METU Studies in Development, 25(4), 1998, 601-624

Costing practices in continuous processors: A comparison of two paper mills

Veyis Naci Tanış
Department of Business Administration, Çukurova University, Adana, Turkey

Abstract

Although the costing practices of discrete parts manufacturers have been extensively investigated by cost/management accounting researchers, continuous processors have not attracted the same attention. The purpose of this paper is to examine and compare the costing practices of two continuous processors: the paper manufacturers operating in Turkey and the UK. This study finds that both paper mills employ similar cost accounting systems and costing practices, and given the technology in use, Activity-Based Costing (ABC) is found to be an inappropriate costing strategy for these two plants.

1. Introduction

The paper manufacturing industry has attracted the attention of only a small number of cost and management accounting researchers. A limited number of case studies and survey research (for example, Shank and Govindarajan, 1989; Reeve, 1991: 22-33; and Fogelholm, 1994: 243-245) have been conducted in this type of manufacturing environment for the U.S. and Finland, and no published studies exist for the U.K. and Turkey. Therefore, the aim of the present study is to fill this gap by investigating the existing costing practices of two paper mills located in these two countries. The study concentrates mainly on product costing and the use of that type of information for decision-making needs. While the primary concern is with manufacturing costs including support departments, non-manufacturing costs, such as marketing, are also investigated to some extent. The study also attempts to shed light on product cost structures

and their links to manufacturing processes in the two mills. As such, the paper seeks answers to the following research questions:

- *do the traditional product costing systems, which have been adopted by the Turkish and the UK paper mills, produce distorted cost information in relation to product costs ?*
- *are the product costing systems and cost drivers employed within the Turkish and the UK paper manufacturers appropriate from a product-costing and decision-making perspective ?*
- *is Activity-Based Costing appropriate for either or both of the paper mills under investigation?*

2. Other studies

Traditional costing methods were examined for today's highly automated manufacturing environments (see, for example, Miller and Vollmann, 1985: 142-150; Cooper and Kaplan, 1987: 204-228). These methods were then claimed to be inappropriate for multi-product and automated manufacturing environments since they tended to distort product costs (Kaplan, 1984a: 390-418; 1984b: 688; Johnson and Kaplan, 1987: 183-194). The reasons and effects of the distortions have been widely discussed in the related literature (for example, Cooper and Kaplan 1987: 215-224; 1988a: 20-26; 1988b: 96-103; Cooper, 1988a: 45-54; 1988b: 41-48; 1989: 34-35). One of the most important features of the manufacturing environments in which cost distortions took place was that, in a single plant, low and high volume products were manufactured together. Although these dissimilar products required different overhead resources, overhead costs were, nevertheless, allocated by using traditional costing methods without regard to differences in resource requirements. Thus, the use of traditional costing methods is claimed to be the basic cause of the product cost distortion.

As a result, new methods have been developed and applied to manufacturing companies. For example, Activity-Based Costing (ABC) was introduced as a solution for most product cost distortions that result from the use of the traditional cost systems. Although this method has been examined in a number of discrete part industries, such as machinery equipment and electronics, it is quite new and untested for the UK and Turkish paper industries. This paper discusses and compares the findings of the case studies performed in these two countries.

3. Activity-based costing as a cost method

Although the term Activity-Based Costing (ABC) was coined by two professors, Robin Cooper and Robert S. Kaplan[1], from the Harvard Business School during the late 1980s, the concept itself is not new. It is a well-known and defended idea that overhead costs should be allocated to products depending upon the main cause of their incurrence. For example in 1952, a committee of the American Accounting Association stated that "overhead cost allocations should be related in a logical manner to the basic activity which give rise to these costs" (Brummet, 1957: 48). This statement serves to emphasise the cause-and-effect relationships between the overhead and cost objects. While the concept is not new, it remained, however, an idea that was not applied or analysed in detail.

Cooper and Kaplan (1987: 204-227), made some important findings about overhead cost structures in some electronics and machinery manufacturing companies. Later, they formulated a radically different approach from the traditional costing methods (1988b). This new method, they argued, could be a better way of evaluating, understanding and assigning overhead costs to products, much more accurately than had been done. The following sections define, describe, and discuss their approach: Activity-Based Costing.

3.1. Definition of activity-based costing and some related concepts

Activity-Based Costing may be defined as a cost system in which costs are attributed to cost units on the basis of the benefit received from indirect activities such as ordering, set-up and quality assurance (CIMA, 1991: 30). Another and more detailed definition is that ABC is a system which focuses on activities as the fundamental cost objects and utilises the cost of these activities as building blocks to obtain the costs of other cost objects (Horngren and Foster, 1991: 150). An activity is any action or movement, that facilitates the accomplishment of a certain amount of work.

ABC employs cost drivers to assign costs to and from the activities and then to cost objects. The concept of a "cost driver" in ABC is different from the

---

[1] Kaplan stated (1990: 5) that the name was used by the John Deere Company, and they studied the company to learn about ABC. He also stated that the system was developed independently in several other companies in the world.

concept of cost allocation in the traditional methods. The traditional approach is that these bases are utilised because, one way or the other, overhead costs should be allocated to products (Cooper, 1987a: 48). In contrast, ABC treats a cost driver as the basic reason for cost incurrence in the manufacturing (and also service) environments. Therefore, a *cost driver* may be defined as any factor, a change of which can cause a change in the total cost of a cost object (Horngren and Foster, 1991: 150). For example, if expending labour or machine-hours causes overhead costs to be incurred, labour or the machine-hour will be the cost driver. On the other hand, setting up a machine, production runs, material movements or inspection can also be cost drivers if any of them cause some overhead costs to be incurred.

Terms such as *value-added* and *nonvalue-added* activity are also employed in the ABC literature. A value-added activity is any activity which adds something to products that customers are willing to pay for, whereas the non value-added activity adds nothing to the product from the customer's perspective, although it consumes time and resources (FMN, 1991: 37); e.g. the set-up of a machine, quality inspection, and material movements. Most companies, therefore, try to reduce those nonvalue added activities.

