TRADITIONAL VERSUS ACTIVITY-BASED PRODUCT COSTING METHODS: A FIELD STUDY IN A DEFENSE ELECTRONICS MANUFACTURING COMPANY

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ABSTRACT
Organizational environments, characterized by an expanding use of advanced technologies, have become increasingly complex in the last half century. A company's management accounting system design elements should capture the underlying technology, be consistent with corporate commitment to total quality and increased automation, and promote its efforts to compete on the basis of cost, quality and lead time. However, the recent literature reveals that traditional cost accounting systems are outdated. The prevailing views are that traditional cost systems systematically introduce serious product cost distortions which lead to inappropriate strategic decisions. These views provide the framework for this paper which utilizes the field study method to explore management accounting system design issues in a single manufacturing organization operating in the defense electronics industry. The Company in question designs, develops, manufactures and markets signal processing devices which receive and analyze radar signals and other microwave transmissions. The Company's product lines are technologically vertically integrated and the strategic focus of the Company is simultaneously on total quality and cost competitiveness. In order to answer the study's research questions, the Company's current product costing system was analyzed and product lines were costed under both this traditional cost accounting system and an activity-based product costing model. These two cost models were compared and the results of this study support the literature's suggestion that product line costs will be cross-subsidized when using traditional product cost accounting methods.

INTRODUCTION
While the world’s attention is focused on the fight to increase productivity and develop new technologies, manufacturing managers – especially those in the electronics and mechanical equipment (machinery) industries – are quietly waging a different battle: the battle to conquer overhead costs (Miller and Vollman, 1985, p. 142).

This quote embodies the theme of this study: a changing organizational environment and the struggle to understand overhead costs.

The current manufacturing environment is characterized by an increasing use of advanced technologies such as robotics, computer aided design, computer aided manufacturing, and flexible manufacturing systems. Organizations must understand the cost of each component of their value chain from product design and purchase of materials, through production and shipment to be able to effectively compete with offshore companies by eliminating wasteful efforts and lowering costs (Cokins and Hicks, 2007; Shank and
Govindarajan, 1992a, 1992b; Porter, 1985). Therefore, knowledge of internal costs becomes critical for competitive action and building of shareholder wealth in the current globally competitive economy.

Management accounting systems (MAS) are the providers of this critical internal cost information. These systems have recently been criticized in the literature as being outdated and for not providing information consistent with the current strategic management paradigm. From a normative perspective, the accounting system should be subservient to corporate strategy; not independent, in conflict with or indifferent to it. The system's design elements should capture the underlying technology, be consistent with the corporate commitment to total quality, JIT, and increased automation, and promote its efforts to compete on the basis of cost, quality and lead time. The cost-management accounting system cannot be designed and run to satisfy largely the information requirements of financial reporting. Accurate and relevant cost information is critical to management's decision making processes (Cokins and Hicks, 2007). However, the literature reveals that traditional MAS do not reflect the organizational complexities of the current era. The prevailing views concerning traditional cost management accounting systems are that they systematically introduce serious product cost distortions which lead to inappropriate strategic decisions, and promote and encourage behavior that contradicts corporate strategies with regard to efficient resource allocation and consumption (Cokins, 1998; Drucker, 1990, 1995; Anthony, 1988; Berliner and Brimson, 1988; Howell and Soucy, 1988, 1987a, 1987b, 1987c; Kaplan, 1988; Johnson and Kaplan, 1987; Rappaport, 1986; Merchant, 1985; Kaplan, 1984, 1983).

Traditional MAS do not reflect current organizational realities because typical product costing procedures were designed in the late nineteenth and early twentieth centuries. In that era, the "prime costs" of direct materials and direct labor, truly were the primary components of production costs while product line diversity was less common (Cokins, 1998; Drucker, 1990, 1988; Berliner and Brimson, 1988; Johnson and Kaplan, 1987; Miller and Vollman, 1985; Chandler, 1977). The production environment of today, with far more automation and indirect costs has caused the true "prime cost" to become the overhead component. The increase in the relative proportion of overhead cost is distorting product costs because of the traditional MAS techniques for allocating the overhead to product lines. Overhead allocation techniques aggregate this large cost component of factory overhead across product lines. They then apply the aggregated overhead to inventory on a basis not necessarily consistent with the actual resources consumed in the production of the individual product lines. The problem with most cost allocation models (i.e. those based on direct labor, direct materials, or machine hours) is that the driving force behind most overhead costs is not unit output or direct labor (Hicks, 2006; Drucker, 1990; Berliner and Brimson, 1988; Cooper and Kaplan, 1988a, 1988b; Johnson and Kaplan, 1987; Miller and Vollman, 1985; Kaplan, 1987, 1984, 1983). Also, the consumption of resources in production may differ extensively among product lines and may not be labor related. Some costs or departmental cost pools may apply to a single or a few product lines, rather than to all products. Cooper and Kaplan (1988) hold that the product cost distortion caused by the commonly used overhead allocation methods is systematic. The result of their use is under-costing of low volume products and over-costing of high volume products (cross-subsidization of product lines). Therefore, the overhead allocation procedure often produces unreliable product and process cost data for management to utilize in their attempts to control costs in the now highly competitive world market.

