Arab Journal of Administrative Sciences

2009, Vol. 16, No. 2, 271 - 321

Mirghani N. Ahmed

King Fahd University of Petroleum and Minerals, Saudi Arabia

SUPPLY CHAIN MANAGEMENT: SYNTHESIS OF THE PERCEIVED ROLE AND CONTRIBUTION OF MANAGEMENT ACCOUNTING

Key Words

Supply Chain Management; Management Accounting; Cost Management; Target Costing; Performance Measurement; Trust; Open Book Accounting; Information Sharing.

Abstract

The rapid growth in inter-firm and collaborative relationships in industrial and business practices over the last two decades has presented management accounting with new challenges. One of these challenges is to provide the techniques and information for the coordination and management of activities across firms in a supply chain. This paper reviews the ways in which management accounting responded to the developments in supply chains and the extent to which accounting and accountants are contributing to the effective management of supply chains. The review focuses on the development of ideas and issues surrounding the emergence of supply chains and the impact on management accounting. The current, potential and future roles of management accountants in this area will be explored, in addition to some illustrations of emerging management accounting practices including practices from studying a supply chain and collaborative relationships in a Saudi organization.

Introduction

In today's competitive business environment, corporate success for many economic organizations depends on their ability to balance a stream of product and service process changes with meeting customer demands for improved cost, efficiency, quality, delivery, and flexibility (Lockamy and Smith, 2000). More importantly, with the increase in global competition, many organizations have acknowledged the difficulties of developing and maintaining the range of expertise and skills to compete success-

Submitted February 2007, accepted December 2007.

fully (Langfield-Smith and Smith, 2003). Consequently, a large number of firms are increasingly relying on strategic relationships and alliances with other firms to expand capabilities and improve economic efficiency and performance (Porter, 1985; Borys and Jemison, 1999).

While the topic of supply chain management has a focal interest across many disciplines e.g. industrial economics, marketing, purchasing and logistic management, information technology, operations management, are increasingly gaining the attention on the agenda of management accounting research. Managing supply chain means managing across traditional functional areas in the company and managing interactions and interdependence external to the company with both suppliers and customers (Lummus and Vokurka, 1999). As conventional management accounting systems have been mainly designed to focus on intra-organizational relations and not on linkages and interdependencies across the legal boundaries of the firm (Porter, 1985; Hergert and Morris 1989; Patridge and Perren, 1994), inter-firm relationships pose new challenges for management accounting (Berry *et al.*, 2000; Dekker 2003). This paper reviews the ways in which management accounting and management accountants have responded to the developments in supply chains and the extent to which accounting and accountants are contributing to the effective management of supply chains.

The paper is organized as follows: Section 2 provides definitions of supply chain management (SCM) and briefly examines the interests in, and motives for, forming supply chains. Section 3 examines why inter-firm relationships such as SCM have introduced new challenges for management accounting. Section 4 reviews the ways in which management accounting and management accountants have responded to the developments in supply chains and the extent to which accounting and accountants are contributing to the effective management of supply chains. Section 5 outlines the challenges and potential problems facing SCM relationships in practice. Section 6 presents some preliminary empirical findings from studying a supply chain and collaborative relationships in a Saudi organization. The final section provides a conclusion and explores future accounting research potentials in this field.

Definition of Supply Chain Management

Various definitions of a supply chain have been offered in the past two decades as the subject gained more attention and increased popularity across many academic and pro-

fessional arenas. According to Horngren *et al.* (2006: 701), the term supply chain "describes the flow of goods, services, and information from the initial sources of materials and services to the delivery of products to consumers, regardless of whether those activities occur in the same organization or in other organizations". In more detailed terms, Lummus and Vokurka (1999: 11) define supply chain as "all the activities involved in delivering a product from raw material through to the customer including sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels, delivery to the customer, and the information necessary to monitor all of these activities". The definitions above not only highlight the activities of planning and controlling the flow of materials from suppliers to end users along the supply chain, but also the flow of information to coordinate and monitor these activities.

Others researchers and professional supply chain agencies have further focused on defining the concept of supply chain management (SCM). This concept demands that organizations look beyond their boundaries and consider relationships with suppliers and customers along the value chain (Berry *et al.*, 2000). As defined by Ellram and Cooper (1993:1) SCM "is an integrating philosophy to manage the total flow of a distribution channel from supplier to ultimate customer". However, a more broad definition is provided by the Council of Supply Chain Management Professionals (CSCMP) which describe SCM as "encompassing the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, Supply Chain Management integrates supply and demand management within and across companies" (2004: 1). The current accepted European definition of SCM is as follows:

"The strategic management process, unifying the systematic planning and control of all technologies, materials and services, from identification of need by the ultimate customer. It encompasses planning, designing, purchasing, production, logistics, and quality. The objectives are to optimize performance in meeting agreed customer service requirements, minimizing cost, whilst optimizing the use of all resources throughout the entire supply chain" (DTI, 1997).

This definition emphasizes the importance of customer needs and the strategic nature of supply chains. Indeed, Harland (1996) notes that the study of networks can be carried out from the perspective of the participants (firms and individuals), activities or processes and resources. According to Berry et al. (2000) most of the work carried out to date on networks' performance has focused on the impact on efficiency of network structural differences and less on other aspects such as customer satisfaction.

Interest in Supply Chain Management[1]

Studies of high-performing companies, such as Toyota (Womack *et al.*, 1990), Nissan (Nishiguchi, 1994; Carr and Ng, 1995), report that these organizations take a strategic view of the whole process of supply from original source of materials to end customers, achieving more efficient, or lean, operations management and more effective strategic management (Lamming, 1993). One reason for such emerging and growing attitude is the fact that in today's business environments and industrial practices, few companies continue to be vertically integrated (Lummus and Vokurka, 1999). Companies have become more specialized and search for suppliers who can provide low cost, quality materials rather than own their source of supply. Thus, improvements in performance are driven by externally-based targets rather than by internal department objectives. Hence, it becomes critical for companies to manage the entire supply network to optimize overall performance (Harland, 1996; Lummus and Vokurka, 1999). Lere and Saraph (1995) noted that with purchase material costs accounting for 60% to 80% of total product cost in some industries, purchasing professionals are increasingly involved in developing cost reduction strategies for purchased materials. Thus, knowledge of a supplier's cost structure and dynamics e.g. the factors that are likely to increase or decrease the supplier's delivered costs and commitment to continuous improvement is critical for the effective management of single sourcing situations (p.26). Kato (1993) also noted that manufacturers like Toyota have come to realize that there is no longer opportunity to reduce costs at the level of the production. Consequently, "they look at upstream of production as a treasure island of cost reduction opportunities" (p. 35).

Another reason for interest in supply chains is to do with benefiting from

(1) See Table 1 for more details of interest and focus issues in SCM.

suppliers' core capabilities, skills and expertise. Many Japanese companies look to suppliers to assist in the design and engineering of the incoming materials. Japanese target costing and value engineering requires high-intensity involvement of supplier engineering resources to develop ways to expand the functionality, raise the quality, and lower the cost of materials and components (Kaplan and Cooper, 1997). Thus, collaborating, integrating, and effective management of cross boundaries functions/activities are becoming critical to deliver products and satisfy customer requirements.

Managing an entire supply chain opens up many opportunities for analysis and improvement. For example, analysis of "time delays" in the supply chain of innovative products or services (where the time for new products to enter the market is critical) allows the supply chain manager to focus attention on those "bottle-neck" businesses in order to shorten the time to market. Kaplan and Cooper (1997: 206) noted that some companies have eliminated their purchasing function for certain items entirely: "they have invited suppliers to place a member of their own staff at the factory site; that person is responsible for ordering and managing the flow of incoming materials before releasing the materials to the production process as needed". Importantly, Kaplan and Cooper further added that some companies are now requiring their suppliers to have supplies of materials and components located nearby the manufacturing facilities or retailer stores.

A third reason partially stems from the increased intensity of national and international competition and globalization (Lummus and Vokurka, 1999). Unlike in the past, customers now have multiple sources from which to choose to satisfy demand; locating product throughout the distribution channel for maximum customer accessibility at a minimum cost becomes crucial. As boarders and markets are opening up, successful companies are those who exploit these opportunities. Below is a summary of perceived benefits and uses of supply chains:

- A drive towards world class performance and continuous improvement.
- Access and sharing of technology, skills and expertise.
- Expanding capacities, capabilities and gaining critical resources.
- Integrating demand management, production scheduling, and inventory deployment.
- Greater emphasis on organizational and process flexibility.