3.2. Distorted cost information

In a multi product environment, a number of low and high volume products are manufactured together in small- and large-sized batches. Products that are manufactured in small batches may demand the same (if not more) number of production runs, set-up, material movements and similar support activities as their high volume counterparts. However, these activities do not vary with production volume, but vary with product diversity, complexity, and the number of production batches. In other words, different manufacturing volumes for different products can cause large variations in the product costs (McGuire and Kocakulah, 1997: 22). Moreover, these overhead resources tend to grow bigger in many industries when the number or duration of the nonvolume-related activities increase. Since the traditional systems allocate the nonvolume-related overhead costs to products according to production volume, the products in the small batches will receive the same amount of overhead cost as their large-batch counterparts if both small and large batches require the same amount of direct labour (see, for example, Brimson, 1998, exhibit 2). Therefore, high volume products will subsidise the cost of their low volume counterparts since most of the overheads of the low volume products are charged to high volume products as a result of volume-based cost drivers (Shank and Govindarajan, 1988: 77). This leads traditional systems to produce distorted cost information in product-costing, decision-making, and individual product profitability.

3.3. Hierarchy of costs in activity based costing

ABC offers a radically different approach from that of traditional systems. Most cost categories, which are considered as period costs in the traditional systems, are regarded as product costs in ABC. Cooper and Kaplan (1988b: 96-7) stated that almost all of the activities of a company went to support the production and delivery of goods and services; therefore, they should be regarded as product costs. Moreover, unlike the traditional systems, in which costs are split into fixed and variable components, ABC classifies all overhead costs as variable, albeit in a different way.

The objective of ABC is to connect the cost of an activity to a product which demands that activity (Troxel and Weber, 1990: 14). Therefore, it employs two stages to assign costs to products. In the first stage, the costs of the activities are aggregated into a number of different but homogenous cost pools. In the second stage, costs, which are collected in the cost pools, are assigned to products by using cost drivers.

The Activity-Based Costing system has been designed to explain costs in a hierarchical manner under which costs are collected in one of four major groups (Cooper, 1990: 4-14). These groups are: *unit, batch, product,* and *facility level* costs and activities. This classification of activities can demonstrate the important differences between the logic of ABC and that of traditional systems that only rely on volume-based allocation bases. As shown below, unit only and facility level costs and activities and their allocation over products resemble those of the traditional methods. Batch and product level costs and activities and their assignment onto products are performed in a radically different way. Moreover, those two levels, which capture the basics of ABC, are considered to be the most important categories in the hierarchy (Cooper, 1990). This hierarchy can be described as follows.

a-Unit Level Activities: Some resources are consumed in proportion to the number of units produced, number of machine-hours run or the number of direct labour hours expended. Therefore, activities that are performed when a unit is produced (or machine-hours run, or labour hours expended) can be defined as unit level activities, and the costs related to them, as unit level costs. Drilling a hole or machining a surface are examples of unit level activities (Cooper and Kaplan, 1991: 131). Direct labour, materials, machine and energy costs also belong to the unit level classification. Innes *et al.* (1993: 113) place depreciation costs into this category as well.

b-Batch Level Activities: Those activities performed when only a batch of products is produced, are referred to as batch level activities. Setting up a

machine, batch inspection, ordering a group of parts or materials, and handling a group of materials are examples of batch level activities. The importance of activities in this category is that they are not affected by the volume of production or the number of units produced, but that they change as the number of batches changes. In other words, these activities and their costs cannot be controlled by changes at the unit level. Also, their costs are regarded as variable only at the batch level of production. Accordingly, the batch level cost assignment to products is as follows. First, the cost of the activities for this level is calculated (cost of a set-up or per hour of set-up, inspection and material movement). The total amount per batch is then divided by the number of units in the batch and assigned to individual products.

c-Product Level Activities: Product level activities are those that are performed to support different products manufactured in a company's product line. Customer liaison, performing engineering change notices, developing special testing routines, expediting product, purchasing and parts administration can be given as examples of the activities falling into this category. Costs of these activities are not affected by the changes at the unit level, nor do batch level modifications affect them, since the activities in this category should be performed for all product lines that exist in the manufacturing environment. The cost of the activities falling into this category can be controlled by changing the number of different types of products rather than by changing the batch size or number. Therefore, costs in this category are variable in the sense that they change depending on the number of different types of products produced. As a result, costs of product level activities are first assigned to different product lines and then the amount of expense per product line is divided by the number of products in that line yielding cost per product.

d-Facility Level Activities: These activities are performed to support the overall production and administration capabilities of a manufacturing environment. Examples of costs in this category are plant management, occupancy costs of buildings and grounds, heating and lighting.

The facility sustaining category of ABC is somewhat problematic. While the links between resource consumption and activities (first stage) can be established in this category, connecting activities to products (second stage) in a logical manner is difficult if not impossible. In other words, the general logic of ABC does not apply to facility level activities. Therefore, the lack of causal-based relationships between activities and products may cause cost distortion if the costs incurred in this category account for a large amount.

Cooper (1990: 4-14) suggested that costs falling into this category may be allocated to products on the basis of value added. However, Cooper and Kaplan (1991: 132-3) later recommended that these costs be kept at the plant level and not allocated to products, and only unit, batch and the product level expenses be assigned to products. Alternatively, Innes *et al* (1993: 114-9) allocated the facility level expenses of their ABC example on the basis of prime cost (direct material plus direct labour).

The hierarchical design of ABC provides managers with an understanding of how supposedly fixed costs of traditional systems will vary in batch and product levels. Moreover, the hierarchy demonstrates that different types of costs should be controlled in different ways. While reduction of unit level activities may result in a decrease in unit level costs, modifying the number of batches and the number of different products assists managers in changing the level of expenses for batch and product level activities, respectively. Furthermore, ABC reduces the level of distortion occurring in multi-product companies that have adopted the traditional product costing methods. Finally, from a managerial perspective ABC provides strategic cost information about the underlying economies of the business (Cooper and Kaplan 1998: 110).

