Understanding total cost ownership issues from a value analysis perspective

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Abstract

Commodity industrial products are no longer self-selling ticket items for manufacturers. Such manufacturers need to assess their value chain from a total cost ownership perspective for both their outsourced and in-house parts needed to assemble the commodity product in order to better compete in the market place. The key question becomes what procedures should manufacturers follow to understand cost and mark-up behavior patterns and their documentation procedures for such parts? In order to identify and eliminate waste at the inter-firm and intra-firm levels a case study using value analysis was conducted for a commodity product manufacturer that outsourced its component parts to independent suppliers. Activity Based Management approach was used to identify the key value added activities and the unnecessary resources used for these activities. Using simple value analysis and affinity diagram approaches a list of questions and methodology were prepared for the analysis. Three models of the manufacturer's product that required similar components but slightly different designs were selected for comparison purposes, and their key cost drives were determined. Problems in the manufacturer's cost differentiating strategies were identified and practical solutions offered.

Keywords: total cost ownership, value analysis, activity based management, affinity diagram, benchmarking, cause-and-effect diagram, transfer pricing, relationship management

Introduction

With shortening product life cycles and increasing global competitive pressures, manufacturers need to better understand their cost behaviors and take corrective action. This is more so for commodity products, which are no longer self-selling ticket items for a manufacturer. Porter (1985) suggested that competitive advantage should be addressed from both the firm's entirety and its discrete activities and cost structures. Therefore, a firm needs to understand the entire supplier and customer cost structure for each product being exchanged in order to deliver superior value at minimal cost through the supply chain. These cost structures include the initial cost related to supplier selection and the resulting procurement costs, the internal cost of using the items purchased, and the internal and external costs associated with salvage value and material failure (Ellram and Siferd, 1998). All these tasks necessitate the understanding of Total Cost Ownership (TCO) for items purchased from both the suppliers as well as the firm's different profit centers. TCO is comprised of acquisition, conversion, and post ownership costs. The purchase price (acquisition cost) is often the major ticket item of total cost ownership for the procurement department, especially for commodity products (Burt, Dobler, and Starling, 2003).

Since total procurement costs are approximately sixty percent of a firm's sales (Degraeve, Roodhoft, and van Doveren, 2005), manufacturers, especially those selling commodity industrial products (e.g., hardware goods, pumps, compressors, and electric motors), are contemplating systematic cost cutting measures with their suppliers to enable them to compete in the short run as they explore their avenues to innovate in their industry. Profitability of such commodity products comes from lowering ones cost as compared to competitors (Tsai, Fan, Liou and Wu, 2006). The question is how to lower these costs? Value chain analysis has been used by researchers to understand cost behaviors and scope of their supply chains and reduce wastes in general (Hergert and Morris, 1989; Shank and Givindrajan, 1993; Francis, Simons, and Bourlakis, 2008). This chain consists of a series of activities that create and build value. Ferguson (2000) reports, for example, that compared to their competitors, firms that employ value chain calculus enjoy a 45 percent supply chain cost advantage, a 50 percent lower order-cycle time and inventory days of supply, and a 17 percent faster finished product delivery.

Purpose

The purpose of this study is to follow the prescription of the value chain framework (Porter 1985) in order to understand the acquisition cost and transfer pricing issues as it applies to a manufacturer selling commodity products. The goal is to identify and eliminate waste (inefficient costing) at the inter firm (supplier cost with respect to the manufacturer's parts) and intra-firm (transfer pricing) level. A case study using value analysis was conducted for a commodity products manufacturer that outsourced its component parts to independent suppliers. Such case studies are considered good for applying theory to real world situations in understanding on-going business operations where the environment cannot be controlled. Case studies may also be used to support current frameworks and theories and answer how and why questions (McCutcheon and Meredith, 1993; Yin 2003).

Although TCO include all costs pertain to the internal and external activities across the boundaries of organizations, this study focuses on the inbound logistics and operational activities for commodity component parts. These activities were considered important for the make vs. buy decisions-making to this firm. In order to explain value analysis (VA), the value chain framework is first discussed. Next, the value analysis methodology is explored. Finally, findings and managerial implications are provided.