- Joint cost savings and cost reduction opportunities via partnerships and collaborations.
- Improving supply continuity and a better match between the supplier's sale specification and the buyer's purchase specification.
- Managing dependence and interdependence.
- Sharing risks and reducing uncertainty.
- Availability of emergency services.
- Increased reliance on purchased materials/components and outside processing.
- Horizontal business processes replacing hierarchical and vertical departmental functions.
- Greater sharing of information and knowledge between venders and customers.
- Product development efforts to improve product design, quality, functionality, manufacturability and cost characteristics.
- Performance tracking of supply chain activities.

Inter-firm Relationships: New Challenges for Management Accounting

One of the earliest conceptions of a strategic role for accountants and accounting information in inter-firm and collaborative relationships can be traced to the work of Michael Porter (1985) on "*Competitive advantage: Creating and sustaining superior performance*". Porter argues that firm profitability is a function of industry attractiveness and the firm's relative position within it. Strong relative positions imply that the firm has a competitive advantage that can be sustained against attacks by competitors and the evolution and dynamic nature of the industry and environment. For Porter, competitive advantage comes from creating values for buyers that exceeds the costs of generating it. Porter identified three sources of competitive advantage which he categorized as generic strategies: low costs, differentiation and focus. Competitive advantage is created by the performance of discrete activities such as design, production, marketing, and delivery. Each of these activities while contributing to a chosen strategy is regarded as a value creating activity. Value chain analysis is a method for decomposing the firm into strategically important activities and understanding their impact on cost behavior and differentiation. For Porter, complex inter-dependencies provide opportunities for optimization and co-ordination between activities and suppliers within a chain. Porter argues that the ability to perform particular activities and to manage the linkages between

these activities is a source of competitive advantage.

Central to Porter's value chain analysis is the identification of critical factors or value creating activities. Each activity that a firm undertakes has an underlying cost structure and behavior. Porter (1985) identified ten factors that determine the cost of an activity which he refers to as "cost drivers": economies of scale, learning or experiencing effects, pattern of capacity utilization, linkages among activities, interrelationship among business units, degree of vertical integration, timing of market entry, firms policy of cost or differentiation, and institutional (legal and regulatory) factors. In Porter's view, the analysis of these cost drivers, is an important aspect of value chain analysis and design, and hence the search for competitive advantage. However, in Porter's opinion, traditional management accounting systems with their product costing and financial reporting emphasis are incompatible with this kind of strategic value-chain analysis. Porter (1985: 63), for example, argued that "while accounting systems do contain useful data, they often get in the way of strategic cost analysis". The inward focus ignores linkages, interdependences and value created outside the firm's legal boundaries (Patridge and Perren, 1994: 22). But traditional costing systems offer little help in the value chain cost analysis because of their functional and hierarchic focus. With its outward-looking perspective, the value chain is "about the creation of value, not just the addition of cost and margin" (p.22). As they ignore linkages and value created outside the firm's boundaries, traditional costing systems are of little help in analyzing the costs of the value chain (Patridge and Perren, 1994). Hergert and Morris (1989) also identified three deficiencies of traditional accounting systems: they do not focus on critical activities, but on responsibility centers, they do not account for interdependence between subunits such as activities; and they offer a poor reflection of the economics of performing an activity and do not accumulate data about cost drivers.

Porter's work on value chain provided impetus for further research that aimed at finding a strategic role for management accounting in supply chain management and other collaborative relationships. Bromwich and Bhimani (1994), for example, suggest that "the use of purchaser/ supplier partnerships, as producers, suppliers and assemblers become increasingly integrated, allows the accountant to introduce altered controls and management accounting techniques suitable for this approach" (p. 242). But it is not clear what the nature of these

altered controls and the nature of the management accounting techniques are suitable for this approach. There is a task to position management accounting so that it can play its full role in the chains of organizations formed by the adoption of supplier and customer partnerships (Bromwich and Bhimani, 1994). More importantly, there is the need to consider how management accounting is or can be designed and used in this area to assist in the formation, implementation and realization of strategies to achieve competitive advantage. Many accounting researchers have recognized the challenge inter-firm relationships presents for management accounting and called for developing the necessary skills which will enable them to become important members of the management team (Cooper, 1996). Others have called for conducting empirical research to investigate the role of information in the management of inter-firm relationships, alliances and networks (Berry *et al*., 1997; Tomkins, 2001).

The next section of this paper reviews the ways in which management accounting and management accountants have responded to the developments in supply chains and the extent to which accounting and accountants are contributing to the effective management of supply chains. This review focuses on the management accounting initiatives, innovations and proposed techniques to support the effective management of supply chains. Table 1 provides a summary of focus issues, proposed techniques and systems that are figured out in the accounting literature. Appendix 1 presents some observations and empirical findings from a selected number of inter-firm research studies.

SCM, Value Chain Analysis and ABC

Following Porter's work on value chain, several accounting innovations have been introduced into the accounting literature, e.g. activity-based costing, ABM, strategic cost management, Total Cost Management and balanced scorecard. Of particular importance is the work of Shank (1989) and Shank and Govindarajan (1992, 1993) in which developed the concept of Strategic Cost Management. This concept later became part of strategic management accounting which consists of analyses of different strategic dimensions of the firm, such as competitor analysis, strategic positioning analysis and analysis of the value chain in which the firm operates (Kaplan and Cooper, 1997). Effective management of supply chains and collaborative relationships by performing a value chain analysis, has become an important constituent of strategic management accounting.

Table I
A Summary of SCM Focus Issues, Proposed Techniques and Systems in the Accounting Literature

SUBJECT	FOCUS ISSUES	TECHNIQUES, MECHANISMS & SYSTEMS
Cost Management and cost Control	Cost analysis of the value chain activities. Improvement of logistics operations and processes. Joint cost savings and cost reduction opportunities (e.g. improving product design, joint cost improvement and elimination of waste and non-value added supply chain activities) Total cost Management and total cost Control. Reduction of the life-cycle costs of new products Monitoring of supply chain cost.	ABM & ABC Target costing Value re-engineering Functional analysis Horizontal information systems Open book agreements Cost achieving activity teams (e.g. multi-disciplinary teams)
Performance Measurement and Benchmarking	Supply network evaluation Product and Service Quality Pricing, cost management and cost savings Business process improvement Innovation, continuous improvement and organizational learning Reduction in supply base Customer satisfaction Technical performance Time in product development Delivery performance New technology development Compensation and reward schemes	Supplier rating systems Benchmarking schemes Electronic benchmarking schemes Productivity and financial measures Best business practices Balance scorecard Open book accounting Quantitative and qualitative performance measures (e.g. failure and defect rates, customer feedback, on time-delivery, quality, customers' complaints, shipping errors) Risk-reward schemes Supplier selection criteria
Open book accounting	Collaboration and partnership Transparency, visibility and openness Information sharing and Communication Information Sharing and Confidentiality Building trust and Long-term relationships	Detailed breakdown of price & product cost information (e.g. costs of components, value added, calculations) Open book agreements Open Book Policies Joint Cross functional teams (e.g. from quality, design, Engineering, Purchasing and Finance Department sharing information). Budget and cost/reports Benchmarking

Table I Continued

SUBJECT	FOCUS ISSUES	TECHNIQUES, MECHANISMS & SYSTEMS
I Information Technology	Information sharing and information exchange with partners The strategic opportunities of IT in the supply chain Horizontal flow of information Cost savings Information sharing, trust and confidentiality	Electronic Point of Sales (EPOS) systems and loyalty card schemes Electronic data interchange (EDI) SCM software ERP Internet (e-mail, e-commerce, Web-EDI) Electronic benchmarking networks video conferencing and e-mail
Trust and inter-firm relationships	Trust and long-term relationships Trust and flexibility in the management of relationships Opportunistic behavior, information asymmetry and goodwill trust Trust and accounting controls Inter-group relations	Establishing joint teams consisting of employees from both the purchaser and the supplier Open book accounting and information sharing Information sharing through participatory and interactive processes Regular meetings, frequent contacts, face-to-face contacts, and multiple channels of communications