4. Case study as a research method

After Kaplan (1983: 703; 1984a: 415) had encouraged researchers to perform case studies to discover insights into innovative companies, it became apparent that more case studies were required in this area (Scapens, 1990: 259). Although there was a growing interest in this type of research in the literature (Scapens, 1990: 260; Otley and Berry, 1994: 45), it is claimed that the use of case studies as a research method in the field of cost and management accounting remains at an early stage of its development (Cobb *et al.*, 1995: 157).

The case study is one type of field-based study employed by cost and management accounting researchers. In the recent management accounting literature the term "field study" is sometimes used interchangeably with the term case study (Spicer, 1992: 10). However, Kaplan (1986: 442) distinguishes the case study method from other field-based research methods (e.g. field studies and field experiments) and defines case studies as the concentrated investigation of a single entity. Other researchers give similar definitions. For example, according to Nisbet and Watt (1982: 6), a case study is a systematic investigation of a specific instance. Similarly, Yin (1994: 13) defines case study research as "an empirical inquiry that investigates a contemporary phenomenon

within its real-life context, especially when the boundaries between the phenomenon and the context are not clearly evident". Yin (1994: 14) also states that case study research can include both single and multiple case studies. Therefore, there are two distinct features of the case study method. First, it investigates a real-life phenomenon in one or more entities. Second, case study research describes an actual situation in which mainly quantitative data are collected through personal observations, interviews, any other sources.

The main purpose of conducting a case study is to provide a rich description of current applications. For this reason, the case study, which is one of the three types of field-based research, may be divided further into five groups. According to some researchers (Ryan *et al.*, 1992: 114; Scapens, 1990: 265), case studies can be classified as descriptive, illustrative, experimental, exploratory, and explanatory depending on their purpose from a management accounting point of view. Nevertheless, Ryan *et al.*, (1992: 116) state that there may be no exact or clear distinction between these different types of case studies. They also emphasise that it is the researcher's intention that determines the classification in each case. If the researcher provides clear insights into current practices by using a case study approach, then the case study approach has achieved its expected objectives.

4. Subject mills

The British paper mill, which will be referred to as 'Alfa' to preserve anonymity, has been operating since the late 19th century and is currently a subsidiary company of a multinational paper manufacturer. The Kompass Directory (1994) identifies this mill as producing five different products. Using two machines, the mill produces five different products, which consist of approximately 45 product lines, each of which is differentiated by up to ten grades. The production volume of the mill is 75,000 tonnes annually. The paper is sold as reels and sheets. The factory uses pulp in the production and purchases it from a number of foreign companies.

On average, the manufacturing cost of a typical product consists of direct costs such as material, steam and power, and packaging (59%); and conversion costs (41%). Direct labour that is included in the conversion cost accounts for less than 5% of the total manufacturing cost. Approximately 500 employees work within the mill. The Alfa mill produces its own electricity by a steam-powered electricity turbine unit. Due to lack of space, a small amount of raw material can be stored within the mill. However, most of the stocks, purchased by consignment, are stored in warehouses outside the factory, and this

application reduces the cost of holding inventory since payment is made when the pulp is transferred to the factory warehouse. Moreover, all finished products are sent to warehouses rented in the city where they are stored for a very short period and then transported to customers.

The Turkish mill, which we will refer to as 'Beta', by contrast, is a government factory with a production volume of 100,000 tonnes annually. One of its machines produces three different products in five grades. Beta produces Kraft paper in reels for cement bags and sacks. The mill also produces its own pulp by converting wood into chips. On average, for the manufacturing process as a whole, the product costs of Beta consist of direct material costs (74%), direct labour costs (2%), and overhead costs (24 %). There are 1,000 employees working at the mill.

6. Research methodology

A descriptive-type case study methodology (Ryan *et al.*, 1992: 114) is employed in this paper in order to examine the costing practices of the British and Turkish paper mills. The case study method is used since it provides the researcher with descriptive detail and allows the exploration of current applications. The study mainly consists of the analysis of the existing cost accounting methods and cost drivers employed by the two mills; interviews with production and support department managers and staff to identify various activities; and observations of the performance of various manufacturing and support activities. Both studies were conducted as follows.

Initially, the research consisted mostly of paperwork and focused on learning the details of the existing cost systems. The cost accounting managers in both cases described the cost systems as well as the manufacturing processes from the beginning of the process to the end. From the researcher's point of view, this work was useful in providing general information about the costing procedures and in understanding roughly how production occurred.

Two visits were then made to each factory floor in order to observe the manufacturing process. Later semi-structured interviews were conducted with the department managers in which they explained the functions of their departments. These interviews lasted between 30 and 60 minutes, during which the following questions were asked to identify activities occurring within the departments:

- How many employees work for the department?

- What do they actually do? (job definition for each different type of employee).
- How long do they work for each particular job? (in terms of approximate percentages)
- What is the rate of consumption of materials and other resources within the department?
- What is level of production for each department?
- Are there any activities such as setting up a machine, material movements, etc.?
- If there are any such activities, what are their resource consumption rates and how frequently must they be performed?

In addition to these questions, each department manager was asked other specific questions in connection with his/her department. The cost system was then re-examined to clarify some further points; product cost evaluation data (in the form of cost tables or spreadsheet models) were collected; and the study was completed.

7. Comparison of the findings of the two case studies

The two case studies revealed many similarities between these two companies from the product costing and manufacturing perspectives although the products and product ranges of the two factories differed. The major reason for these similarities is that paper production, regardless of product type, requires similar procedures and machines. For example, basic manufacturing procedures that may be observed in almost every paper factory may be classified as: liquidizing pulp, mixing pulp with chemicals, feeding machines with liquid pulp, producing, cutting and reeling paper. Other processes, such as coating and buffing paper, may differ from one factory to the other since these processes depend upon the type of product being produced. The following two sections compare the findings of the two case studies.

