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CHANGE IN MANUFACTURING AND ITS EFFECTS ON COST AND MANAGEMENT ACCOUNTING

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Abstract

Manufacturing environments have changed enormously over the last three decades. Computers, computer-integrated systems, and robotics enabled manufacturers to produce what they could not do previously. New technology also caused global competition to increase, and assisted manufacturers from the Far East to dominate western markets in automotive and electronics products. Although Japanese manufacturers continued to employ traditional cost systems in this new manufacturing environments, their American counterparts blamed existing product cost systems and implemented new ones to enable themselves in competing with the Japanese. Today's customers require high quality and diversified products, and new manufacturing environments enable manufacturers to do so. However, manufacturers should know how to use these computer integrated systems and try to reduce the cost of non-value-added activities before changing their cost systems.

Özet

İmalat Sanayiinde Değişim ve Bunun Maliyet ve Yönetim Muhasebesine Etkileri

Son otuz yılda üretim teknolojilerinde önemli değişiklikler meydana gelmiştir. Bilgisayarlar, bilgisayarlı üretim sistemleri ve robotlar, üreticilerin daha önce yapamadığı üretimi yapmalarını sağlamıştır. Yeni teknoloji aynı zamanda global rekabetin de artmasına yol açmış ve uzak doğulu üreticilerin elektronik ve otomotiv sektörlerinde batılı pazarları ele geçirmelerine neden olmuştur. Bu yeni üretim teknolojileri ile birlikte geleneksel maliyet sistemlerini kullanan Japon üreticilerin aksine Amerikalı üreticiler, rekabetteki başarısızlıkları nedeniyle mevcut maliyet sistemlerini

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suçlamışlar ve yeni sistemler oluşturmaya çalışmışlardır. Günümüz tüketicisi, yüksek kaliteli ve bol çeşidi olan ürünler talep etmekte ve yeni teknolojiler de bunu mümkün kılmaktadır. Fakat, üreticiler bunu başarabilmek için öncelikle bilgisayarlı üretim sistemlerini kullanabilmeli ve mevcut maliyet sistemlerini değiştirmeden önce de ürüne değer eklemeyen faaliyetleri azaltmalıdırlar.

Introduction

Manufacturing environments have evolved through centuries and have changed a great deal since the Industrial Revolution. Many companies employed rudimentary forms of cost accounting in the medieval era; later many others improved it according to their needs, and depending on technology and manufacturing techniques that were in use. However, development of cost accounting slowed down prior to the 1950s although manufacturing technology was improving faster than before. Moreover, many companies have begun to introduce advanced manufacturing techniques; computer integrated manufacturing; and flexible manufacturing systems in the last quarter of the twentieth century (Senker, 1985:227; Jaikumar, 1986:69; Bear *et al*, 1994:20). These systems have increased the scope and quantity of products, reduced the number of workers required for production, and enhanced the quality of products. Nevertheless, most manufacturing companies, if not all, continued to adopt conventional cost accounting techniques that were claimed to be obsolete, i.e. inappropriate for the new and advanced manufacturing environments (Cooper and Kaplan, 1987; Kaplan, 1983, 1984b; 1986b).

The aim of this paper is to discuss why companies have adopted new and advanced manufacturing systems; how those systems have affected manufacturing processes, products, and product costs; and how cost and management accounting has responded to this change. This paper consists of three sections. The first discusses the process of change, and employee resistance that may be encountered when new cost and management accounting methods are implemented. The second section describes change in manufacturing environments and its underlying reasons such as global competition and changing customer expectations. Japanese and US manufacturing environments are contrasted in terms of scope, quantity, and quality of products produced. The third section deals with the response of cost and management accounting, including the emergence of new product costing techniques and philosophies that have been considered suitable for advanced manufacturing environments. Moreover, the final section discusses why most product costing systems have been regarded as obsolete in this new environment, and the consequences of this obsolescence.

1. The Process of Change

The last decades of the 20th century have witnessed important changes in most manufacturing environments. Global competition in many manufacturing industries, especially automotive and electronics, forced western companies to adopt advanced techniques (Dhavale, 1989:66; Jaikumar, 1986:69). The following sections describe the process of change and its inevitable partner, resistance.