In their analysis of a value chain, Shank and Govindarajan (1989, 1992, 1993), assumed that the analysis takes into account the interdependencies and interrelationships between the activities/ functions of buyers and suppliers (Shank and Govindarajan, 1992). In the analysis, the chain is decomposed into strategically relevant activities, assets, revenues and costs are assigned to these value activities. An important part of value chain analysis is the diagnosis of cost drivers that explain variations in costs in each value activity (Porter, 1985). Activity-based information can provide relevant information about activities across the entire chain of value adding activities (both internal and external to the firm) in order to improve the firm's competitive advantages. These steps enable the firm to analyze the behavior of costs and sources of differentiation. When the analysis includes multiple firms across the value chain, insight is gained into how buyers' and suppliers' activities are interrelated in terms of cost and differentiation. To develop a sustainable competitive advantage, the outcome of the analysis will be used to control cost drivers (e.g. elimination of non-value added activities) and reconfiguration of the value chain (Shank and Govindarajan, 1992; Dekker, 2003). For example, a VCA may lead

partners to conclude that supply chain costs will be reduced when the supplier delivers products in another form, improving the efficiency of the buyer's receiving and stock keeping activities, or when activities are aligned with firms in the supply chain who can perform them more efficiently (Dekker,2003).

In inter-firm relationships, however, the cooperating firms need to share cost and performance information. It is perceived that such joint analysis of the value chain, integrates cost data of multiple firms, leading to a broader scope than an internally oriented VCA, and a higher accuracy of cost data than when analysis is performed by one firm taking an external perspective (and making assumptions about other firms' activities and costs). Such a joint analysis, however, requires the willingness and trust among partners to participate in the supply chain and sharing cost information (Dekker, 2003; Langfield-Smith and Smith, 2003). It has been argued that large opportunities for cost savings can come from upstream operations (Kaplan and Cooper, 1997). By understanding the supplier-related activities (e.g. product designs, ordering, receiving, moving, delivery, inspection, storing, and costs associated with these activities) a company may be able to engage in negotiations with its suppliers on matters such as cost reduction opportunities during product design and development, lowering inventory levels and total supply chain costs, and sharing cost savings. Chrysler, for example, has worked with its suppliers to develop ABC models of the supply chain relationships so both can learn how their product-design decisions affect the manufacturing costs of the other party (Kaplan 1997 and Cooper). This understanding "enables both parties to make better decisions to reduce total manufacturing costs throughout the supply chain" (Kaplan and Cooper, 1997: 208).

Quillian (1991), for example, discussed the usefulness of activity analysis within a 'Total Cost Management (TCM) approach' (itself containing three key elements: ABC, process value analysis and performance measurement) for improving logistics operations and cost management of a UK electrical product manufacturer. According to Quillian, the application of TCM principles to processes and activities across the supply chain has led to tangible benefits such as a reduction in total logistics costs. Based on a description and application of a model intended to identify the true costs of providing several specialized logistics services for key customers by a British firm, Quillian, noted that "Total Cost Management can act as catalyst for integrating isolated logistics functions,

leading to substantial improvements in costs, cycle times, inventories and levels of customer services" (p. 9). Dekker (2003), who studied the use of an activity-based costing (ABC) model by Sainsbury (UK) and a group of its suppliers, reported that costs were managed cooperatively with suppliers by integrating cost data across the supply chain. The integrated cost data was used to analyze the cost performance of supply chain activities, the causes of performance, and to generate ideas for improvement. According to Decker, the supply chain analyses were used for initiating and supporting SCM practices: "specific analyses performed were benchmarking between suppliers, regions and store types to identify opportunities for improvement; strategic what-if analyses to quantify the cost consequences of supply chain changes; and monitoring of supply chain cost development over time" (p.18). Thus, the cost model facilitated the joint coordination and control of Sainsbury's and suppliers' activities.

SCM, Target Costing and Total Cost Control

Target costing as developed by Toyota during the 1960s, is a process for ensuring that a product launched with specified functionality, quality, reliability, sales price can be produced at a life-cycle cost that enables the firm to earn a desired profit (Kaplan and Cooper, 1997; Cooper and Slagmulder, 1997; Lockamy and Smith, 2000). Target costing is a management control mechanism that focuses on the planning, design and development process of a product or a service (Cooper and Slagmulder, 1997). In particular, it focuses on reducing costs during the manufacturing stage of the total life cycle of a product (Athkinson *et al.,* 2004).

Kaplan and Cooper (1997: 217) laid down the very simple principles of target costing:

1. Let the market place determine the selling price of the future product,
2. Subtract from this selling price the profit margin that you want to generate, and
3. This figure yields the target cost at which the product must be manufactured.

In target costing, unlike traditional product costing approaches, the cost of the new product is no longer an outcome of the product design process; it becomes an input into the process itself i.e. target costing is imbedded within the firm's product development and introduction process (Kaplan and Cooper, 1997). For that reason, the target costing process requires information pertaining to the firm's competitive position, product,

and supply strategies. Once this information has been established, and as the firm moves from the product strategy phase of the product development and introduction process through product concept and design to manufacturing and logistics, the various activities of target costing are performed.

With target cost for the product established, the company begins the task of attaining the target cost. Value engineering is performed to redesign the product, its manufacturing process, and its distribution and service system. The value engineering process includes examination of each component of a product internal to the firm or across the supply chain to determine whether it is possible to reduce costs while maintaining functionality and performance. Hence, target costing processes does not focus solely on savings in materials, labor, assembly, and machining costs in the internal production process, but also extends beyond to include supplier, distribution, and customer relationships. With that perception, suppliers play a critical role in making target costing work (Atkinson *et al.*, 2004). Lamming (1993) also supports this view by arguing that in lean supply, the target costing process is extended into the supplier, in order to identify specific needs for cost reduction which become targets for the attention of both parties working together. Critics of this approach, however, points to the concern that target costing often puts excessive pressure on subcontractors and suppliers to conform to schedules and plans to reduce costs, and this may lead to alienation and conflicts between parties involved in the target costing process (Atkinson *et al.*, 2004).

In a managed supply chain, it is also anticipated that the trading partners within the supply chain must develop market feedback mechanisms designed to anticipate changes in customer requirements and to evaluate the supply chain's effectiveness in providing customer satisfaction. Target costing can be used as a means for integrating market feedback into the supply chain through the development of a total cost structure reflective of current customer requirements (Lockamy and Smith, 2000; Kaplan, 2004; Atkinson *et al.*, 2004). For example, the members of supply chain may undertake joint and value engineering activities and efforts e.g. correcting and improving product design, joint cost improvements, elimination of waste and non-value added supply chain activities, to ensure the achievement of the target cost and hence customer satisfaction (Atkinson *et al.*, 2004: 378). Based on customers' survey, Mercedes U.S., for example, developed indexes of characteristics

(e.g. safety, comfort, economy, air conditioning, styling, chassis, electrical system, transmission) and formed functional groups that worked closely with its suppliers on target cost projects during the early stages of the development of its M-class models (Albright and Davis, 1999). By including suppliers as members of the function groups, Mercedes was able to take advantage of their expertise and advice on matters such as supplier capability, cost, quality, product work development and larger design issues (p. 172).

Carr and Ng (1995) also shed light on Nissan Motor Company's (UK) approach to total cost control which used a form of target costing principles. They noted that while Nissan (UK) has little control over many upstream costs, it directed attention to materials and components which represent just over 80 % of its costs. For Nissan, "achieving total cost control throughout the whole supply chain has represented a critical challenge in the overall cost control" (p.348). In the two suppliers' case studied by Carr and Ng (1995), Nissan utilized a team effort approach; for example, the total cost achieving activity teams are "multi-disciplinary teams pulled from the Quality, Design, Engineering, Purchasing and Finance Departments" (p.357). While the total cost control approach aimed at cost reduction opportunities, the role of the finance or accounting staff was not a key one. For example, in "the early stages of new model development, finance plays a support role" (p. 356). Instead, value engineering is emphasized at the design stage and subsequently, "value analysis is used to continually review product costs and manufacturing process" (p.356). Carr and Ng also observed that neither accounting staff nor finance staff is used in the supplier selection and development processes.