7.1. An assessment of the appropriateness of the existing cost systems

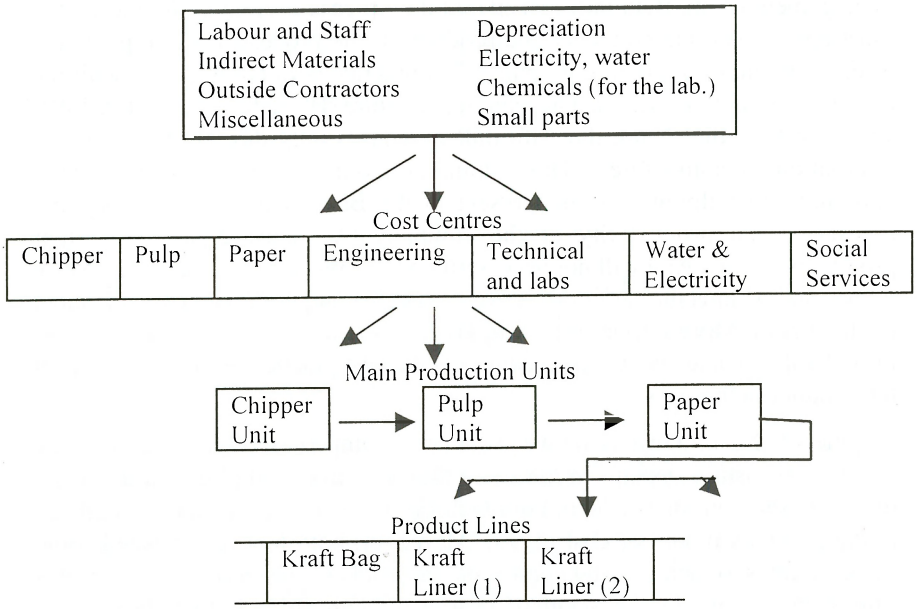
The manufacturing procedures of the two companies differ slightly. The Turkish company, Beta, manufactured its own pulp, whereas the pulp production process did not exist in the British company, Alfa. It was observed that this affected the selection of the cost system being employed. For example, Beta adopted a process costing system to cost its three products - wood chips, pulp, and paper. First, total production cost of the chips had to be evaluated to

find the direct material cost of the pulp. Then, the cost of the pulp was evaluated, which was finally used as the direct material cost of paper. Thus, the management of the Beta mill considered the process costing system to be the most appropriate method since the product of one process, e.g., chips, is the direct material of another, e.g., pulp. This practice is in compliance with the existing cost and management accounting literature (Horngren and Foster, 1991: 143). On the other hand, the Alfa mill purchases pulp directly from several international manufacturers. This eliminates two important processes, namely chipping and pulping, that are present in the Beta plant, and increases the efficiency and productivity of the company by focusing only on paper production. Thus, Alfa will not necessarily need a process costing system since it does not manufacture different products, and the output of which are the input of the others. More importantly, employing a certain cost system is a choice made by the management, which considers the best practice for its factory given the production process.

One of the similarities between the two companies is that they employ absorption costing systems in the sense that both assigned all manufacturing-related costs to products. Also, both factories use actual costs that are realised in the previous month or cost period. Moreover, both have established some standard rates to measure and control the material consumption. However, this cannot be regarded as a standard costing system since both factories use standard rates only for materials, not for labour or overhead. The cost systems of both factories allocate overhead costs to products in two stages as done in traditional product costing systems (Cooper, 1987a: 43-51, 1987b: 39-45). The following paragraphs describe the functions of these stages for the two factories under study.

In the first stage at the Beta mill, costs are incurred in related cost centres as they occur. A number of production and non-production departments are assigned to labour, indirect materials, repair and maintenance costs, water and electricity charges, and other costs that have a similar overhead nature. These costs are assigned to the departments depending on the actual consumption rates of each unit and service rendered where applicable. Other costs, such as social expenses are accumulated in the related departments, e.g., cafeteria. The cost accounting system has been designed and runs in a similar way at the Alfa mill. The actual overhead costs that relate to labour, indirect material and parts, rentals, some chemicals, etc., are accumulated within production and non-production departments during each cost period. The following figure depicts how overhead costs are allocated at the Beta mill.

Figure 1
Overhead Cost Allocation for the Beta Mill

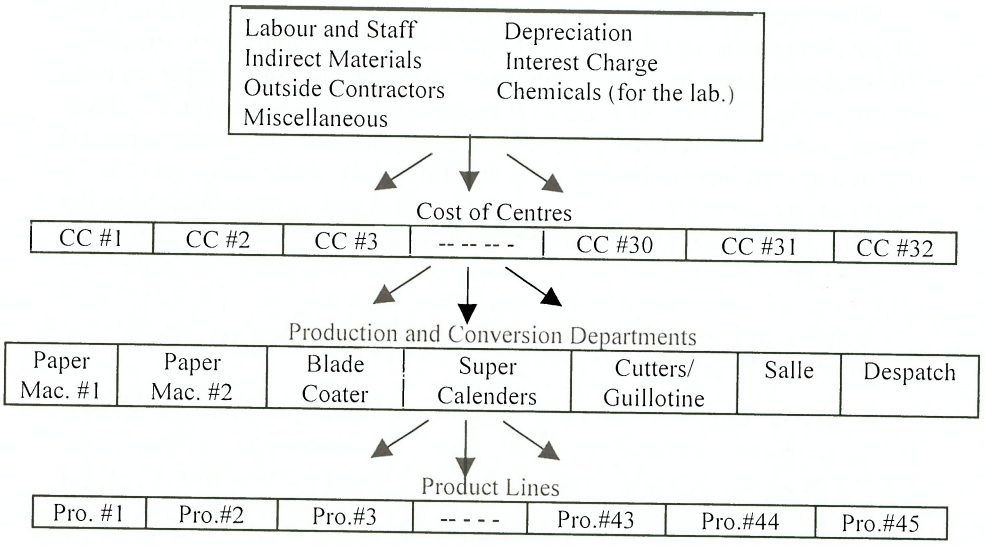


In the second stage, the procedures that the two factories follow to allocate overhead may seem slightly different from each other. Once all overhead is accumulated in a number of cost centres, Beta allocates these costs to products using machine-hours as a second stage cost driver. This is because machine-hours expended is regarded by the management as the most appropriate cost driver for allocating paper machine costs to products manufactured. This cost driver also represents a bottleneck in the factory.