Porter's Value Chain Framework

Value analysis using transfer pricing and cost issues may be applied both within and across firms in a supply chain (Crain and Abraham, 2008). Porter's (1985) value chain framework depicts the stages of value-added activities and support functions that are needed to serve the customer from the product's inception. The framework may be categorized into three broad value-added areas, namely, a firm's (a) different strategic business units (profit centers), (b) the primary supply chain activities (logistics, manufacturing, marketing and services) of a firm, and (c) the support functions (procurement, technology, human resources). The inbound logistics activities and costs are chiefly due to order processing, shipping, receiving, and storing of goods and the associated material handling, inventory management, and delivery issues. Manufacturing pertains to value-added activities necessary to change the form of the materials (e.g., machining, testing, and facility operations).

Although Porter's value chain framework covers several aspects of an organization, this study focuses on the acquisition cost issues pertaining to: (a) the profit centers that are applying transfer pricing to the component parts under consideration, (b) the supply chain inbound logistics and manufacturing activities, and (c) the inefficient human resources and technology practices.

The outcome of any value chain analysis is to create a cost advantage and differentiation strategy for a firm. Margin is a good performance measure for understanding these cost advantages. However, manufacturers generally use the traditional methods of cost accounting (indirect and direct costs) and fail to identify the cost drivers (e.g., economies of scale, learning curve, capacity utilization, linkages among activities, interrelation among business units, institutional factors on transfer pricing) associated with these activities to calculate margins (Porter, 1985; Hergert and Morris, 1989; Stabell and Fjeldstad, 1998). This study addresses these cost driver issues too.

Methodology

In order to conduct a simplified value analysis, three models of the manufacturer's product that required similar components but slightly different designs were selected for comparison purposes. A three-item comparison has been used by other researchers (e.g., Taylor, 2005). By comparisons, firms identify wastes and non-value added activities (Francis et al., 2008). Initially, the Bill of Materials (BOM) for these models were reviewed to identify the various components and parts, the manufacturing processes, the vendors, and the internal departments involved in each transaction. A part was defined as a piece that goes into the sub component of the final component that was

purchased (Figure 1). The three models had 45 to 65 parts associated with it. The components were then assembled at the manufacturer's facility.

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Place Figure 1 about here

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Affinity Diagram

Based on the affinity diagram technique, color coded index cards were used to map all parts including packaging and shipping material. Different colored cards represented different levels of assembly for these component parts, making it easy to identify subassemblies. The part numbers, vendors' names, addresses, phone numbers, and billing zip codes were obtained from the company's disorganized computer information system and other company experts. Each card contained the part number, the quantity utilized in the complete production of a model, and the associated cost as listed in the BOM. For comparison purposes, the most recent invoice price for each part was listed on the appropriate index card. Cards were placed in the assembly-order sequence for each model to form a hierarchical structure. Bright orange circular stickers (dots) were placed on all cards that contained steel parts (top company's priority). Bright green dots were placed on internal transfer parts in order to study internal margins (Sachdev, Hoffman, and Reeves, 2006).

The relevant costs associates with the inbound logistics and manufacturing including transportation, packaging, materials, labor, tool amortization, and overhead allocation were identified. These cost areas were all considered critical to produce the part and/or component. Since stamped steel parts were a significant itemized cost of the overall component purchased, its cost was traced separately.

Benchmarking methods

Activity Based Management approach was used to identify the key value added activities, and the unnecessary resources used for these activities (Kren, 2008). Using simple value analysis procedures a list of questions were prepared (e.g., what is it? What does it do? What does it cost? How else can the job be done? Can any part be eliminated without impairing the operation of the complete assembly? At what cost? Is unnecessary machining or process being performed? Can different materials be used?). For this commodity product, stamping and painting were considered major processing costs for the steel parts. Vendors supplying steel parts were then contacted to obtain answers for the following typical supplier-related questions pertaining to major production process, material, and acquisition costs (Burt, Dobler, and Starling, 2003).

- Is special tool/dye required to make the part? If so, who owns the tool/dye?
- If the tool is owned by the vendor, what is the amortization schedule if any?
- What are the set-up costs for producing this component?
- What type of steel is being utilized, specifically hot vs. cold rolled steel, and whether or not it is galvanized?
- Is the part stamped? If so why?

- Is the part painted? If so why?
- What are the current pricing procedures and levels for volume discounts?
- What shipping information is provided (e.g., weight, number per package, and shipment zip code)?