SCM and Open Book Accounting

A common theme in the supply chain management literature, in particular, studies focusing on Japanese automobile manufacturers is the need for openness and transparency between parties in the supply chain (Lamming, 1993). This need is illustrated by the use of 'open book accounting" in supplier-customer and partnership arrangements (Carr and Ng, 1995). Open book accounting involves the supplier opening his books to the customer in a process which supports the idea of active collaboration and partnership. Unlike arm's length contracting where suppliers often provide price quotations, open book suppliers provide detailed breakdown of the price and costs of their components. Cost transparency means the sharing and exchange of costing information

between customer and supplier including data which would traditionally be kept secret by each party (Lamming, 1993). Customers must share data (including cost and value-added calculations) with the supplier about the procedures between the delivery of components and their subsequent use in the assembly process. Christopher (1998), for example, noted that "open book accounting" is another manifestation of the move towards cost transparency by which cost data is shared upstream and down stream, and hence each party's profits and benefits are visible to others.

Berry *et al.* (2000) who studied the consequences of inter-firm supply chains for management accounting in a number of UK based manufacturing companies found evidence of some forms of open book accounting practices. One supplier, a subsidiary of a large U.K multi-national, had offered the assembler (itself a subsidiary of a large American multinational) an open book agreement plus rolling cost cuts in return for assurances on demand and participation in research and development. The initial supply agreement between the two companies which was based on a document drawn up by the assembler stressed the principle of an open and trusting relationship which "delivers tangible and measurable benefits to both parties over a long period, and allows the sharing of ideas and information including cost and value added calculations" (p. 41). The study also reported the use of an open book costing system in a U.K construction company which included sharing profits where process changes have reduced costs through the supply chain (see Appendix 1). Similarly, Mouritsen *et al.* (2001) found one of the two companies involved in the supply chain, LeanTech, has introduced an 'open book accounting' as a strategy to support the management of its outsourcing operations (see Appendix 1). According to Mouritsen *et al.* (p. 233), the technique provided the logistics management in LeanTech with access to time and cost information about production processes and all material flows information from delivery of the individual types of components to the final shipment of the product to the customer. In addition, the 'open book accounting' system provided information about suppliers' cost structures (e.g. adjustment times for assembling machines, the size of the intermediate product inventory and rate of turnover). Importantly, open book accounting made it possible for the company to benchmark suppliers and redesign suppliers' production and distribution processes. Mouritsen *et al.* (2001: 233) noted that "open book accounting inscribed a network of companies in terms of productivity, capacity, financial re-

sources, competencies and it also let the logistics manager play a new role as inter-organizational co-coordinator between firms". The study concluded that the functional analysis and open book accounting systems introduced by the two companies "re-installed a sense of control in relation to the out-sourced processes as they enabled the managers of NewTech and LeanTech to overcome the distance between the firms and their subcontractors" (p. 239). Mouritsen *et al.'s* study, however, did not indicate whether management accountants or accounting staff were involved in any capacity or level in the design and implementation of target costing/ functional analysis and open book accounting systems.

While maintaining an open book policy and sharing information between a supplier and a customer may reflect the existence of trust between the parties, the policy could be open to exploitation. Carr and Ng (1995) observed that two of Nissan UK's large suppliers were hesitant on the issue of open book accounting. One of these companies showed "a great concern as to whether Nissan would exploit its position of power, particularly in the light of its tougher circumstances.... the fear is that the open book policy may be seen as way of putting pressure on the company for further cost reduction" (p. 36).

SCM and Performance Measurement

Lamming (1993) has emphasized the need for performance measures covering operational factors such as delivery performance and strategic challenges such as new technology developments in supply chains and collaborative relationships. He also addressed the importance of encouragement of innovations, continuous improvement, and organizational learning. Hope and Hope (1995) also emphasized the need for team based agreement about performance measures being used. It has also been suggested that firms in a supply chain may gain control over supply chain activities and functions through developing a wider perspective and understanding of supply chain performance (Kaplan and Cooper, 1997; Tomkins, 2001). This may be achieved by using broadly-based performance measures such as a balanced scorecard, targets and the benchmarks, which focus on areas such as customer satisfaction, delivery responsiveness, product quality and cost. Kaplan and Cooper (1997), for example, noted that companies, such as Northrup, Texas Instruments, McDonnel Douglas, Black and Decker, and Digital Equipment, have developed elaborate supplier-rating systems that explicitly incorporate total cost of ownership. The strategic

relationships between buyers and suppliers "are no longer evaluated by traditional performance measures like purchase price variances; they reflect, in addition to purchase price, costs that measure delivery, quality, flexibility, and service performance" (209). Olorunniwo and Hatfield (2001) reported a large number of financial and non-financial measures of performance and purchasing criteria in formed supply chains in the US electric utility industry e.g. product quality, reliability, EDI service, lead time to delivery, full-line supplier, price, total ownership cost, after sale services, capacity planning, vendor-maintained inventory and emergency service. The study by Smith *et al.* (2005: 413) of a large UK NHS Trust Hospital also revealed the existence of six key performance indicators designed to judge the performance of their suppliers: cleanliness standards; response time to ad hoc requests; valid complaints against the number of tasks suppliers do in total per week; suppliers meeting legislations when carrying out domestic services; suppliers meeting the hospital policies and procedures relevant to the performance of domestic services; presentation and communication of supplier staff.

Although the accounting literature contemplated the possibility of measuring the performance of the whole supply network, research evidence points to the tendency of most firms to concentrate on two party relationships (Seal *et al.*, 1999; Berry *et al.*, 2000). The exploratory study by Zheng *et al.*(1998) of large 16 firms in six UK industries (including automotive, fast moving consumer goods, electronics, pharmaceutical and communication technology) found that most firms tended to evaluate network performance only at dyadic, or immediate relationship level (see more details in Appendix 1). Only four cases according to Zheng *et al.*(1998) made attempts to evaluate the supply network as a whole and with limited understanding of the appropriate measures to evaluate the performance of the whole network. Despite this tendency, performance measurement systems used in inter-firm context are beginning to emerge. In the case of Sainsbury (UK) mentioned above, Dekker (2003: 15) observed what appeared to be a holistic way of network evaluation using a benchmarking technique where benchmarking was used to compare suppliers' activity costs with the average of their network (see more details in Appendix 1). The most important measure for the benchmark analysis according to Dekker was the "cost per cost driver". When a supplier's relative performance against the network average deviates significantly from the average

cost, the Logistics Operations Department would initiate a discussion with the supplier to find out cause(s) of the difference and to assess whether and how performance could be improved. The study also reported that "strategic what-if analyses" were performed to analyze the effects of changes in the supply chain on supply chain costs. When, for example, as a result of a benchmark analysis, Sainsbury and a supplier develop ideas or scenarios for improving supply chain processes, the ABC model was used to calculate the expected changes in costs of each scenario.

Langfield-Smith and Smith (2003) who studied the use of management control systems and trust in an outsourcing relationship of two Australian companies noted that high levels of uncertainty in the specification of the outsourced function made initial performance standards difficult to specify. However, as the two parties' shared knowledge of processes increased over time, they were able to develop outcome controls: "through numerous discussions and meetings between managers at Central and Global, performance measures and targets were developed to provide the most appropriate incentives for the outsourcer to deliver quality services" (p. 301). Interestingly, Langfield-Smith and Smith's study reveals the existence of a risk-reward scheme which was introduced to encourage the outsourcer to achieve more profits when undertaking new discretionary projects, while also delivering cost savings to the outsourcing company. Similarly, Cullen *et al.* (1998) found evidence of the existence of an incentive scheme to share profit and cost savings in a long-term strategic partnership relationship involving Morrison Construction and a selected number of clients. The arrangement is such that the retail client gives a budget (linked into concept of target cost) to Morrison Construction and then Morrison aim to work within that budget. If they complete the project in a cost less than the original budget, then the profit is shared between the two parties on an agreed basis. The use of the incentive scheme according to Cullen et al. has contributed to a significant reduction in build times, in addition to improvements in project quality and more effective use of personnel. The study cited one particular supermarket project completed in 23 weeks which was apparently very quick given the nature of project.