1.1. A Model of Change

The process of adopting new technologies is known as diffusion (Stoneman and Karshenas, 1993:177), which may require changes in management accounting systems and in the organisation structure. According to Shields and Young (1991a:460), managing advanced manufacturing environments by adopting appropriate management accounting techniques and philosophies is as important as improving them. According to a research performed in seven manufacturing companies in the electronics industry (Innes and Mitchell 1990a), management accounting change occurs as a result of several factors that interact with each other. These factors include a competitive and dynamic market environment, organisational structure, production technology, product cost structure, management influence, and deteriorating financial performance. These factors, according to Innes and Mitchell (1990a), can be classified under a change model comprising three groups that supplement one another, ***motivators, catalysts, and facilitators***. These can be defined as follows (Innes and Mitchell, 1990a:12-14).

- ***Motivators*** are the ones that influence management accounting changes in a general manner. Competitive market conditions, organisational structure, production technology, product cost structure, and short product life cycles can be given as examples of motivators.

- ***Catalysts*** can be defined as factors which are directly associated with the changes, and occurrence of which correspond closely to the timing of change. Examples include loss of market share, poor financial performance, launch of a competing product, arrival of new accountants, and organisational change.

- ***Facilitators*** provide managers with some favourable conditions that are necessary but not sufficient by themselves for a management accounting change. Examples of facilitators include accounting staff and computing resources, degree of autonomy from parent company, and authority of accountants. The relationships among these groups may be depicted as:

- *MOTIVATORS → CATALYSTS → FACILITATORS.*

During their research, Innes and Mitchell found out that management accounting change occurred through the interaction of these three factors. They also found that, although motivators and catalysts generated the change, they only became effective when there were appropriate facilitating conditions. This change model is considered (Cobb *et al.*, 1995:172) strong on the external elements, but weak on how change occurs within the organisation and how it affects employees. The following section describes the effect of change on employees, and how to overcome resistance.

1.2. Resistance to Change

The implications of technological changes should be considered within the organisational and cultural contexts in which the change takes place (Hopwood, 1990:14), because the human factor exerts an important effect against change (Lammert and Ehrsam, 1991:445). Resistance should not be dismissed by considering it as illogical and emotional; however, it should be analysed in detail to overcome further opposition (Scapens and Roberts, 1993:30). Employee opposition may disturb and delay the change process, if not cause a failure. Managers should be aware of the four most common reasons that employees resist change (Kotter and Schlesinger, 1979:107). They are

- a desire not to lose something of value,
- a misunderstanding of the change and its implications,
- a belief that change does not make sense for the organisation, and
- a low tolerance for the change fearing that they cannot develop new skills or behaviour required for the new system and become unsuccessful.

Recent studies identified some of these reasons as the basic causes of resistance to change regarding product cost systems. For example Walley *et al.*, (1994:23), in their research study conducted among 20 UK manufacturers, reported that many owners and managers (9 out of 20 companies) exerted a negative influence on change of existing cost systems. The researchers found that satisfaction with the existing system, shortage of resources, and inadequate information were among the reasons given for resistance.

Managers and owners may consider that elaborate and advanced cost systems are not necessary as long as their existing and simpler cost systems are providing them with adequate information (Kellett and Sweeting, 1991:25). Also, many of them perceive that the cost of implementing more detailed cost systems

may exceed the expected benefits (Horngren, 1986). However, perhaps one of the most important aspects of resistance to change may stem from a manager's fear of becoming, or to be seen as being unsuccessful, since adopting a new cost system may change company profits and performance measures. Shields and Young (1991b:452--454), for example, state that changing cost systems or continuous improvement processes may reduce short term profits and earning per share in capital markets. Moreover, reported performance of employees may decrease as a result of implementing a new cost management system. Therefore, these changes may have great impact on employees. To reduce resistance to change, Shields and Young argue that employee education programmes should be started before changes occur. Also, performance measures should be revised; and short term performance measures should be replaced with long-term ones. Other specific organisational circumstances should be understood to penetrate basic motives of resistance (Scapens and Roberts, 1993).