The Alfa mill, on the other hand, allocates the overhead costs accumulated within the cost centres to the production (paper machines, coater and super calenders) and processing (cutters, salle, and dispatch) cost centres first. The following chart depicts how overhead costs are allocated at the Alfa mill.

This allocation is performed by employing several cost drivers, such as production tonnes, sales tonnes, service-hours rendered and number of employees working, all of which are regarded by the management as the most appropriate cost drivers for the first allocation. Then the costs that are aggregated within those seven cost centres are allocated to products using machine-hours expended and tonnes processed. The machine-hour cost driver,

Figure 2
Overhead Cost Allocation at the Alfa Mill



for example, is used for the paper machines, coater and super calenders; whereas production tonne is employed for the costs accumulated in cutters, Salle, and dispatch cost centres. Nevertheless, the second stage allocations are very similar in both factories from the cost drivers' perspective. The difference, a further cost allocation to the seven cost centres, is the result of an attempt to associate costs with products at the Alfa mill. For example, the costs that are incurred within the engineering departments can only be associated with products if they are allocated first to the machines to which repair or maintenance service is rendered. A similar procedure is followed at the Beta mill. However at the Beta mill, the expenses incurred in the cost centres, such as engineering, are allocated to the previous production centres (the chipper and pulp units). No allocation is performed within the paper unit since there is only one paper machine (whereas Alfa has two paper machines, one coater, three supercalenders, and five cutters). In other words, costs are assigned to the single cost centre, the paper machine unit, whereas they are assigned to the seven cost centres at the Alfa mill. Also, material costs (pulp and chemicals) are directly assigned to each particular product in both factories. Therefore, it can be said that both mills have almost the same cost systems and overhead cost allocation

methods, where the machine-hours expended is a dominant second stage cost driver.

While the two mills have almost identical cost systems and overhead cost allocation methods, small differences were found in the product cost structures. The total manufacturing cost of products at the Beta mill, for example, consists of, on average, 74% direct material (varying between 66 and 76%), 2% direct labour and 24% overhead that relates to production and non-production departments. However, the water and electricity cost, which is included in the overhead, accounts for 11.5% of the total product cost and is allocated to the products depending on the machine-hours demanded by each type. The reason for this type of allocation instead of direct assignment is that water and electricity consumption rates are found by engineering studies to be highly correlated with the machine-hours expended since the product range of the factory is limited to a family of products.

As stated before, manufacturing costs of the Alfa mill consists of 59% direct materials, packaging, steam and power; and 41% overhead costs on average. Direct labour cost, which accounts for less than 5% of the total manufacturing cost, is included in the overhead. However, the water and power cost item is considered to be a direct cost for the Alfa mill and is allocated to products depending on consumption rates. 7% of the total manufacturing cost is accounted for by water and power.

The case studies showed that product costing practices of both factories are performed reasonably accurately. The total product cost of Beta, for example, consists of a great deal of material (up to 74%), that is directly associated with each type of product manufactured. Also, the labour cost of the paper machine can be readily assigned to each product using machine-hours expended as a cost driver. This is considered by the management to be an appropriate cost driver for the labour costs because what keeps those employees busy is the running paper machine. The speed of the machine or amount of production has almost no effect on the work of the employees. In other words, the workers perform the same jobs when the machine is producing 70-90 gr. paper as when it produces within the 120-150 and 160-300 gr/m^2 ranges. Therefore, the machine-hours expended may be the best representative cost driver for the labour cost.

Other major overhead costs are depreciation, maintenance, social expenses, technical and lab, and indirect materials. There is no doubt that machine-hours expended is the best cost driver to allocate machine depreciation cost because, according to the official terminology of CIMA (1994: 117), the depreciation concept may be defined as "the measure of wearing out, consumption or other loss of value of a fixed asset whether arising from use, effluxion of time or

obsolescence through technology and market changes". Therefore, the wearing-out cost of a machine may be allocated to products by using the time intervals in which it has run.

The maintenance cost, on the other hand, is directly related to the paper machine and no association can be established between the repair and maintenance costs and product types. This is because maintenance and repair are performed upon the machine regardless of the type and amount of product produced. No particular product requires the machine to have specific maintenance. Moreover, all types of paper are manufactured by the same machine; and they require a similar process until they are sold. Therefore, the machine-hour may be considered to be the most appropriate cost driver to allocate repair and maintenance expenses to products. The same may be applied to the other overhead cost items at the Beta mill, such as social expenses and technical labs. The social expenses are not related to production, but relate to the number of employees. Thus, the social expenses can be aggregated in the paper unit and are then allocated to the products by employing machine-hours since the workload of the unit is the only variable for this allocation. In other words, paper machine capacity is the only bottleneck in the factory. Similarly, the costs incurred in the technical labs can be associated with the products indirectly. This department exists to assure quality of direct materials, chemicals, and paper. The tests they carry out are related to the amount of paper manufactured. The more machine-hours expended, the more paper is produced; and hence, this departments tests more direct materials, chemicals, and paper. Therefore, the machine-hour expended can be regarded as a reasonably representative cost driver to allocate the costs of this unit.

The Alfa mill, too, has similar applications. The bottleneck in this factory is the production capacities of the two paper machines although the coater and the super calenders play important roles in coating and buffing the paper. If the two paper machines do not make any production, the coater and the super calenders will be idle. All these machines are used as major cost centres in which manufacturing and non-manufacturing overhead are aggregated for further allocation. Another group of machines (five cutters and a guillotine) and two service departments (salle and dispatch) are also used as major cost centres. All of the overhead costs are assigned to these seven major cost centres as part of the second stage allocation. This is the only way that products may be associated with overhead costs, and for which the following may be given as possible explanations.