SCM and Information Technology

Information Technology (IT) has become integrated into effective supply chain management due to its ability to facilitate many of the phenomena which surround the supply chain (Ber-

ry *et al.*, 1997; Marson and Massey, 1998). IT's ability to improve and facilitate cost reduction and efficiency drives e.g. improving inventory turnarounds and reducing processing overheads (Mukhopadhyaya *et al.*, 1995; Albright and Davis, 1999), facilitating benchmarking of suppliers (Dekker, 2003)), increasing JIT deliveries and reducing delivery times (Peppard, 1993), increasing information sharing (Zheng *et al.*, 1997) and its ability to aid in the access of new markets (Peppard, 1993) have made it a key area to assist in the control and management of the supply chain activities.

Many organizations are now realizing the strategic opportunities of IT in the supply chain management (Marson and Massey, 1998). By choosing to link with suppliers through some form of information technology, companies can share long-term and short-term forecast demands to aid upstream suppliers in their scheduling requirements. One of Volvo's plants, for example, use EDI to link with a supplier to share forecasts of supplies of goods three to four days in future (Albright and Davis, 1999). The EDI system then creates sales orders and initiates purchase orders so that the forecast can be met. Further, EDI links are planned for suppliers of Volvo's suppliers (second-tier suppliers) to further expedite the transfer of information and maintain proper materials flow amongst suppliers and Volvo.

Technology is also affecting the supply chain business-to-business e-commerce on the Internet. The Internet has dramatically changed the way corporations do business with one another. It enables customers and suppliers to share information nearly instantaneously. In addition, it has changed the marketplace, often having the effect of cutting out the "middle man". Boeing, for example, allows customers to browse its catalog and order spare parts from an Internet site (about 4,000 transactions per day); a procedure that has resulted in reducing order-processing costs by 25 percent and also has shortened delivery time (Albright and Davis, 1999). Industries such as automobile, airline, hotel, and electronics have made commitments to purchase some of or all of their supplies and raw materials in the huge business-to-business electronic marketplaces (Mukhopadhyaya *et al.*, 1995; Albright and Davis, 1999; Massey, 1998).

Zheng *et al.* (1997) reported the benefits of using IT and electronic links (e.g. EDI, internet, video conferencing and e-mail) including improvement in communications with key immediate suppliers, increase in the quantity of data and information sharing between actors and faster

speed at which information was exchanged. In the logistics industry, the study indicated that the use of IT was perceived as leading to faster stock turnover, lower levels of inventory and higher levels of service, and in the fast moving consumer goods networks, IT was used for invoices and placing daily orders (p. 10). Dekker (2003: 11) also reported that Sainsbury (UK) and its suppliers have developed and implemented an internet-based 'Web-EDI' as a cost reduction alternative for the costly normal EDI-system. The new system, according to Dekker, improved information exchange by enabling suppliers to receive orders and production planning forecasts, and to send invoices by the Internet.

SCM, Trust and Accounting Information

While many researchers have focused on accounting and accountability implications of inter-firm relationships, others have dealt with trust as one key aspect in these relationships (Sako, 1991; Seal and Vincent-Jones, 2001; Tomkins, 2001; Langfield-Smith and Smith, 2003; Vosselman and Van der Meer-Kooistra, 2006)). Trust may develop over time through processes of learning and adaptation which are essential to the strengthening of the relationship between partners, making it more durable in the face of conflict and encouraging interactions between partners involving knowledge exchange and promotion of each other's interests (Johanson and Mattsson, 1987). Close relationships with suppliers may involve the sharing of information, joint product and process development, and joint cost improvement activities; and trust allows such alliances to flourish (Langfield-Smith and Smith 2003). It has also been argued that certain minimum levels of trust are essential in inter-firm relationships, as trust reduces the possibility of opportunistic behavior (Vosselman and Van der Meer-Kooistra, 2006). Several researchers have noted the link between trust and information requirements (for example, Tomkins, 2001; Langfield-Smith and Smith 2003). Importantly, trust is characterized as an alternative uncertainty absorption mechanism for providing increased information (Langfield-Smith and Smith, 2003). This has led some researchers to suggest that there is an inverse relationship between willingness to trust and the need for information (see, for example, Tomkins, 2001; Langfield-Smith and Smith, 2003). However, other researchers see the trade-off as more complex (see, for example, Seal and Vincent-Jones, 1997).

Sako (1992), for example, distinguished between three types of trust in

long-term relationships. Contractual trust is when partners keep their promises and there may or may not be a written agreement. Competence trust involves ensuring that partners have the ability to carry out a task and deliver on their promises. Finally, there is goodwill trust which allows discretion beyond contractual and competence trust implying a more open commitment. Sako (1992) found that long-term relationships reap significant benefits to the companies involved e.g. increased in market share, better performance, and increased likelihood of adopting JIT without a cost increase. In their study of the relationship between management control and trust in one outsourcing project of an Australian energy company, Langfield-Smith and Smith (2003) found that control was achieved through outcome controls (controls that measure and monitor the outputs of operations or behaviors, using techniques such as performance measurement) and social controls (controls develop from shared norms, values and beliefs) developing over time, and through the development of trust, particularly goodwill trust. According to Langfield-Smith and Smith establishing mutual interests and building goodwill trust helped the company in "setting the ground rules for the operation of the contract to be established, performance measures to be developed and the risk-reward system to be debated and implemented" (p. 303)

SCM: Challenges and Potential Problems

While the rationale and the desire to form supply networks and other collaborative relationships appeared to be fairly well documented in the literature (e.g. focus on core competence, expanding capabilities and resources, exploiting cost reduction opportunities, developing good work relationships, building trust and openness, building stable relationships, sharing of knowledge, skills and risks, etc.) relatively little guidance exists as to how these strategic alliances and relationships are structured, formed, managed and evaluated (Zheng, 1998). With few exceptions, most of supply networks that have been studied in European countries are managed on a dyadic or immediate relationship level and few of them had mapped the processes across their networks (Zheng *et al.*, 1998; Seal *et al.*, 1999; Berry *et al*, 2000). Although research findings began to unveil some applications and uses of accounting systems and information in negotiations, strategic analysis and managing supply chains e.g. ABC, value analysis, target costing, total cost control, open book policies, benchmarking, balanced scorecard and performance

management, the role of accounting staff and specialists is not yet obvious. Similarly, the Japanese literature reflecting on accounting perspective (Carr and Ng, 1995; Kato, 1993) seems to form a general view of the value of cost management in enabling strategic and collaborative relationships and that management accountants mostly tend to function within cross functional teams.

Despite the fact that a prominent role for management accounting in managing supply chains has not yet been firmly established, research studies undertaken (for example, see, Cullen *et al*., 1998; Berry *et a*., 2000; Mourstein, 2000; Dekker,2003; Smith *et al*., 2005) have revealed interesting opportunities for management accountants to become involved in supply chain management issues. For example, Cullen *et al*. (1998:4) reported that that management accountants in the organizations covered by their study were involved at different levels and performing a variety of roles ranging from the routine, to higher levels of system integration and design, then on to strategic analysis. In the context of supply chains, they noted that "the link with logistic is obviously important, and it was interesting to find that one of the accountants involved in our study had come from a logistic background before taking his CIMA examinations" (p. 4). Cullen *et al*. (p. 5) further noted numerous examples of management accountants being appointed to positions which were identified along the lines of "supply chain accountant" and members of "cross functional teams" in addition to evidence of techniques such as horizontal information systems, kaizen costing, benchmarking, open book accounting, value engineering and target costing.

While some roles for management accounting in inter-firm relationships are evolving, barriers and potential problems to successful and effective roles should not be overlooked. Several research studies have pointed to obstacles such as inability to broaden the supply chain concept and vision beyond procurement or product distribution to encompass larger business processes, difficulty of managing inter-related network of multiple members and complex relationships, lack of guidelines for creating alliances with supply chain partners (Olorunniwo and Hartfield, 2001), concentration of power balance within the network (Frances and Garnsey; 1996) and lack of trust between parties (Turnbull *et al*., 1992), lack of integration between performance measurement systems and practical requirements for supply chains (Chan *et al*., 2006). Other studies (e.g. Zeng *et al*., 1997; Berry *et al*.,

2000) pointed out that the existing work on supply chain management is dominated by a normative and functionalist perspective and noted the danger of taking for granted the desired qualities and benefits of forming a supply network or viewing them in isolation from the embedded network, modes of control, positioning of actors within the network and in general the social and cultural boundaries and processes of the network system.