2. Change In Manufacturing Environments

Since the 1970s, many US manufacturing companies have begun to implement new manufacturing systems and philosophies, such as flexible manufacturing systems and just-in-time respectively, in order to be able to compete with Japanese and other Far-East manufacturers (Young and Selto, 1991, 265). US manufacturers considered that their Japanese counterparts who had installed advanced manufacturing systems had gained competitive advantage by producing customised, cheap, and good quality products. Thus, the following sections consist of definitions, significance and benefits of the advanced manufacturing systems; and emphasize the importance of customers, whose effect has led manufacturers to change their manufacturing environments.

2.1. Definition, Importance and Benefits of Advanced Manufacturing Technologies

Advanced manufacturing technologies (AMT) are the essential tools that change manufacturing processes in today's world-class manufacturing companies, because these systems enable companies to reduce set-up and throughput times; improve product quality; increase manufacturing flexibility; and reduce the number of defective products (Drury, 1992:620). Examples of these systems are numerical control machines (NC); computer-aided design (CAD) and computer-aided manufacturing (CAM); flexible manufacturing systems (FMS); and computer integrated manufacturing (CIM). Advanced manufacturing systems, with regard to the related literature (Drury, 1992:621; Bromwich and Bhimani, 1989:22-25), may be summarised as follows.

Numerical control machines (NC): These are programmable machines that use punched cards to store set-up or machining instruction for performing various manufacturing operations. Computerised versions (CNC) are also in use. These machines are accurate and able to perform repetitive actions with higher flexibility and they can be set up quickly for different types of products. By using these machines, set-up times can be reduced; quality can be improved; scrap, rework levels and number of workers can be decreased significantly.

Computer-aided design and computer-aided manufacturing (CAD/CAM): These systems refer to the use of computer and mechanical technology together for facilitating design and manufacturing of a product. CAD helps engineers and designers to make new products and to analyse them from different perspectives by examining alternative configurations. By using CAD, designers and production engineers can work together effectively at the design stage of a product. If the designers design a model that is difficult or expensive to produce, the production engineers are able to warn them at this stage, and ask to change the design. Moreover, the system assists designers to reduce the number of parts required by displaying products from different angles and shapes. Furthermore, it allows them to see whether existing standard parts may be used in new products and, hence, helps them to reduce cost and to simplify new products. CAM systems, on the other hand, comprise numerically controlled machines, robotics, and flexible manufacturing systems. Robots in this system are used for certain environments in which tasks are relatively simple and repetitive, and where human intervention is not required. However, their flexibility may be limited (Drury, 1992:621).

Flexible manufacturing systems (FMS): These systems are able to produce a family of products in a flexible manner. An FMS consists of automated material handling, semi-independent work stations and a network of computers. The significance of an FMS over a traditional manufacturing system is that it has the capability of producing a variety of distinct parts automatically in different volume levels. The system also enables manufacturers to respond to customer demands quickly and reduces labour costs by cutting the number of workers required. Users of these systems may easily modify design of a product at any stage of its life and change product mix when the demand level changes (Gold, 1982:90-91). Moreover, short set-up times, increased product quality and machinery efficiency, low inventory levels and less space requirement may be counted as advantages of the system (Bromwich and Bhimani, 1989:25; Foster and Horngren, 1988). For example, when one Japanese company, Yamazaki Machinery, installed a flexible manufacturing system, it reduced the number of machines from 68 to 18; employees from 215 to 12; floor space required for manufacturing from 103,000 square feet to 30,000 and average processing time of a product from 35 days to 1.5 (Kaplan, 1986c:87). Therefore, the company

reduced its costs; gained higher flexibility; and shortened throughput times. As a result, it increased its response rate to customers, and hence its competitiveness.

Computer integrated manufacturing (CIM): Computer integrated manufacturing is regarded as the final step towards full automation in a manufacturing environment. By using CIM, many elements of advanced manufacturing technologies (AMT) can be integrated and run in harmony. Today's factories often require human bridges between work stations. Since they cause delay by performing non-value-added activities, the final aim in a CIM system is to eliminate the human bridges and replace them with fully automated, computerised machinery and robots.