A number of studies voicing these criticisms have proposed the development of relevant, timely management accounting information systems. This study's objective is to explore the developments in product costing and cost control systems required to support one company's unique strategic situation. This research is intended to contribute the development of existing theory through analysis of this Company's experience.

THE RESEARCH SITE

The Company in question is a defense contractor that designs, develops, manufactures and markets signal
processing devices which receive and analyze radar signals and other microwave transmissions. Their product lines are technologically vertically integrated, and consist of components (A), frequency discriminators (B), digital radar frequency memory devices (C), and electronic support measures receivers (D). The strategic focus of the Company is simultaneously on total quality and cost competitiveness. Within these strategies, concurrent design teams have been implemented to support both quality production runs and cost reduction through reduction of waste and rework. Further, this Company operates in an extremely competitive, highly regulated environment - the defense industry. Recent Congressional defense spending cuts have caused fewer contracts to be available for bids, thus increasing competition. Also, Company revenues are constrained by federal cost recovery regulations. These regulations, not the information requirements of internal quality and cost control decisions, are the basis of the design of the Company's accounting system.

To support the federal government regulations for detailed overhead rate information, rather than to sustain a system of responsibility accounting, the Company’s management accounting system is driven by their budgeting process. First, budgets are drawn up by functional areas. There are six functional areas in the Company: Engineering, Product Design and Control, Manufacturing, Marketing, Quality Assurance and Planning, and General and Administrative Planning. The functional areas serve as cost centers for the purposes of allocating overhead to products. The costs included in each of these areas are primarily indirect, with indirect labor being the largest component. Manufacturing is the exception; this area employs mostly direct labor personnel and most costs are capital related.

The next step in the overhead rate allocation process is to completely assign portions of Product Design and Control and Quality Assurance Planning into the Engineering and Manufacturing areas. This leaves four cost centers for which to calculate overhead rates: Manufacturing, Engineering, Materials and General and Administrative. Overhead rates are then calculated based upon the total indirect costs in each cost center, including portions allocated in from Product Design and Control and Quality Assurance Planning, and planned direct labor cost in each cost center. Thus, this Company uses multiple rates, rather than a single overhead rate as commonly found in the defense industry. The Company’s cost accounting system uses these overhead rates primarily for quoting (bids) and inventory valuation. Cost information is not used for internal decision making.

A potential problem with this Company’s costing system is that overhead is calculated based upon direct labor cost, which is not the driving force behind the incurrence of the indirect costs in this Company. Another potential problem with the costing system is that direct costs incurred are not traced by product line. Costs are accumulated by major contract, but not on a periodic or systematic basis. Thus, the potential for misquoting in various contracts is quite great. Further, decision making regarding the Company’s product lines is not supported adequately to be of use to management.

RESEARCH QUESTIONS AND METHODOLOGY

In order to answer the following research questions, this study analyzes and suggests how the Company's current system may be redesigned to support decision making in the current manufacturing environment. Considering the focus of this study is upon one organization's situation and is field-based research, it is exploratory in nature. Because this type of investigation does not lend itself to the traditional scientific method utilized in explanatory research, the case study method was used. The categorical research questions which concern how overhead should be allocated to products are as follows:

1. How can activities which consume resources be more directly assigned to individual product lines?

2. For common costs not directly assignable, what transactions drive the consumption of overhead
costs, and therefore, constitute defensible bases for overhead allocation?