In the next section of this paper, some preliminary empirical findings from studying a supply chain and collaborative relationships in a Saudi organization will be presented.

SCM at Saudi Aramco: Case Description and Findings

Background

Saudi Aramco, the state-owned national oil company, is the largest oil corporation in the world and the world's largest in terms of crude oil reserves and production. Headquartered in Dhahran, Saudi Arabia, Saudi Aramco also operates the world's largest single hydrocarbon network, the Master Gas System. The company is a fully integrated global petroleum enterprise that explores, produces, refines, distributes, ships, and markets crude oil, gas and other oil products. Although main operations are in Saudi Arabia and Arabian Gulf, its affiliates, joint ventures and subsidiaries are all over the world. Saudi Aramco has several joint venture and collaborative agreements with many domestic and international companies e.g. Shell, ConocoPhillips, Petrocon Arabia Ltd., Yokogawa Middle East, Dow Chemical and France's Total. Its associated companies/subsidiaries include Aramco Services Company, Aramco Overseas Company, Aramco Training Services Company, Saudi Refining Inc., Saudi Pertoleum International and Vela International. Some of its main contractors and suppliers include Schlumberger, Halliburton, Arabian Drilling Company, Saudiconsult, and Zamil Group.

Research Method

Saudi Aramco was selected as a research site for three reasons. First, the company is known to have established its supply chain now almost seven years since it became operational. The company and many of its affiliates and associates are currently involved in a wide range of inter-firm relationships including strategic partnerships and outsourcing. Second, because of its size and nature of operations, the company operates with a large number of domestic and foreign suppliers, contractors and sub-contractors. Third, the company acquires many capabilities viewed as

essential elements in facilitating the functioning of supply chains e.g. advanced IT infrastructure, logistics and information competencies, and established accounting and purchasing systems (see Gregory, 1995; Lamming, 1993).

Data was collected over a period of three months (June-August 2007), mainly through semi-structured interviews with access to some internal company documents. Interviews were conducted with senior personnel in areas of materials supply, purchasing, finance and accounting. The researcher also benefited from discussion and case presentations on supply chain and outsourcing practices made by some of Aramco's staff who are participants in the MBA program at KFUPM. These company's staff eventually became key contact persons and a valuable information source. Others sources of case materials included personal e-mail messages, Aramco's web sites, presentations, symposiums and workshops on supply chain management.

The supply chain management issues investigated in the company included the strategic motivation for supply chain and collaborative programs; whether there appeared to be a supply chain strategy and if it was shared at the level of the network; the administrative structures and capabilities in place to facilitate the functioning of the supply chain; and the role of management accountants and accounting information, if any, in the management of inter-firm relationships. To obtain a perspective of the managers' perceived success or otherwise of these relationships, managers were asked to reflect on the benefits that Aramco or its departments have gained from these relationships. Some of the questions used in the interviews or correspondence were open and opportunity was given to staff to talk about supply chain issues, challenges and their own experiences. Table (II) presents a summary of preliminary findings and observations from the case study.

Motivation for Supply Chain Relationships

The main strategic motivation for establishing the SCM program cited by the company officials interviewed included developing value-added relationships and greater trust, delivering greater customer satisfaction, reducing inventory along the entire supply chain, conducting joint process improvements, developing and using technology effectively, sharing information with suppliers and customers, and exploiting cost reduction opportunities. These motives appear to be both consistent with the company's

mission and strategic business objectives. The materials and supply chain staff interviewed consistently emphasized the importance of the company's supply network in the context of globalization, innovation, learning, and the desire for excellence. Over the years, Aramco has moved from a focus on upstream crude oil activities to being a fully integrated, international hydrocarbon enterprise that includes refining, distribution, natural gas operations, international shipping, and a world network of affiliates and joint ventures. In the words of one senior company staff ''improving knowledge on supply chain management means the company would be able to plan, schedule, and execute operational requirements in a timely manner and, hence meeting its customers' demands and expectations''.

Table 2
Summary of Case Study Findings (Aramco Case)

Focus Issues	Supply Chain Strategies and programs	Findings, Observations, Systems and Techniques
Enhancing company-suppliers relationships Enhancing efficiency through supply chain management Joint cost savings & cost reduction opportunities via partnerships and collaboration Development of long-term partnerships and alliances Promoting logistics efficiency Development of integrated in-Kingdom logistics systems Managing inventory Outsourcing inventory and warehousing Sharing information and risks Cost management and cost control Measuring suppliers' performance	Develop value-added relationships and greater trust Deliver greater customer satisfaction Reduce inventory along the entire supply chain Conduct joint process improvements Develop and use technology effectively Share information Look constantly for cost reduction opportunities Improve, continuously, SCM practices	Supplier managed inventory arrangements are utilized to transfer some form of ownership of inventory planning to suppliers, increase capacity utilization, increase visibility, and reduce supply risk and costs Partnership projects enabled the company to reduce lead times and improve supplier on-time delivery, exchange information, and identify integrated issues In-kingdom logistics has been outsourced giving the company more visibility in its supply chain The SAP technology has been integrated into the company's supply chain activities and processes Sharing information, skills and expertise with suppliers, but not technology Suppliers are linked to Aramco through tailored portals, punch out websites and formerly EDI Outsourcing projects have been utilized to improve operational efficiency, reduce inventory holding and achieve maintenance cost savings The company has a supply chain strategy, but it may not be shared at the level of the whole supply network

Table 2 Contined

Focus Issues	Supply Chain Strategies and programs	Findings, Observations, Systems and Techniques
		Suppliers are managed at different levels in the company Information sharing and knowledge mainly with immediate suppliers and customers with little evidence of information sharing beyond that. Most of network activities and knowledge related to the dyadic level and no evidence to suggest the existence of a holistic view of the supply network In the outsourcing case investigated, the performance measurement system and payment schemes have been firmly linked to a set of agreed key performance indicators/targets composed of both financial and non-financial measures Measuring the performance of Aramco's suppliers is a business requirement Performance measurement mainly focuses on supplier delivery performance and materials availability KPIs e.g. on-time delivery have been established to measure suppliers' performance Finance and accounting staff are utilized in assessing new supply chain agreements and alternatives; analysis of customer demand and forecast; price negotiations and consultation The company holds annual symposiums and workshops to discuss common SCM issues and problems with its suppliers.

Supply Chain C Strategies and Programs

To enable the supply chain relationships to work effectively, the company developed strategies and created programs aimed at providing the appropriate environment, needed infrastructure and capabilities. Documents provided to the researcher demonstrate programs that have created a strategic shift in the materials Supply Department's processes, systems and technology. These include[2]:

(2) See Saudi Aramco: Purchasing Policies and Registration Procedures, p.3.

- Implementation of integrated computer systems
- Development of integrated in-Kingdom logistics systems
- Expanding roles of vendors in the supply chain process
- Assigning responsibility to vendors for managing the complete supply chain of their commodities
- Development of long-term partnerships and alliances where opportunities exist for reducing total cost of ownership and providing total solutions
- Utilization of e-commerce based on the business to-business standards through supplier web sites and electronic catalogs.

According to the interviewed Materials Supply staff, the implementation of these processes, systems and technologies were intended to encourage suppliers to assume greater responsibility for managing the supply chain. Saudi Aramco's suppliers are also encouraged to be innovative and to implement strategies that will reduce inventory costs, decrease lead-times, eliminate redundant practices, and incorporate the technology necessary to bring about efficiencies in the supply chain. When asked about Aramco's expectations from its suppliers, one materials supply executive replied by noting that "suppliers are expected to perform a wide range of SCM functions, place emphasis on quality and service, provide a wide range of products and invest in IT capabilities and timely information". There was no evidence that the supply chain strategies and the strategic shift in programs, systems and technologies are shared equally or matched by its suppliers. However, the Materials Supply Department stressed the need for Saudi Aramco's suppliers to allocate resources and develop skills to implement supply chain processes and systems and build IT infrastructure that would place them in a competitive position.