2.2. Change in Market Conditions and Customer Expectations

The use of advanced manufacturing technologies may be a result of changing customer expectations that have affected markets world-wide. Customers are the ones who have desires, wishes, preferences, needs and abilities to choose among different products. They are the consumers who also take economic factors into account when they want to buy. These factors play important roles from the consumers' point of view in deciding what and when to buy. In the past, however, customer behaviour was slightly different from that of today. For example, in the 1950s and 1960s, customer demands were high and manufacturers were selling whatever they produced (Gault, 1994:23). Especially, the electronics and automotive industries showed significant developments in sales during these periods in the US. In other words, these industries boomed as customer wealth increased. Japanese products, by contrast, were considered by US customers as cheap in price and poor in design and quality in those decades (Hayes, 1981:57). However, both Japanese manufacturing and its reputation changed in the 1970s. They improved their production processes and product quality in the late 1960s. Also, recessions and oil shortages that affected many countries in the 1970s helped the Japanese manufacturers to become tough competitors. In the automotive industry, for example, most of the US companies were producing big cars that consisted of large engines with high petroleum consumption, whereas Japanese cars were relatively smaller than their US counterparts, cheaper to buy and drive.

In the 1970s, when the oil shortages and its inevitable consequences - price increases in many products - hit many countries, Japanese cars started to enter and, in a short time, dominated the US markets. Moreover, because of their inflexible manufacturing environment, US car manufacturers could not respond when the market demanded cars with low petroleum consumption. However, having been installed flexible manufacturing systems that both reduced cost and increased quality, Japanese manufacturers were able to offer a wide variety of

products to different customers with reasonable prices. Therefore, the state of the industry increased the Japanese domination in US markets.

In the last two decades, customers not only demanded better quality products that were reasonably priced, customised and reliable, but they also wanted after-sales service and better marketing channels for fast and timely delivery (Howell and Saucy, 1987:42). Moreover, in this highly competitive markets and manufacturing environments, product life cycles have become shorter, which has forced manufacturers to produce new and innovative products to maintain their competitiveness. Manufacturers had to install advanced production systems that were required by the new manufacturing environments if they wanted to survive. Information technology improved, resulting in consumer awareness about product price, quality, and after sales service. In other words, it can be stated that it is customers who have forced manufacturers to change.

2.3. Reasons for Japanese Manufacturing Success

Advanced manufacturing technologies provide manufacturers with radically different production processes from those of conventional systems. Reduction in defective units and set-up times; shorter and flexible production processes; less space usage; fast information flow from work-shop to management and vice-versa; and many other advantages (see, for example, Goldhar and Jelinek, 1983) can be achieved by using these systems. Moreover, size of production batches is not important for these new systems. There will not be a significant difference between the unit cost of producing one or many products, provided that the essence of the systems is well captured by the manufacturers (Goldhar and Jelinek, 1983:143).

Flexible manufacturing systems do not care whether they are producing small or large-sized batches, as long as the required instructions are loaded onto the computers that are linked to them. All products in a batch, from the first to the last, are manufactured precisely in the same manner by a flexible machine since it repeats exactly the same procedure to produce. Moreover, these systems are designed to reduce waste to minimum levels. Changeover from one type of product to another - within limits of a family of products - is performed according to the information loaded onto the computer of an FMS. Since the flexible systems possess these abilities, there is no need for large-sized batches to reduce the cost of production runs. Therefore, all types of stocks, e.g. raw material, work-in-progress, and finished goods, may be kept at minimum levels, resulting in changes in the economic order quantities and reduction in storage capacities.

Japanese manufacturers have incorporated these abilities of flexible machines with their cultural conventions to achieve manufacturing success. Their different approach to business (Morgan and Weerakoon, 1989:40) has been known since the beginning of the 20th century. Their cultural and social values play an important role in their manufacturing success (Hayes, 1981:57; Drucker, 1981; 1990). For example, the Japanese are willing to sacrifice their personal lives for the company, and they are more tolerant of working long hours in uncomfortable working conditions than their US counterparts (Martin *et al.*, 1992). On the other hand, the most important characteristics that makes the Japanese manufacturers successful lies behind their commitment to the use of advanced manufacturing technologies and philosophies (Morgan and Weerakoon, 1989; Hiromoto, 1988; Jaikumar, 1986). For example, while US manufacturers had 1,200 robots for manufacturing in 1974, the Japanese had 1,000; within ten years, while US manufacturers increased their robot stock to 13,000 units, their Japanese counterparts increased to 64,657 (Stoneman and Karshenas, 1993).

