be used both by pure cell manufacturers as well as those combining job shop and cellular manufacturing (CM).



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CM is a reconfiguration of a job shop into mini-assembly lines that manufacture similar products. The mini-lines, called cells, are based on the concept of group technology.[38] Each cell, based on the product mix, will have a unique ABC information flow. The distinction between direct and indirect costs disappear in cellular manufacturing, since each cost can be traced to a particular cell, not to the individual products in a family, giving an obvious advantage over traditional accounting methods.

The use of cellular manufacturing blurs the distinction between activity-based costing and traditional costing. In a cellular-manufacturing environment, the resources are dedicated to only one product. With only one product, there is no problem in determining product costs. One need only divide by the total cost of production into the total quantity produced. Because all costs are direct costs in a cellular manufacturing environment, there is no need to concern oneself with the allocation of shared costs among multiple products. On the other hand, activity-based management may play an important role in focusing on opportunities for process improvement in a cellular manufacturing environment.

In the PQ Company, if we were to drop Product Q, we would have a focused factory manufacturing only Product P. The analysis of the cost drivers for each activity, the cost of each activity, and the performance measures for each activity would still permit a company to identify the activities and related tasks that have the greatest potential for process improvement. Just the fact that the cost per minute for activity B is $2.00, whereas the other activities have costs that are less than $0.21 per minute, suggests that activity B is one that should be examined for potential process improvement. Activity B would be broken into tasks and the cost of each of the tasks should be determined. Then the cost driver and performance measure of each task identified. This information, combined with benchmarking information, would identify the nonvalue-added tasks that are performed in activity B. Once those non-value-added tasks have been identified, management may undertake a reengineering effort to enhance the process and free up capacity in activity B.

**Facility layout.** Decisions regarding facility layout are evaluated in terms of its contribution to productivity as measured by cost, quality, flexibility, and delivery. The information provided through cost drivers has been instrumental in the re-designing of layouts at a number of companies, resulting in greater operational efficiency through simpler machine loading and scheduling, decreased waiting and throughput time, and lower in-plant transportation costs.[39] Baxendale and Gupta have demonstrated how the unused capacity in the labor activity of a silk-screen printing company prompted the management to rearrange the process layout to minimize the amount of time the production laborers would need to interrupt their workflow to walk from one machine to another.[40] The recognition that the labor activity was the constraint prompted management to focus their process improvement efforts on creating some unused capacity in the labor activity in order to be able to produce and sell more products without increasing operating expenses.

## Workforce management

The management of the workforce, in the context of the operations function, is concerned with maximizing performance within the applicable organizational constraint(s). Accountability precedes authority for decision-making. Departmental managers or front-line workers are approached to determine exactly what causes specific activities. ABC's translation of cost factors into processes and activities supports benchmarking operations such as job enrichment and employee empowerment, since it provides a clearer vision of each employee's contribution to the bottom line. ABC helps to change the roles and responsibilities of managers and workers. The former are no longer the sole decision-makers. As information is made available to the workers, redistribution of the decision-making authority occurs, enabling workers to understand their jobs more

**ABC HELPS TO CHANGE THE ROLES AND RESPONSIBILITIES OF MANAGERS AND WORKERS.**



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**ACTIVITY-BASED COST MANAGEMENT SYSTEMS REORIENT ORGANIZATIONS TOWARDS UNDERSTANDING AND MANAGING WORK PROCESSES.**

clearly and assume responsibility. Managers are released to concentrate on other strategic value-added activities. ABCM also assists in establishing and evaluating performance measures. The primary objective is the workers' acceptance of accountability for their part of the value chain by exploiting the awareness, knowledge, and insights gained. McNair et al. noted that new manufacturing methods such as JIT manufacturing have exposed the informational and motivational shortcomings of traditional accounting systems.[41] Feedback, in the form of standard cost variances, has been counterproductive. Other financial reports—such as profit and loss statements, budgets, and margin analysis—have been too aggregated, too late, and too one-dimensional to be useful to operations managers.[42]

ABCM enables the development of a system of performance evaluation based on more nonfinancial and operating measures such as cycle time, order backlog, throughput time, order cycle time, customer satisfaction, and productivity. For the operations function, such information could be vital to assess who controls and monitors performance, which may lead to a redistribution of authority (to include previously uncontrollable factors). This, in turn, results in higher job satisfaction, improved quality, and a lower turnover rate among employees.[43] By tying ABC data to financial data, McNair et al. also stress building a performance pyramid to communicate shop floor successes (such as reduced lead time, zero defects, or increased customer satisfaction) to top management in addition to the standard financial indicators.

Through the identification of operational controls and factors that deter performance, ABC information enables more reliable actions and measurements. ABCM systems can have a significant impact on a firm's employees, particularly in the areas of employee empowerment, worker accountability, roles and responsibilities, and performance measurement. In order to stress the significance of workforce involvement, Turney suggested a "workforce activity-based management" (WABM) group process.[44] WABM combines the power of ABCM information systems with tools (such as storyboards, dots, yam, and other items) that visually represent information. In this group process, work teams have a clear focus, a set of complete and measurable goals, and, most importantly, a simple set of tools for documenting, measuring, and improving their activities within the overall process. Thus, the WABM group process has a positive impact on an organization and its workforce by enabling work teams to see how their contributions affect organizational performance in terms of cost, time, and quality.

Baxendale and Levitan have demonstrated that the unused capacity information revealed by an ABCM system may be useful as a basis for managerial performance evaluation.[45] Referring to the PQ Company, a performance evaluation system could be developed that would compare the actual unused capacity for each activity with the budgeted amount at the end of the accounting period. The goal, of course, should be to free-up unused capacity in the constrained activity and then make use of that free-up capacity by selling products at profit. Baxendale and Levitan suggested a method by which the variance between actual unused capacity and budgeted unused capacity may be analyzed to determine the cause of the variance. This approach differentiates variances caused by process improvements, changes in the capacity levels through acquisition of additional capacity or divestiture of capacity, and variances caused by changes in the product mix and or the quantity of product produced and sold.

## Conclusions

In the past, corporations have used traditional cost accounting systems that encourage employees and suppliers to manipulate processes instead of improving the processes. Activity-based cost management systems reorient organizations towards understanding and managing work processes. Activity-based cost accounting systems trace the cost of activities such as purchasing, engineering, production, and marketing to the products that benefit from these activities.



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In the process, ABC also reveals unused or excess capacities of the activities. This ability to trace costs to activities as well as to products and to identify usage of various activities/resources has far-reaching implications for all areas of a business, including manufacturing and operations management. Activity-based accounting systems help operations managers make better decisions in areas of: i) product planning; ii) management and control of quality; iii) processes selection; iv) capacity planning/scheduling; v) inventory management and; vi) work force management. ■

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