SCM and IT Infrastructure

A key capability of the supply chain strategies and programs at Aramco has been the integration of the company's SAP system into its supply chain activities and processes. As a leading global source of crude oil and gas, Saudi Aramco needed an efficient suite of systems in place across the hydrocarbon supply chain to assure uninterrupted supplies to its customers. Before the implementation of the SAP system, Saudi Aramco's management was concerned about the flow of information and integration of business processes across sales and marketing, oil supply planning and scheduling, production, shipping, and finance. Within the company's functions and divisions,

separate and isolated systems had been developed for production forecasting, sales orders and receivables, crude oil tracking, product tracking and scheduling, inspection, refining information and international marketing. The SAP General Manager summed the lack of integration and the urgency to provide solutions[3]:

"Over the years, separate departments involved in the hydrocarbon supply chain management had developed their own applications and created islands of information... there was no single view of the business...there was no flow of information between either the systems or departments. Many users had their own legacy systems or developed their own spreadsheet applications, resulting in a great deal of duplication of data entry. Individual departments worked with their own version of the facts, and there was no transparency or accuracy in analyses or reports that crossed departmental boundaries".

The lack of integration between business departments motivated management to take a strategic move. SAP was deployed to provide a solution and fill the information gap. According to the SAP General Manager:[4]

"We needed a single suite of applications that will integrate all our business processes and allow departments to share consistent information. We implemented several SAP applications focused on supply chain management for oil and gas industry to pull everything together..... SAP for Oil & Gas maps supply chain solutions onto the specific requirements of our industry. This made a marked improvement in our operational efficiency and enhanced our optimization and decision making around hydrocarbon production and sales".

Initially, the SAP system was introduced to manage production and planning systems across 33 bulk oil and gas plants. To provide a real-time interface between the plants, Saudi Aramco used a terminal automation solution, a key capability of the SAP Oil Downstream Management application. Next, other elements of SAP's applications for oil and gas were introduced to replace the 11 legacy systems and to cover all the production and export sales processes throughout the hydrocarbon supply chain. Saudi Aramco since then has been using SAP Oil Downstream Management, SAP Trader's and Scheduler's Workbench, SAP Advanced Planning & Organization (SAP APO), and SAP NetWeaver Business Intelli-

(3) See SAP Customer Success Story: Saudi Aramco, p. 2.

(4) See SAP Customer Success Story: Saudi Aramco, p. 3.

gence (SAP NetWeaver BI) to provide a single integrated system to handle hydrocarbon planning, scheduling, movement and operations, sales billing, and financial accounting. This new system allowed the exchange of valuable information with other systems within Saudi Aramco, including global inventory management, worldwide berth scheduling, pipeline batching, and worldwide quota management. The SAP General Manager enumerated the benefits Aramco has generated from the application of the SAP software to the company SCM activities and processes(5):

"SAP for Oil & Gas allows us to manage and execute bulk supply chain activities- from planning through to final settlement- as a seamless, end-to-end process. It allows us to manage downstream marketing activities, covering tanker allocation, terminal management, berthing, and customer sales. With SAP, we can align supply and production plans with market demand and achieve optimum results that benefit both our business and our customers. Using SAP applications, we have eliminated paperwork, eradicated duplication of data entry, and replaced the previous silos of information. Everyone now works with the same information, and we have a solid audit trail and full control over information flow. From one order number, users can track everything connected with that transaction online, right through to final billing and settlement"

The feeling amongst the interviewed Materials Supply staff was that Saudi Aramco has managed to create a reliable single data source for reporting and a sound foundation for understanding all aspects of its business including the company's supply chain processes and activities. This gives the company enormous flexibility to respond quickly to dynamic changes in business and market conditions. There are cost savings, too, that result from increased scheduling effectiveness, greater inventory visibility, and more accurate forecasts. In addition, the total cost of ownership is automatically reduced because the company no longer has to maintain and support the disparate and unconnected legacy systems.

Administrative Structure and Organizational Networking

In addition to the information technology capability, the company provided other facilitating elements to support the management of its supply chain. The Materials Supply Department has in place a well developed administrative structure and an organizational networking that in view of its

(5) See SAP Customer Success Story: Saudi Aramco, p. 3.

staff is a contributing factor to the smooth functioning of its supply chain activities. The supply management tasks performed by the department included materials requisition, inventory management, purchasing management, shipping and transportation, warehouse management, repairs, returns & disposals, control & authorization, and materials supply contingency planning. Also, within the department, five divisions were established to handle certain activities in Aramco's supply chain management: Materials Standardization, Materials Control Services, Project and Testing & Inspection, Materials Management and two Materials Requirements planning divisions across several geographical areas. Each of these divisions has its own functions and responsibilities in materials supplies and control. More importantly, all procurement functions are fully supported by an on-line information system which monitors users' requirements from the requisition stage through development, placement, expediting, traffic, invoicing, and receiving. An electronic catalogue has been developed within the supply chain module containing the description, specification, and other information of more than one million items. This has been integrated with other modules, such as the Finance and Quality Management modules. The department also has expanded the Local Delivery Order and Receipt (LDOR) system and e-commerce, and more recently has adopted long-term frame agreements for strategic commodities. According to the department staff, these initiatives were intended to improve responsiveness to customers, reduce costs, improve processes and enhance the company-supplier relationship. The department also works with and is linked to many cross functional committees e.g. Saudi Aramco Project Management Team, Saudi Aramco Proponent Organizations. Finally, the department has qualified, trained and experienced staff well equipped to deal with resource planning, supply sourcing, negotiation, order placement, inbound transportation, storage, handling, inspection, and quality assurance.

Tangible Benefits

The evidence gathered suggests that Aramco's SCM initiative and collaborative relationships have begun to deliver some tangible benefits. The Manager of the Materials Supply Department pointed out that "the department has changed its way of doing business by expanding the supplier-managed inventory arrangements, adopting supply chain management practices, implementing SAP and integrated Kingdom-wide logistics". At the Materials Supply's third annual supplier symposium in 2002, the Aramco's Materials Supply Executive Director,

told senior executives from more than 300 of Saudi Aramoc's domestic suppliers and vendors that the implementation of the SAP module and SCM changed the way Saudi Aramco does business: "Now, like half of the world's Fortune 500 companies, Saudi Aramco manages the fast assortment of goods it needs for its daily business on line". One senior accountant noted that "we are constantly reaping benefits from initiatives related to improvements in our SCM processes and systems...we have just outsourced our in-Kingdom logistics and have used lean techniques to streamline our costs of ordering and handling material. With good price negotiations we have been able to keep our prices competitive". When asked about sharing of information, technology, skills and expertise with suppliers, he replied "Yes, we share a great deal of our information with our agreement holders, but not technology. We share our skills and expertise with supplier visits".

Managing Inventory along the Supply Chain

The discussion with the accounting and materials supply staff reveals that Aramco has significantly made use of new strategies for stocking and staging materials by local suppliers through SCM programs such as "Supplier Managed Inventory" (SMI) and "Stocking Distributor". "The Supply Managed Inventory" or "Frame Agreement" technique allows the supplier to take greater responsibility in managing the customer inventory supplies (Albright and Davis, 1999). This means that the supplier can be allowed to monitor the manufacturer's stock levels and to replenish the stock when it is necessary to do so. This allows both the supplier and the manufacturer to reduce their safety stock levels and other related costs. At Aramco, SMI has been applied in areas such as oil company tubular goods, IT, catalysts, turbines and drilling bits supplies in total of approximately $400 million. According to the materials supply staff, the SMI arrangements are usually long-term agreements and cover uniquely engineered, high volume and value products. More importantly, they involve single manufacturer(s) with expertise with these products. Benefits generated by Aramco from implementing SMI agreements cited by both accounting and materials supply staff included lower transportation and warehousing costs, increased visibility, reduced inventory levels, reduced supply risk and improved customer service.

Unlike SMI, the "Stocking Distributor" system involves common materials, many manufacturers, wide variety of products, many customers and large or lower materials volumes.

At Aramco, this inventory system covers inventory supplies such as building materials, electrical equipment, instrumentation and pumps. While the stocking distributor system involves long-term agreements and transfer of ownership of inventory and warehousing functions to suppliers, it proved to be beneficial in absorbing excess inventory. Other operating improvement realized from implementing the system included a reduced warehousing workload, high material availability, fewer agreements, close customer interface and improved customer service.