The Japanese learned how to think about manufacturing operations in an effective way, and put that thinking into practice in a disciplined manner (Wheelwright, 1981). They have captured the essence of how to make the machinery, new technologies, and people work together to achieve company goals. If flexibility is required for production, they install flexible manufacturing systems and run the systems according to the capabilities of the machinery. In other words, if the machinery allows for shorter set-up times, Japanese manufacturers have shortened set-up time and became more flexible. Toyota, for example, evaluated the set-up time for a certain process taking six hours for one US automobile company and four hours for Volvo and its German competitor (Hayes, 1981:59). However, Toyota reduced the time of the same set-up activity to 12 minutes. As resource consumption rates of such non-value-added activities are reduced to minimum levels, their impact on the cost of a product will also decrease.

According to some researchers (Jaikumar, 1986; Hayes, 1981) who conducted comparative research in US and Japanese companies that installed FMSs, there were significant differences between those two manufacturing environments. For example, US manufacturers treat the flexible manufacturing systems as if they were simply 'new machines' of what they had been using for high volume production. They increased the batch sizes to reduce set-up costs. However, the idea of producing large and hence economic batches, is far from reality in this new production environment.

Japanese manufacturers use FMS to produce low volume as well as high volume customised and innovative products with an almost zero defective unit. If any faulty product is produced, they immediately stop the whole system and

investigate the cause. When they reduce the number of defective units, they reduce product cost since they reduce the number of inspectors and employees doing rework, and hence increase productivity. It has been claimed (Hayes, 1981:63) that "a 2% reduction in defects is usually accompanied by a 10% increase in productivity." Other aspects that the US manufacturers do not achieve in their factories may be summarised as follows (Hayes, 1981):

- The Japanese have clean and orderly work places, in which very little stocks are held.
- They do not overload the machines in order to avoid break-downs and they monitor the systems continuously.
- They work without having a crisis atmosphere and, unlike US companies.
- Their capacity measures are based on actual performance data rather than theoretical or absolute standards.

Therefore, the Japanese manufacturers have captured the essence of producing low cost, high quality, innovative and customised products, and became world-class competitors in the last two decades.

3. Cost and Management Accounting Response to the Technological Change

These changes that have occurred in many production environments have also produced questions about the validity of traditional cost and management accounting systems that are in use. Some researchers (for example, Kaplan, 1983; 1984b; Cooper and Kaplan, 1987; Johnson, 1988; 1991) stated that cost accounting principles were established when production environments and market conditions were different from those of today. In the 19th century, companies were employing a great number of workers who actually produced products, and whose costs constituted a significant portion of cost of the products. Moreover, since capital investments were relatively less than those of today, and most of the investments were for labour-intensive technology, the total overhead costs of those companies were lower than the ones in today's capital-intensive organisations. Many companies used labour hours (or cost) as a basis of allocating overhead costs to products. This choice was justifiable for those companies, because the labour hours and the labour cost were always two important subjects for managers, records of which were regularly kept and carefully examined. They were ready data that managers could trust. Moreover, the production process was usually a function of the direct labour hours, i.e. the more labour hours that were expended, the greater the amount of products that

were produced. Furthermore, collecting and classifying detailed overhead data was unnecessary for those products, the total cost of which mainly consisted of direct labour and material, and which were not highly diversified. Thus, overhead costs were easily allocated to products by employing labour-based cost drivers. However, these cost drivers are now considered to distort product cost information by most researchers (Seed, 1984:39; Brimson, 1986:29; Kaplan, 1988:61; Cooper and Kaplan, 1988b) for today's more advanced and automated manufacturing environments, in which the use of direct labour declined considerably. The following section describes the consequences of adopting traditional cost allocation bases by comparing US and Japanese cost and management accounting practices.

3.1. Effects of Technological Change On Cost Accounting Systems

Technological change has significant impacts on the cost structure of products (Kerremans *et al.*, 1991). The elements of product cost have changed their importance and composition as companies gradually shifted from labour to capital-intensive technology (Tishlias and Chalos, 1986:167; Lowell, 1988:45). The advent of advanced manufacturing technologies has decreased the number of employees to such a degree that many manufacturing companies now regard direct labour cost as a small fraction of the manufacturing overhead (Hunt *et al*, 1985:59; Chalos and Bader, 1986:106). The result of this reduction has caused the need for direct labour standards to become questionable (Chalos and Bader, 1986:110) since the direct labour costs represent less than 5% of the total cost of a product in many manufacturing companies. Also, some other types of variances do not exist in AMT environments (Bromwich and Bhimani, 1989:53). For example, purchase price variances tend to disappear when buyer-vendor relationships are established by long term contracts for small volume deliveries rather than large quantity orders. Efficiency variances relating to scrap and rework can be traced on the factory floor as soon as they occur, rather than through management level correction which is delayed until data is received.