The data collection techniques consisted of interviews and archival data. The data were then analyzed to develop a product costing model based on the current theory which holds that costs should be directly assigned to product lines where feasible (Berliner and Brimson, 1988; Cooper and Kaplan, 1988b). When direct assignment is infeasible, costs should be allocated based on cost drivers which reflect organizational activities from the design through the manufacture, sale and shipment of product lines (Cooper, 1990; Drucker, 1990; Berliner and Brimson, 1988; Cooper and Kaplan, 1988a, 1988b). The product costing model developed based upon these premises was then used to cost four contracts, one per product line. The models' results were compared with the traditional accounting system costing.

RESEARCH RESULTS
Prior to this study, no evidence was available concerning the cost to design, develop and manufacture each product line. All product costs were aggregated into overhead pools, rather than segregated by product line. Research question #1 motivated the search for which Company costs might be directly assigned to the individual product lines. Two categories of product-specific direct cost assignments resulted from the study: activities of employees, and special equipment or work cells installed and/or separable expenses. The interviews revealed that some personnel were fully dedicated to a particular product line or split their time between several product lines. The conversion costs (labor and overhead), including the person's share of departmental support costs, of the activities in question were transferred to the product line to which the person's efforts applied. Product lines occasionally created the need for special installations. Also, some expenses were devoted solely to a particular product line's production. These costs were identified from the departmental budgets as well as the facilities and equipment charges. Information obtained from the interviews provided the basis for the assignment to specific product lines. Table 1 contains the activity and facility costs directly assigned to each product line (A-D). Costs which could not be directly assigned to product lines were categorized into one of the overhead categories to be allocated via cost drivers (discussed in the paragraph regarding Research Question #2 below).

Table 1 outlines the direct assignments of costs to product lines, as follows:

<table>
<thead>
<tr>
<th>Costs of:</th>
<th>Product Lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employee Activities</td>
<td>A</td>
</tr>
<tr>
<td>Special Installations and Separable Expenses</td>
<td>77</td>
</tr>
<tr>
<td>Total</td>
<td>$480</td>
</tr>
</tbody>
</table>

Table 1
Direct Assignments to Product Lines (in $000's)
Research question #2 concerned the treatment of indirect costs which could not be directly assigned to product lines. Based upon the analyses of the interviews, these types of costs resulted from indirect departments' production support functions which were unit- or volume-related. Three cost drivers were identified from the departmental interviews: (1) the number of manufacturing orders for the Production Control and Documentation Departments; (2) the number of purchased parts for the Procurement, Reliability Engineering, and Procurement Quality Control Departments; and, (3) the number of parts being built in-house for the Inventory Control, In-Process Inspection, Quality Control Engineering Departments and for the costs of creating the Multi-use Parts. The specific cost drivers, which often related to the number of components in any one product, were used as the basis of allocation. The indirect cost in each case was allocated to each product line in terms of its proportion of quantity of the cost driver. Table 2 details the costs allocated to each product line (A-D) in this manner.

Table 2
Cost Driver Allocations
(in $000's)

<table>
<thead>
<tr>
<th>Costs Allocated by:</th>
<th>Product Lines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Manufacturing Orders</td>
<td></td>
</tr>
<tr>
<td>$112</td>
<td>$165</td>
</tr>
<tr>
<td>Purchased Parts</td>
<td>40</td>
</tr>
<tr>
<td>Parts Built In-house</td>
<td>255</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>$407</strong></td>
</tr>
</tbody>
</table>

The costing of the contracts using the study's model was compared to the Company's traditional system's contract costs. This comparison yielded a cross-subsidization of product lines which supports the literature's assertion that product cost distortions result from traditional accounting methods. Table 3 details these product line cross-subsidizations.

Table 3
Product Line Cross-Subsidization
(Amounts in $000's)

<table>
<thead>
<tr>
<th>Product Line</th>
<th>Mfg. Volume</th>
<th>Amount Over or Under Contract</th>
<th>Percent of Contract Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2,236</td>
<td>(105)</td>
<td>130%</td>
</tr>
<tr>
<td>B</td>
<td>412</td>
<td>262</td>
<td>7%</td>
</tr>
<tr>
<td>C</td>
<td>32</td>
<td>(368)</td>
<td>40%</td>
</tr>
<tr>
<td>D</td>
<td>13</td>
<td>(44)</td>
<td>10%</td>
</tr>
</tbody>
</table>

Three contracts were overcosted and one was undercosted. Note that the
highest volume product line (A) resulted in the greatest undercosting on a percentage basis.