For comparison purposes, few vendors supplying non-steel parts were also contacted to obtain answers to the same questions. This approach also helped identify some questionable activities and resources used for them (e.g., galvanizing steel stampings and painting it). The respective suppliers were contacted to obtain key cost information regarding the manufacturing process and material and logistics issues. Based on the firm's computer information system, supplier-provided information, and purchasing department input, major costing errors were identified and the BOM purchase prices were modified for the three models where possible (Sachdev et al., 2006). The traditional benchmarking practice of comparing a company's cost with itself over time was used for this study. These models were compared over two years (Table 1).

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Using Pareto's analysis the top seven cost drivers for each model were identified as raw material quality, manufacturing process, questionable value-added processes (e.g. painting), lead time priorities, tool amortization, shipping methods, and margins. These items were then sequential numbered from the most expensive to the least expensive drivers. Approximately 80 percent of the total material cost for each unit was in the seven cost drivers. In addition, this value analysis revealed that certain key customers were guaranteed a two-week lead time as a method of differentiation to obtain sales.

Cause-and-Effect Diagram

Besides the fact that cost information was not adequately documented and several employees from within and across the firm to identify and validate costs, the Cause-and-Effect diagram was used to identify problems related to the cost variances in the BOM. Using the five categories of Human Resources, Machinery, Material, Method, and Measurement, the main problems are discussed below:

<u>Material</u>

True to the value analysis questions developed for this study, the manufacturing procedures for certain parts, predominantly steel parts did not have proper justification. For example, the reasons for using galvanized steel or hot vs. cold rolled steel require further benchmarking and material science studies. The firm's outsourced parts may require value engineering.

The three models studied had several common parts; some of the parts were only slightly different in dimensions. Special adjustments were also being made for certain customers such as changing the hose assembly inlet position without understanding acquisition cost implications for both parties. Lean manufacturing techniques of

standardization across parts and materials may reduce total acquisition, storage, and assembly costs. Supplier work may further be consolidated and help both parties. Such standardization may improve material quality, design time, development cycle, and management time among other issues.

Machining

In order to please certain customers, manufacturers frequently obliged to their requests to adjust diameters of a hole and machining of certain areas of the component. For example, special adjustments were also being made for certain customers on changing the hose assembly inlet position without understanding acquisition cost implications for both parties.

Methods

The firm's computer information systems were inadequate. Some cost information was unavailable, which made accurate cost identification a challenge. In addition, the different cost and quantity information of each BOM were only updated once a year, and thus cost variances and tolerances were not appropriately recorded. Non-value added costs such as pallet design and material, transportation, and back haul for reused packaging were not properly recorded. Overhead cost allocation of both the supplier and internal transfer pricing was set at 200 percent (a number discussed in several textbooks). These non-material costs were largely unnecessary.

The improved logistics customer accommodation principles of short lead times to key customers were increasing costs. In addition, the inefficient coordination process with these customers and/ or caving into their haphazard ordering process was interfering with the logistics services. On several occasions emergency suppliers were used to complete the orders for these customers, which increased the cost two-folds.

Measurement (Cost)

Each profit center was treating transfer pricing to make the profit center look efficient. "If each segment of the supply chain is acting in a way to optimize its own value, there will be discontinuities at the interfaces and unnecessary costs will result" (Meredith and Shafer, 261). In this firm, each facility that handled a part operated as a profit center and applied a mark-up as parts flowed through its operations. This haphazard internal mark-up was making cost identification difficult. Furthermore, the company did not have a methodical cost calculation table at different value-added points, making mark-ups superficial. This method of costing resulted in artificially high prices, leading to lost sales and diminished market shares.

Human Resources

A lot of time and effort was expended in gathering information for this study since cost and Activity Based Management information were stored and obtained from several employees across the company and supplier base. In addition, the tasks of validating cost information and following the paper and electronic information trail could only be accomplished by interacting with several management and staff.