The yard and the stock preparation departments incur labour costs. The role of these departments is to stock pulp bales and convey them to liquidizers when

needed. Thus, the most appropriate cost driver for these cost centres will be the amount of pulp loaded to the two conveyors since it is the only difference between them. There are no different activities performed, nor are there any other factors that may affect the resource consumption in these departments. Moreover, the work carried out in these departments is a function of production output: the more paper is produced, the more pulp is required. Therefore, the output of the paper machines (in tonnes) may be a representative cost driver for these two cost centres, as is used in the existing cost system of the Alfa mill.

On the other hand, the engineering department costs, which account for 28% of the total overhead incurred in a typical period, are allocated to the seven major cost centres by using service-hours rendered for each. However, no association can be established between the engineering department costs and products, as is the case at the Beta mill. The role of these departments is to provide manufacturing units with smooth and uninterrupted production. Regardless of the product type, they perform routine and/or unexpected repair and maintenance. The only relationship between them and the products produced is the service they render to the machines. Therefore the cost of these units, after being apportioned to the machine cost centres, may be allocated to the output depending on the machine-hours expended for each product.

The same applies to the other cost centres. No relationships can be established between the costs incurred within the cost centres and the different types of products manufactured. Thus, all overhead costs should be associated with the departments since most of the work that is carried out within each department (cost centre), regardless of product type, is due to the existence of that unit. For example, the paper machines would receive the same engineering service regardless of whether they produce five or 500 products. In other words, product diversity (within the limit of a family of products) has no effect on engineering expenses. Also, the technical and quality control, and quality assurance departments perform almost the same number of tests per unit of completed or semi-completed products regardless of whether the factory produces five or 50 products (again, within the limit of a product family), since all products are tested depending upon production output. In other words, samples are taken from reels, say every quarter of a tonne, for which approximately the same number of tests is performed. This finding is also similar to that found at the Beta mill. At the Beta mill, the number of tests performed also does not differ from one unit of product to the other.

Therefore, it may be concluded that both factories have similar product costing systems in which similar cost drivers are employed for the first and second stage cost allocations. It is not quite possible to associate overhead costs

directly with different types of products. Rather, these overhead costs can be associated directly with the production and non-production departments in both manufacturing environments. Then, costs are allocated to the products manufactured using cost drivers by which logical relationships may be established between departments and products. Moreover, the researcher was convinced when performing both case studies that the two paper factories had reasonably accurate product costs and appropriate cost systems for their manufacturing environments. Having had an accounting strategy of costing products with a reasonable cost and effort, both factories have established the best possible and logical ways to associate overhead costs with products, which otherwise may be difficult to allocate.

7.2. An assessment of the appropriateness of activity-based costing

This paper also assesses the appropriateness of the Activity-Based Costing system for the two paper factories. The hierarchical model of Cooper (1990: 6) is used to classify costs and activities. Thus, the following comparisons of the two mills are performed using this approach in which manufacturing and non-manufacturing costs and activities are classified as being at the unit, batch, product or facility level.

7.2.1. Unit level category

The unit level cost category consists of pulp, chemicals, power, water and steam in the two factories. Both assign the cost of the pulp and chemicals directly to the products. The cost assignments are also similar: both employ actual costs for pulp and chemicals as well as overhead. However, while the Alfa mill regards power, steam and water as a direct cost, the Beta mill allocates them to its products using machine-hours since these three cost items are considered direct elements, the consumption rates of which are highly correlated with machine-hours expended.

At the Beta mill, the costs that fall into the unit level category account for most of the product costs (74%). This amount, however, is around 60% of the total manufacturing costs at the Alfa mill since the ratio of the direct materials to total cost declines as a result of further processes such as coating and buffing. The unit level costs are generally assigned to products in both factories by their actual figures, thus eliminating the possibility of a cost distortion.

7.2.2. Batch level category

The paper mills perform mass production in which processes depend on repetitive manufacturing actions. A limited number of paper machines are run 24 hours a day and a variety of different paper types belonging to the same family of products is produced. In other words, a paper machine that is designed for Kraft paper production cannot produce, for example, fine paper or cigarette paper although both require similar machinery and processes. Thus, the machine type may determine the product family to be produced; and since the paper machines require very expensive investments, a factory is unlikely to have different machines for different product types. Therefore, every factory is specialised on a very limited number of different products.

The two case studies showed that there was a critical point in paper weight at which machine set-up was required. This weight was observed to be 100 grams per square metre. The Beta mill has one paper machine that is involved in manufacturing a limited number of products that are under and over 100 grams per square metre. This requires workers to set the paper machine when changing from a lower-weight product group to a higher one. However, this does not affect the cost of a typical product at the Beta mill since it manufactures a limited number of products with long production runs, which eliminates the possibility of any cost distortions due to set-up costs. The Alfa mill, on the other hand, has two machines, one of which is assigned only to products that are less than 100 grams per square metre and the other for products that are over 100 grams per square metre. Thus, neither of the machines requires set-up under normal working conditions. Rather, they require changeovers (a change in product grade) without stopping the machines or production process. The changeover process may cause some amount of off-grade paper to be produced. However, the amount of this loss is reported by production engineers and is associated with each product grade, the production of which causes the loss. Both the Beta and Alfa mills include their losses in product costs when evaluating their cost of production. This eliminates cost distortion that might have occurred if the loss had been allocated to products by using an average figure.

Other batch-related activities, such as material movements, batch inspection, and son, were either not observed or the researcher was convinced that they were negligible in both factories. None of the factories studied had direct material (pulp and chemicals) movements to the paper machines. Rather, the mixture (the pulp and chemicals) is pumped to the machines through pipes. After production, the parent paper reels are taken by a crane and carried to be processed further. This activity, and hence the cost of it, does not differ from

one product to another since the crane carries standard parent reels in both manufacturing environments. On the other hand, the two factories do not perform batch inspection; rather they inspect individual products on a tonnage basis, which may be regarded as a product level category in this study. Therefore, no important costs, which effects the batch level category of the ABC hierarchy, was found regarding the two factories.