New manufacturing systems require more capital investment than their predecessors, since machines, computers, and robots are being used together to achieve company goals. The costs that are regarded as "fixed" with respect to production volume have become sunk in many cases since the expenditure must be made before production begins (Johnson and Kaplan, 1987b:37). The increasing levels of capital investment have changed the product cost structure for many industries, such as electronics and automotive and, while overhead cost is increasing, cost of direct labour, as explained above, has gradually decreased. Hence, according to some researchers, product costing systems that employed direct labour based allocation methods caused product cost distortions in many production environments since the incurrence of overhead could not be associated

with the decreasing direct labour content of a product. Yet, many companies continue to allocate their overhead costs to products using labour hours or cost (Tayles and Drury, 1994:11).

Japanese manufacturers still employ volume-based traditional cost systems for their product costing needs (Bhimani and Bromwich, 1993; Hiromoto, 1988). They work in competitive markets and produce new and innovative products by using FMSs and other advanced manufacturing systems. Most products that they produce have short life cycles, another outcome of the new manufacturing environment. Moreover, Japanese manufacturers produce customised products in low volumes that often require set-ups, changeovers, material movements, and quality inspections. Therefore, it may be said that Japanese manufacturers have encountered all the conditions that some researchers (such as R.S. Kaplan and R. Cooper) claim as symptomatic of a need to seek out more appropriate cost systems.

Nevertheless, Japanese manufacturers do not suffer from overhead cost mis-allocations, or over and under-costed products that may cripple their market share and competitiveness in general. Most of their success, as emphasised in the previous sections, has come from their commitment to use advanced technologies in their factories. They have captured the essence of how to use flexible systems; they reduce set-up times, eliminate inventories and customise products. As in the Toyota example, the effect of set up cost, the time of which has been reduced from six hours to 12 minutes (1/30th), will not be significant for products produced in this new manufacturing environment. Japanese manufacturers have reduced the inventories by adopting new philosophies such as just–in–time and quality management; and hence, they have decreased all inventory related costs and increased product quality (Kaplan, 1986c:87). Also, application of the JIT philosophy drastically simplified the receiving process since suppliers deliver products of absolute reliable quality (Holzer and Norreklit, 1991:9). These applications help Japanese manufacturers to eliminate most of the overheads, such as costs of inventory managers and staff, material handling, sophisticated inventory systems, material expeditors, quality inspectors, scrap, extra resources and employees for rework and repairs. Most of the activities carried out by those employees are non-value-added, which do not increase the value of products produced, but which consume resources. Since the Japanese have eliminated them, they manage to reduce the cost of products. More importantly, when the cost of non-value-added activities had been reduced, volume-based cost drivers, such as labour and machine hours, became reasonably representative for the overhead costs incurred.

Japanese manufacturers adopt target costing and market driven strategies for pricing their products (Berliner and Brimson, 1988:225-6; Hiromoto, 1988).

Before the design stage of a product, management estimates the price at which a product can be sold. They deduct some amount from this price as profit margin according to company policy, and the remainder is the target value that the manufacturing cost of the product should not exceed. The target cost is always determined below an amount that, under current conditions, it is difficult to achieve (Morgan and Weerakon, 1989:42). At this stage, designers and production engineers work together to achieve the target costs. Design proposals, engineering, analysis and cost estimations continue until the target cost is attained. When it is achieved, the production process starts. However, the cost reduction activities also continue.

Yoshikawa *et al.*, (1989a:22), who conducted a survey to compare Japanese and Scottish manufacturing companies, found that Japanese companies gave more attention to product costing prior to the manufacturing stage than their western counterparts. For example, while Japanese companies spend 83% of the time of a product life-cycle to planning and basic design, their Scottish counterparts spend 69% of the product life-cycle time for the same purpose. Also, it was stated that Japanese companies adopted functional analysis, which is a technique based on value analysis, for cost reduction purposes. Moreover, they use cost tables to show how the cost of activities in a production process is affected by a range of cost drivers (Yoshikawa *et al.*, 1990:31). Detailed analysis of these practices, however, is beyond the scope of this study (see Yoshikawa *et al.*, 1989b; 1990).