Conclusion

Although the TCO concept has been in literature for decades, management teams, in general, have not paid serious attention to it as their industries were making healthy profits and strategic cost thinking was not on most managers' plate. Revenue generation was considered the more prominent task. With a depressed economy and opening of globalized competition, firms are rethinking their profit margin drivers and learning to pay close attention to the important ones. Understanding supplier's cost as it relates to the manufacturer's procurement needs is an essential first step and very effective information and negotiating tool for managing supply chain costs in relation to TCO. These costs include labor, material, engineering, tooling, overhead, logistics/distribution, GS&A, and profit (Burt et al., 2003). In order to survive in today's global competitive markets, management must take decisive action pertaining to the activities and the related costs to improve the competitive position of a company. Appropriate strategic plans will allow a company to capitalize on its core business. The purpose of this research was to use Activity Based Management and VA to understand acquisition costs in terms of inbound logistics and manufacturing portions of Porter's model (1985) and identify problems in a firm's cost differentiating strategies.

Previous researchers have found that suppliers in general do not have the necessary information needed by the manufacturer to effectively govern the supply chain. In addition, the information contains errors that affect supply chain operations (Closs, Roath, Goldsby, Eckert, and Swartz 1998). Thus improvements in the firm's computer information system should be a top priority. The system in place for this manufacturer was out-dated and was significantly affecting several functional areas within the organization. In addition, BOMs need to be updated on a regular basis. The current practice of updating BOMs once a year affects the ability of the manufacturer and supplier to manage inventories and manufacturer's margins. When trying to compete in a price sensitive commodity market the company cannot afford this extra burden.

The internal transfer pricing needs to be re-evaluated. Many supply management practices of the firm have been in place for numerous years and are not data driven. As a beginning, data should be properly recorded at each touch point along the supply chain to adequately compute transfer pricing and appropriately assign shipping and handling costs. The make vs. buy decision should be revisited for these internal transfer parts to understand their economies of scale and also mark-up procedures. In this VA study, it was determined that arbitrarily placed margins by different divisions within the firm was driving up the firm's costs.

Hergert and Morris (1989) have identified several accounting deficiencies for firms using the traditional cost allocation procedures (e.g. labor hours). A firm needs to review and standardize its overhead application process throughout the organization. The cost drivers of all products in relation to customer needs should be implemented using activity based cost measures.

The differentiating strategy using lead time for key customers need to be revisited. For example, if the lead time may be made more flexible, human resources and other supply chain activities could be made more productive. This may reduce a supplier's set up and production run costs and ultimate price to the manufacturer and customer.

The BOMs for the models need to be changed in order to reduce the number of parts being ordered for the three models. A detailed VA may help in this regard. In order to reduce acquisition costs on these component parts, the company needs to study ways to standardize parts across their product line and collaborate with end-users to eliminate the need for certain customized parts for the final product using value/concurrent engineering methods (e.g., Tsai et al., 2006).

The areas of human resource management both within and across firms should be reorganized. The people responsible for understanding cost behaviors should be placed under a single authority (e.g., Chief Procurement Officer) for accountability and corporate governance purposes. The management should be more open to relationship development and sustainability issues while paying close attention to reduce the seven wastes in the areas of production, motion, processing, shipment, machine time, inventory, and defects (Burt et al. 2003). The relationship dimensions of quality (e.g., trust, commitment, collaboration, information sharing), contact density (number of key interpersonal relationship ties) between firms, and contact authority involved in the decision-making process assist in identifying value, non-value, and redundant information (Palmatier, 2008). The relationship management techniques may be used to both verify the accuracy of information as well as find value-added opportunities. Competent negotiations using the relationship management tools of information sharing, monitoring, and flexibility may reveal an overall cost benefit and margins for all parties involved in the exchange.

The basic rules of acquisition cost should be re-examined. Firms may use cost analysis negotiations, where each cost driver is negotiated individually and the negotiations focus on sharing the cost savings of each cost driver across the product line (Burt et al., 2003). Customer designs and specifications need to be revisited for potential opportunities to trim costs. The pricing practices both within and across the firms need to be closely monitored. The basic principles of relationship governance of collaboration and open information sharing across the parties in the supply chain (suppliers, the manufacturer, and the final customers) should be implemented.