7.2.3. Product level category

The two paper factories incur product level costs in certain departments that render services to all product types and grades. These are engineering, yard, stock preparation, technical and quality control, marketing, buying stores, salle, and dispatch departments. These departments play different roles from the products' perspective, and hence two major consequences may be realised concerning their costs.

Firstly, the cost of some of these departments that render services to all manufacturing departments cannot be directly associated with the products produced. For example, the expenses of the engineering departments, which account for 28% of total overhead, cannot be directly associated with products since they render services for the departments rather than individual products. Therefore, both factories allocate engineering costs to products by using machine- hours expended for each type or grade. This cost driver selection is appropriate from an ABC perspective as well.

On the other hand, the costs of departments such as yard, technical and quality control, stock preparation, buying stores and salle can be allocated to products by using volume-based cost drivers since, in both factories, logical associations may easily be established between volume-based cost drivers and products. These cost drivers, machine-hours expended and production output (tonne), are regarded as the most appropriate variables to allocate those expenses that are classified at the product level category in this study. Moreover, interviews and observations at the two mills also verify the appropriateness of these mills' selection of cost drivers. Therefore, the following conclusion may be reached: the classification of costs within this category of ABC will not produce any different product cost information than that produced by the existing systems at the two factories.

7.2.4. Facility level category

The ABC system classifies all costs that are not related to the manufacturing processes in this category. Examples include factory security costs, some administrative costs, and heating and lighting. The ABC method, unfortunately, cannot produce any different cost drivers than those of the conventional methods. Therefore, using a facility level classification would not change the result of the cost allocation if the ABC system were applied.

7.3. Discussion

Manufacturing processes that are referred to as *convergent* and *divergent* for discrete-part (assembly -- electronics and machinery equipment) and continuous (such as paper, oil and chemical production) industries respectively may have quite different consequences from the cost management perspective (Reeve, 1991: 22; Fogelholm, 1995: 2). In the convergent processes, a number of different components are built, finished, inspected and assembled to form complete units. All required components, machines and tools that are necessary for assembly are made ready before the process, which demands extensively non-volume related and non-value-added activities such as set-up, material movements, quality inspections and production scheduling. The diversity of the product components and processes increases overhead resource consumption, which may result in high overhead costs. These costs may not be the same for every product, but they may vary among low and high volume, simple and complex products. Therefore, employing volume-based cost drivers, particularly labour-based ones, can distort product cost information since they may not establish causal-based relationships between most overhead costs and products.

On the other hand, the continuous processing environments that are referred to as divergent process industries generally require a common raw material flow through the course of manufacturing (Reeve, 1991: 24-25). In addition, manufacturing processes do not differ for each product. The final products, however, may have slight differences in terms of their thickness, width, colour and packaging. The end product variety of divergent processes may demand the consumption of some overhead resources, whereas component, process and volume diversity may consume most of the overhead in convergent process environments (Fogelholm, 1995: 2; Reeve, 1991: 22-24). Therefore, these differences may make ABC systems unsuitable for the divergent process environments although the system may be identified as quite useful for discrete parts and assembly industries, such as electronics and machinery equipment.

8. Summary and Conclusion

This paper compared the findings of the two case studies that have been conducted in a Turkish and a British paper factory. This study not only indicated similarities and differences between the existing costing practices of the two factories, but also assessed whether Activity-Based Costing is appropriate for them. This paper has attempted to answer whether:

- the traditional product costing systems that have been adopted by the Turkish and the UK paper factories produce distorted cost information in relation to product costs.
- the product costing systems adopted and cost drivers employed within the Turkish and the UK paper factories are appropriate from the product costing and decision--making perspectives.
- the Activity-Based Costing system is appropriate for either or both of the two paper factories researched.

The findings and further discussions revealed that the existing traditional product costing systems that are adopted within the two factories studied are appropriate. Moreover, the two volume-based cost drivers, machine-hour and production tonne, are also appropriate for the two paper factories studied, and they do not distort product cost information. These cost drivers are considered to be the most appropriate ones in representing resource consumption of production and non-production departments, and the links between those departments and products produced in both factories. Finally, the ABC approach was not identified as producing dramatically different product costs as found in the previous research studies performed in the electronics and parts industries.

References

BRIMSON, JAMES A., (1998), "Feature Costing: Beyond ABC", *Journal of Cost Management,* 12(1), 6-13.

BRUMMET, LEE R., (1957), *Overhead Costing,* Ann Arbor: University of Michigan.

CIMA, (1994), *Management Accounting: Official Terminology,* London: The Chartered Institute of Management Accountants.

COBB, I., HELLIAR, C. and INNES, J., (1995), "Management Accounting Change in a Bank", *Management Accounting Research*, 6(2), 156-68.

COOPER, R. and KAPLAN, R. S., (1987), "How Cost Accounting Systematically Distorts Product Costs" in W. J. Bruns and R. S. Kaplan, (eds.) *Accounting & Management Field Study Perspectives,* Boston, Mass.: Harvard Business School, 204-28.

COOPER, R., and KAPLAN, R. S., (1988a), "How Cost Accounting Distorts Product Costs", *Management Accounting,* April, 20-26.

COOPER, R., and KAPLAN, R. S., (1988b), "Measure Costs Right: Make the Right Decisions", *Harvard Business Review,* September - October, 96-103.

COOPER, R., and KAPLAN, R. S. (1991), "Profit Priorities from Activity-Based Costing", *Harvard Business Review,* May-June, 130-137.

COOPER, R., and KAPLAN, R. S. (1998), "The Promise Band Peril of Integrated Cost Systems", *Harvard Business Review*, July - August, 109-120.