US companies, on the other hand, could not cope with the technological change and its requirements. Most US manufacturers who have installed FMSs or other advanced manufacturing systems continue to produce high volume products as well as low volume ones. They increase their product range to become more competitive and profitable, and to respond to more customers. However, an increased product range has led to an increasing number of set-ups, material movements, engineering change orders, material and customer orders, inspections, and other non-value-added activities. The more the non-value-added activities, the higher the overhead costs. In contrast to their Japanese counterparts, the US companies were not able to reduce or eliminate those non-value-added activities significantly. Moreover, the new structure of the overhead cost was a result of non-volume related activities, the cost of which can hardly be allocated by using volume based cost drivers. As a result, those companies failed to produce accurate product costs, since the product costing systems they adopted were mostly depending on volume related variables that did not represent increasing non-value-added overhead costs. Therefore, wrong use of the flexible systems led US companies to change their product costing systems. The following section discusses the impact of new cost and management accounting techniques upon manufacturing companies.

3.2. Impact of Cost and Management Accounting Changes

A research study (Innes and Mitchell, 1989) concerning 10 electronic companies found that management accounting practices have changed and are continuing to change, particularly in three areas: costing, performance measurement, and decision support. According to the study, complexity is eliminated and simpler actual costing practices are developed; recognising the limitations of the traditional financial measures, non-financial measures are established for product quality, delivery performance, launch time for new products, and customer satisfaction. Also, new techniques that emphasize competitive analysis and design for cost (similar to Japanese applications) as well as "landing cost", a term which is used for all costs from production to delivery, are adopted to support the decision-making process (Innes and Mitchell 1990a).

Innes and Mitchell stated that the development of management accounting practices affected the firms that they studied in two different ways. Firstly, managers perceived some benefits as a result of changes; they received more timely, relevant and comprehensible new information for cost reduction, cost control, product quality, and performance measurement. Secondly, the role and status of management accounting also changed, since new managerial policies facilitated the practical accounting changes that were the responsibility of management accounting (1990a:9-11).

On the other hand, Coates and Longden (1989:9-13) analysed twenty UK and five US high tech companies and revealed a wide range of developments in management accounting practices. The researchers found that traditional practices and absorption costing were still dominant in almost all the high tech companies they studied. New techniques such as MRP and JIT (materials requirements planning and just-in-time) were introduced and these had an impact on management accounting methods. Moreover, quality costing was emphasized by the company managers as important. Nevertheless, most accountants were not aware of new management accounting techniques; and they did not feel that they needed new techniques to cope with the changing environments.

Another study revealed more detailed information about the UK manufacturing firms and their management accounting practices. Bright *et al* (1992) surveyed 677 manufacturing firms operating in the UK, and revealed that 68% of the companies had made significant changes in their management accounting systems within five years. Moreover, this percentage increases up to 82% if this period is extended to ten years. Among the respondents, 32% of the companies were identified as activity based costing (ABC) users; however, the researchers considered this figure as somewhat exaggerated because of group pressure on accountants when they had completed the questionnaire. It was also

reported (Bright *et al*, 1992) that many manufacturers employed traditional cost systems that were modified to adapt existing conditions. The benefits that were expected by management of those companies from introducing new costing practices include (p. 207): product profitability improvement (65%), cost reduction (60%), and more timely and relevant management information (59%).

Bright *et al* (1992:209) also reported that the study found inconsistencies between manufacturing and advanced costing techniques and practices. Moreover, they revealed that inconsistencies also existed between advanced costing techniques and practices. For example, it was found, that although 48% of the respondents would be using the JIT technique in three years time, only 24% of them would simplify their cost and stock accounting system. Furthermore, while 69% of the companies will be using TQM as a manufacturing technique in three years time, only 52% were going to support this system with Cost of Quality Reporting. Therefore, the researchers concluded that there is a need to understand management accounting innovations properly.