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Table 1

Results

Cost Variances				
Model	**BOM Material Costs 2005**	**Invoice Material Costs 2004**	**Difference (BOM- Last Invoice)**	**Percent difference**
A	$252.46	$207.90	$44.56	17.6%
B	$236.00	$254.86	($18.86)	(7.99%)
C	$85.19	$87.33	($2.14)	(2.5%)
Average	$191.22	$183.36	$23.56	12.3%

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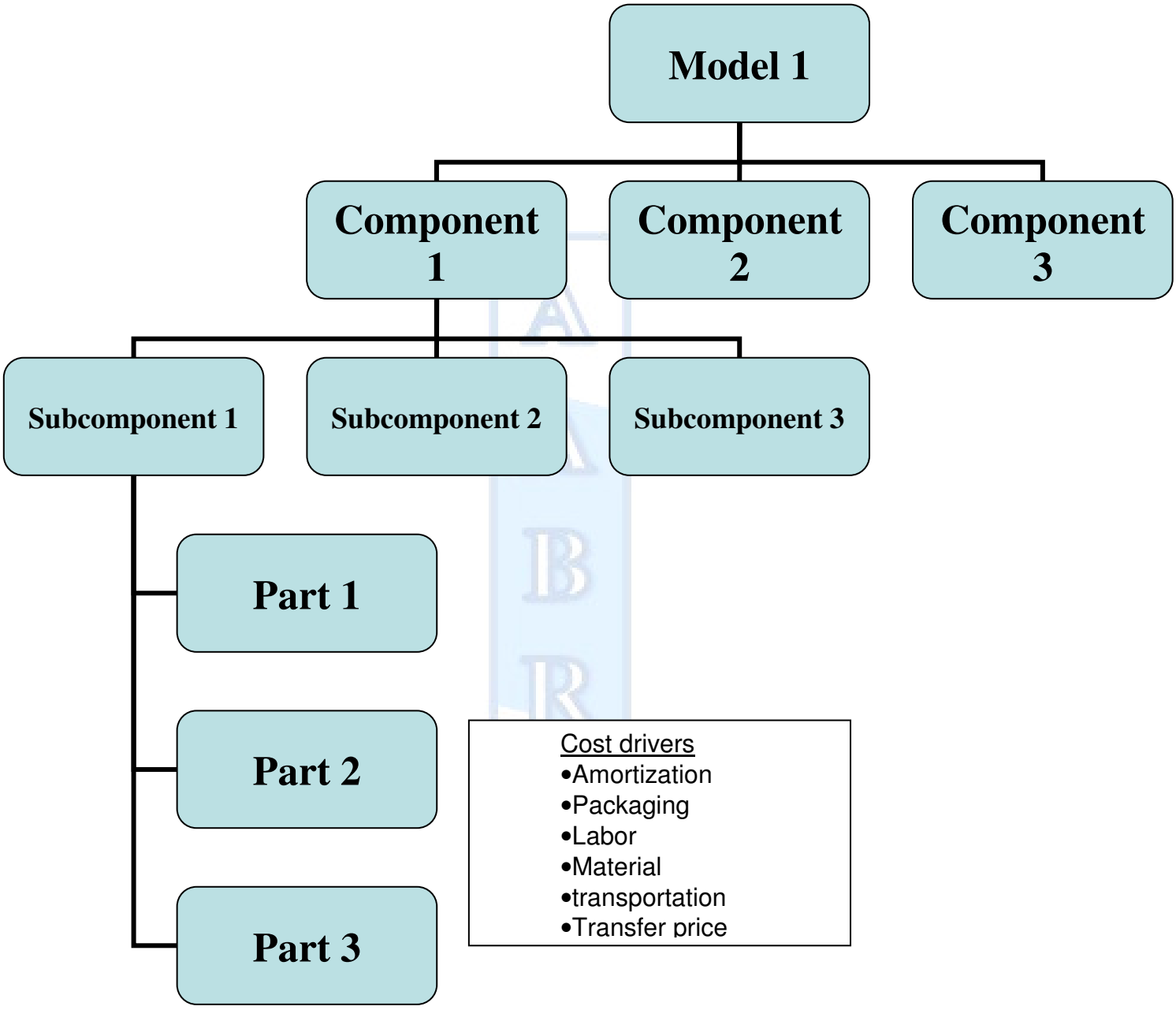
Figure 1


Model 1
Component 1
Component 2
Component 3
Subcomponent 1
Subcomponent 2
Subcomponent 3
Part 1
Part 2
Part 3
Cost drivers
•Amortization
•Packaging
•Labor
•Material
•transportation
•Transfer price