COOPER, R., (1987a), "The Two Stage Procedure in Cost Accounting -Part One", *Journal of Cost Management*, Summer, 43-51.

COOPER, R., (1987b), "The Two Stage Procedure in Cost Accounting -Part Two", *Journal of Cost Management*, Fall, 39-45.

COOPER, R., (1988a), "The Rise of Activity-Based Costing - Part One", *Journal of Cost Management*, Summer, 45-54.

COOPER, R., (1988b), "The Rise of Activity-Based Costing - Part Two", *Journal of Cost Management*, Fall, 41-48.

COOPER, R., (1989), "The Rise of Activity-Based Costing - Part Three", *Journal of Cost Management*, Winter, 34-35.

COOPER, R., (1990), "Cost Classification in Unit-Based and Activity-Based Manufacturing Cost Systems", *Journal of Cost Management*, 4(3), 4-14.

FMN (Financial Management Network), (1991), "The New Revolution in Cost Management", *Financial Executive*, November - December, 37-38.

FOGELHOLM, J., (1994), "Product Costing Systems in Use in the Finnish Paper Industry", *Paper Ja Puu -- Paper and Timber,* 76(4), 243-45.

FOGELHOLM, J., (1995), "Cost Modelling in the Paper Industries", Conference Paper Presented at the Prosem 95, Norway, on May 18, 1995, 1-16.

HORNGREN, C.T. and FOSTER, G., (1991), *Cost Accounting: A Managerial Emphasis*, Seventh Edition, Englewood Cliffs, New Jersey: Prentice-Hall International.

INNES, J., YOSHIKAWA, T., MITCHELL, F. and TANAKA, M., (1993), *Contemporary Cost Management*, First Edition, London: Chapman & Hall.

JOHNSON, H. T. and KAPLAN, R. S., (1987), *Relevance Lost: The Rise and Fall of Management Accounting*, Boston: Harvard Business School Press, 1-269.

KAPLAN, R.S., (1983), "Measuring Manufacturing Performance: A New Challenge for Managerial Accounting Research", *The Accounting Review*, 58(4), 686-705.

KAPLAN, R.S., (1984a), "The Evolution of Management Accounting", *The Accounting Review,* 59(3), 390-418.

KAPLAN, R.S., (1984b), "Yesterday's Accounting Undermines Production", *Harvard Business Review*, July-August, 95-101.

KAPLAN, R.S., (1986), "The Role for Empirical Research in Management Accounting", *Accounting Organizations and Society*, 11(4/5), 429-450.

KAPLAN, R.S., (1990), "Contribution Margin Analysis: No Longer Relevant/ Strategic Cost Management: The New Paradigm", *Journal of Management Accounting Research,* 2, Fall, 1-7.

KOMPASS PRODUCT DIRECTORY - UK, (1994), *Products and Services, 1994-1995,* West Sussex, Eng.: Reed Information Services.

MCGUIRE, B.L. and KOCAKULAH, M.C., (1997), "Using ABC to Identify Cost Drivers in a Manufacturing Environment", *Journal of Cost Management,* 11(5), 22-29.

MILLER, J.G. and VOLLMANN, T.E., (1985), "The Hidden Factory", *Harvard Business Review,* September-October, 142-150.

NISBET, J. and WATT, J., (1982), *Rediguide 26: Case Study*, Edited by M.B. Youngman. TRC Rediguides Ltd, Oxford, 1-21.

OTLEY, D.T., and BERRY, A. .J. (1994), "Case Study Research in Management Accounting and Control", *Management Accounting Research*, 5(1), 45-65.

REEVE, J.M., (1991), "Cost Management in Continuous-Process Environments", *Journal of Cost Management,* Spring, 22-33.

RYAN, B., SCAPENS, R. W., and THEOBALD, M., (1992), *"Research Method and Methodology",* in *Finance and Accounting,* London: Academic Press Ltd.

SCAPENS, R.W., (1990), "Researching Management Accounting Practice: The Role Of Case Study Methods", *British Accounting Review*, 22(3), 259-81.

SHANK, J.K. and GOVINDARAJAN, V., (1988), "The Perils of Cost Allocation Based on Production Volumes", *Accounting Horizons*, December, 75-84.

SHANK, J.K. and GOVINDARAJAN,V., (1989), "Transaction-Based Costing for the Complex Product Line: A Field Study", *Strategic Cost Analysis*, Homewood, Illinois: Irwin.

SPICER, B., (1992), "The Resurgence of Cost and Management Accounting: A Review of Some Recent Developments in Practice, Theories and Case Research Methods", *Management Accounting Research,* 3(1), 1-37.

TROXEL, R.B. and WEBER, Jr., M.G., (1990), "The Evolution of Activity-Based Costing", *Journal of Cost Management,* 4(1) Spring, 12-7.

YIN, R.K., (1994), *Case Study Research: Design And Methods*, Second Edition, London: Sage Publications.

Özet

Sürekli üretim süreçlerinde maliyet uygulamaları: İki kağıt üreticisi arasında bir karşılaştırma

Son dönemde makine parçası üreten firmaların maliyet uygulamaları ile ilgili oldukça fazla sayıda araştırma yapılmıştır. Fakat kütle üretimi yapan endüstriler maliyet ve yönetim muhasebecilerinin çok fazla ilgisini çekmemiştir. Bu nedenle bu çalışmanın amacı, biri Türkiye'de diğeri de İngiltere'de faaliyet gösteren iki kütle üreticisinin (kağıt fabrikası) maliyet muhasebesi uygulamalarını incelemektir. Ayrıca activity-based costing (ABC) olarak bilinen "faaliyet esasına dayalı maliyet" sisteminin bu fabrikalarda uygulanıp uygulanamayacağı da araştırılmaktadır. Bu çalışma iki fabrikanın da benzer maliyet uygulamaları olduğunu tespit etmiş, ancak ABC'nin uygulamasının mevcut teknolojinin özelliği dolayısıyla verimli olmayacağı sonucuna varmıştır.