Another impact that has affected cost and management accounting is the development of activity based costing (ABC). ABC was first introduced as a cost finding technique between the years 1988 and 1990, then its managerial side was emphasized (ABCM), i.e. its use in identifying value-added and non-value-added activities, cost driver analysis, and for budgeting purposes. Apart from its use for product costing, its managerial use resembles what Japanese manufacturers have done in their factories to eliminate non-value-added activities that were described in the previous sections. Although it does not stop cost distortion itself, ABC cost information directs managers' attention to areas where non-value-added activities incur costs that can be reduced or eliminated. Since the Japanese success is a combination of their cultural values and their commitment to use flexible systems, ABC, particularly its use for managerial purposes (i.e. ABCM), can help manufacturers to capture the essence of flexible systems. Therefore, they can cope with global competition and the requirements of the 20th century.

ABC has received a great deal of interest both from academics and practitioners since it was first publicised in the latter half of 1980s. Moreover, it has been reported (Innes and Mitchell, 1994:9) that the idea of implementing ABC is gaining more ground among manufacturing companies in the 1990s. According to their questionnaire survey research, Innes and Mitchell (1994) have reported that 60% of the respondents had been involved in ABC; however, 13% did not implement ABC after an assessment had been performed. On the other hand, 27% of the respondents were currently considering implementation, and 19.5% had implemented ABC. The rate of implementation they found was higher than that was found by Cobb *et al*, (1992a), who reported that only 6% of the respondents had begun to implement an ABC system.

Through telephone interviews and visits, Cobb *et al*, (1992a; 1992b) identified a number of reasons for failure to implement ABC. Among them were: implementing ABC would be costly and consume accountants' and managers' time; and ABC is not suitable for their business. These two basic reasons were confirmed in the later study by Innes and Mitchell (1994) who also investigated companies rejecting ABC in their survey. In addition, they found that some firms failed to implement ABC because they could not identify the benefits of ABC; and others claimed a variety of circumstances that reduced the relevance of ABC to them.

Summary and Conclusions

Advancement in manufacturing technology and increase in global competition have led manufacturing companies to change both their product mix and production philosophies. Advanced manufacturing systems such as FMS, CAD, and CAM, enabled manufacturers to increase product range and quality. However, the increase in product range and competition among companies to manufacture innovative products caused product life cycles to become shorter than before. Since today's new and innovative products can only be produced in this new manufacturing environment, companies were obliged to install new technology in order to compete and to survive. For example, Japanese manufacturers who have installed new manufacturing machinery and computerised technology in their factories have become world class manufacturers in the last two decades. The most important features of advanced manufacturing systems are to enable users to shorten set-up and changeover times; reduce all types of inventory levels (if JIT is also implemented); simplify cost and stock accounting; and increase product quality. As a result, Japanese companies, having captured the essence of these systems, reduced product costs and increased quality. Moreover, they also produced new, innovative and high quality, yet cheap products that today's customers want to buy. They gained market domination by not only installing new technologies, but also by managing those systems as they should be managed.

On the other hand, although they installed AMT, US companies could not capture the essence of the new factory floor. They failed to reduce or eliminate the cost of non-value-added activities. The new manufacturing environments would not have these non-value-added activities at significant levels were they be managed properly. As a result, overhead costs of those non-value-added activities grow bigger, causing the traditional product cost systems to become obsolete. Therefore, new product costing systems and philosophies, such as ABC, JIT and TQM, are considered essential if companies are to achieve global competitiveness.

Changing cost systems, without analysing company culture, may cause resistance among employees against change. Most of this resistance has come from company owners and managers who fear their being seen as or becoming unsuccessful because of the implementation of the new system. The resistance, however, can be overcome if employees are educated, and if long term, rather than short term performance measures are applied.

US manufacturers changed their cost systems while their Japanese counterparts kept their traditional cost systems but attempted to reduce or eliminate the reasons that would cause the cost systems to become obsolete. The Japanese also implemented manufacturing philosophies such as JIT and TQM, to supplement their cost systems. By contrast, many western companies considered ABC as a method of producing accurate cost information and a tool for decision-making, which could replace traditional costing methods. Since the Japanese success is a result of their different cultural, working, and managerial style, it can be concluded that implementation of ABC in a manufacturing company can be regarded as a useful attempt to achieve competitive success in manufacturing and a means to become a world-class manufacturer.

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