LIMITATIONS, IMPLICATIONS AND CONCLUSIONS
The two major limitations of this study stem from its research design: the field study. First, construct validity, establishing operational measures for the concepts being studied, is of concern in this study. Two weaknesses exist in the information used in constructing the model: the model was based on self-reports and numbers generated from the Company's traditional accounting system. All of the overhead cost direct assignments and allocation bases were determined from the interviews. As such, they are self-reports which may or may not reflect the actual consumption of resources, and therefore, may be subjective accounts of departmental activities. Given that the Company's current system does not collect information on indirect personnel's efforts, self-reports were the only reliable data available. Also, occasionally throughout the study, persons would indicate that costs were driven by activities for which the Company's traditional accounting system had not kept records. In most cases proxies could be developed, however in some cases they could not. Considering that some costs could not be assigned or were assigned based on proxies, the precision of the study's costing model is confined. Thus, construct validity is limited in this study.

Second, external validity has been a major barrier to the acceptance of case study research because these cases offer poor bases for generalization. This study represents the product costing issues relevant to one specific organization operating in the defense industry. Its intent was to determine whether or not current criticisms in the field of MAS held in this specific situation. Thus, the intent was to generalize to current theory and determine whether or not this theory was supported. This study accomplished that objective. However, though this field study by definition was not intended to be generalizable to the population, the findings may be applicable to other labor intensive manufacturing organizations. These types of companies may also believe that labor hours or labor costs are applicable cost drivers when in fact they may not be reflective of the true underlying cost structure. These findings would particularly be generalizable to organizations with both varying equipment configurations and support personnel utilization.

This research examined how one Company's management accounting system might be improved to reflect its current operating environment. This Company operates in an extremely competitive, highly regulated environment. In response to the competitive environment, the Company has begun to make strides toward applying the current strategic management theories, by becoming more team-based. This study supports the literature's suggestion that product line costs will be cross-subsidized when using traditional accounting methods in the modern organization.

This study also supports the literature's assertion that traditional accounting information is too aggregated to be of use in the assessment of the costs of teams' and/or workcenters' efforts. Disaggregation of costs in this study led to some of the workcenters costing far more to operate than others. The costs of support activities and expensive equipment, which applied to some areas in the Company and not to others, were primarily responsible for these cost differences. Much more meaningful and useful information would be provided to management by a system which focuses on the team or the workcenter as its cost object. The miscosting of product lines in this study confirms the assertion in the literature that seriously distorted product costs can cause managers to de-emphasize profitable product lines. The Company's Product B was the only profitable product line in the study. Yet, this product is viewed as in the declining phase of its lifecycle. While the Company views Product A as a "cash cow," that product yielded the greatest losses on a percentage of contract cost basis.

This study did not support two viewpoints in the literature. First, it is asserted that product cost distortions are caused by automation. This Company does not have an automated manufacturing process; it is labor-intensive. However, the results of this study support the contention that labor cost is most likely not an
appropriate overhead allocation base, even in a labor-intensive production process such as this one. Second, the literature also suggests that high volume product lines will be over-costed and low volume product lines will be under-costed. However, because low volume products often involve more specific manual labor activities, and thus greater direct labor charges, as in this study, they are being charged proportionately higher amounts of overhead, not lower.

The reason for both of these differences from the literature's viewpoints is that support costs and expensive equipment vary from department to department, and use of labor cost as an overhead allocation basis does not capture these variances. Low cost labor often operates the most expensive machines, causing some of the highest resource consuming shops to be charged with the lowest amounts of overhead. Frequently, the high volume products are produced using mostly the low cost labor shops, thus are not receiving overhead charges reflective of resources consumed.

This study has compared the costs assigned to product lines in a traditional cost accounting system to those assigned by a costing model developed based on the resource-consuming activities of the organization. The results of the study suggest that the study's costing model supplies more meaningful product line cost information than traditional MAS. However, the model developed in the study was based on self-report data which may be subjective in nature. To address this limitation, future research should attempt to control the data collection phase by recording the indirect department efforts over a representative period of time. Thus, the measures on which the cost model is based would be more suggestive of the actual effort being approximated and construct validity would be strengthened.

Considering the findings of this study apply to one organization, their generalizability is limited. To support the advancement of the growing body of knowledge, this study should be replicated in companies in both similar as well as in different industries. If similar findings held in other labor-intensive job shops producing technologically advanced products, industry specific cost structures could be delineated. Further, replication of this study in dissimilar companies would yield general truths regarding the cost structures of modern organizations.

REFERENCES