Improvement in inventory management has also been strengthened by outsourcing contracts. In July 2006, DHL Exel Supply Mideleast signed the Group's largest ever contract logistics deal with Saudi Aramco. It involves managing the entire supply, sourcing and delivery of everything for the company within the Kingdom. The deal is spread over ten years, and is worth US$500 million. Part of the deal is to develop the oil giant's national logistics infrastructure. This encompasses the provision, management and operation of four Materials Distributions Centers (MDCs), or 'cross-docks', in Dammam, Riyadh, Jeddah and Yanbu. With a dedicated fleet of 300 vehicles and 400 staff, DHL Exel Supply Chain provides services to 24 Material Service Centers (MSCs) nationwide, all located near to refineries or the oil fields themselves. DHL also manages vendors and suppliers and uses Key Performance Indicators (KPIs) to measure their services and gives Aramco transparency on performance levels. The adding value for Aramco from this long-term strategic partnership was described by the Materials Supply staff as significant: "replacing quite fragmented logistics arrangements with an integrated supply chain service, giving the company visibility in its supply chain, improving responsiveness to customers, reducing costs, improving processes and enhancing the company-supplier relationship".

Partnership Agreements and Cost Management

Documents provided to the researcher reveal some partnership success stories. For example, the Materials Supply (MS) and Drilling & Work Over (DWO)[6] Departments formed a team to review and develop supply strategies to sustain increased drilling activities. In 2005, for example, operating rigs increased from 48 to 82, and were forecasted to be 119 by mid 2007. There was also tight mill capacity, shortage of raw materials and increased steel prices and freight

(6) DWO and its operating units are referred to as "customers".

costs worldwide. Fore these reasons the two departments stepped efforts to cope with operating changes. There was a strong expectation that a strategic partnership with suppliers would enable DWO to analyze customer demand, enhance operating processes, improve on time delivery, reduce lead times, minimize production cost, rationalize inventory and improve service level.

The partnership achievements were not possible without involving material planners in MS activities, orienting MS employees on customers' operation requirements and exposing customers themselves on the SCM process enhancements. Partnership responsibilities on part of Material Purchase Requisitions staff were to communicate effectively with DWO and its operating units, expedite the release of purchasing requisitions to suppliers, monitor changes in DWO's inventory profiles, analyze forecast, and maintain inventory parameters, meet with DWO's staff on a regular basis and extend them any required technical support. The partnership responsibilities on part of DWO's and its customers included conducting effective communication with the material Purchase Requisitions Controller, planning testing and inspection with sufficient lead time, validating requirements prior to releases of reservation, rationalizing inventory and providing proper approval for high value reservations. Through this partnership between the two departments and coordination with the drilling support suppliers some achievements have been made: an annual cost avoidance of $127 million, a total cost savings of $6.2 million, advance shipment notifications, expedited customs clearance and expanded delivery support coverage. One senior company staff noted that "partnering together enabled us to achieve best-in-class services in the whole supply chain".

Outsourcing Strategies, Performance Measurement and Payment Schemes

Aramco has also utilized partnership strategies elsewhere to improve operating performance. The Saudi Aramco Shell Refinery Company[7] (SASREF) built a strategic agreement with (PP), a British-based contractor, in which the latter took the responsibility for managing the reliability and maintenance of the Rotating Equipment section. This section is one of two that composed the Mechanical Department at SASREF.

(7) SASREF is jointly owned by Saudi Aramco and Shell Saudi Arabia Refining Ltd.

Before this strategic agreement with "PP" in 2005, SASREF made an attempt to enhance the efficiency of the Rotating Equipment Section and managing its operating costs. The discussion with SASREF staff reveals that the company's past initiatives and programs, in particular, during the period 1993-2000 were successful in lowering the cost curve in a satisfactory manner. However, after 2000, no significant improvement in reducing costs was recorded and the cost curve was steadily up. This situation led top management to examine alternative strategies including applying the Managed Reliability Program (MRP) to shift the cost curve down and improve the efficiency and productivity of the Rotating Equipment Section. Because SASREF wanted to concentrate on its core competencies and activities, cooperating with an expert company specialized in the field of reliability maintenance became a viable option. PP was chosen to perform the outsourced function for many reasons including its reputation and worldwide experience in areas of rotating equipment reliability program, oilfield process optimization, oilfield water management, on-line "smart" support systems and supply chain management of pump materials. Managers at SASREIF described the relationship with PP as a "strategic alliance".

SASREF was keen from the beginning to have the outsourcing contract designed in a way that criteria such as efficiency, effectiveness, cost reduction, and continuous improvement were to be emphasized out as key primary issues. There was a general consensus among the company staff interviewed that the most effective way to guarantee a given level of performance is to tie payment for services to a defined and measurable performance outcome. Given this planned strategy, the outsourcing contract was written in a language that specified (1) targets over five years (also broken down to annual targets) (2) the measurable outcomes that are to be achieved, and (3) incentives tied to measurable outcomes.

Targets formed over five years included improving the rotating equipment reliability by up to 100%, reducing rotating equipment material usage costs by 30%, and reducing average cost per repair (CPR) and inventory holding for rotating equipment. Enhancing decommissioning-repair-commissioning activities, strengthening preventative maintenance activities and enhancing SASREF workforce through a continual training program were also equally featured as important targets over the duration of the outsourcing contract.

An interesting finding from the discussion with managers at the Rotating Equipment Section has been the

use of KPI indicators and benchmarking schemes to assess the performance of the outsourcing contractor. Key performance indicators (KPIs) state that (PP) is paid annually based on the achievement of reductions in: rotating equipment outages, equipment type average cost per repair (CPR), rotating equipment material usage by 30% over the contract term, and rotating equipment inventory.

The rotating equipment outage reduction is intended to improve reliability of rotating equipment over five years. The average annual number of outages taken from three years worth of data from January 2002 to December 2004 is (279) outages and the targeted five years' improvement is to reduce total annual outages rate to (155) outages (assuming no change in contract population). An outage is defined as when a piece of rotating equipment is uncoupled, fully or partially dismantled and one of the wearing components is replaced. The MRP also set targets (on an annual basis and over 5 years) for reducing cost per repair for each equipment type. PP will be paid a deferred fee on achievement of pre-qualified KPIs. The KPIs include the following targets and payments:

- PP will be paid per outage reduction of each individual equipment type.
- Payment amount equals 50% of average Cost per Repair (CPR) per equipment type multiplied by number of outages reduced.
- Target annual outage level per equipment type capped at year 5 targets.
- 15% of deferred fee risked against achieving targeted equipment type CPR reduction.
- Annual deferred fee payment through shared benefit (50:50) of rotating outage reduction.
- Minimum payment - Zero.
- Maximum payment - capped at reaching 155 outages per annum.

It is clear that the risk-reward payment scheme was intended to mo-

Table 3
Deferred Fee Payment for RCP (Rotating Centrifugal Pump

	Outages	CPR
Base Figure	170	SAR 36,899
Target Figure	145	SAR 36,899
Achieved Figure	150	SAR 35,000
Reduction	20	SAR 1,899
Deferred Calculation	20 * (SAR 36,899*50%)*100%)	
Deferred Payment	SAR 368,990	

Table 4
Deferred Fee Payment for MEAN (Fin Fans)

	Outages	CPR
Base Figure	65	SAR 11,825
Target Figure	60	SAR 11,825
Achieved Figure	55	SAR 13,825
Reduction	10	SAR (2,000)
Deferred Calculation	10 * (SAR 11,825*50%)*85%)	
Deferred Payment	SAR 50,256	

Total Deferred Payment for RCP & MEAN: SAR 419,246.

tivate the outsourcing contractor to achieve more profits when meeting performance targets while also delivering cost savings to SASREF. The researcher was given a demonstration (see Tables 3 and 4) of how deferred payments for two types of rotating equipment were determined for the results for first year of implementing the outsourcing contract.

The reduction of the rotating equipment material usage involves SASREF setting an annual budget over 5 years (linked into the concept of target cost) for PP to work within. A net difference (positive or negative) will be paid to PP through the reduction or increase of the annual material budget covering rotating equipment material costs. For example, if PP's annual material budget falls below the annual target, the maximum benefit to PP will be a 10% reward (calculated on the basis of the budget), plus PP labor cost.

Finally, PP will be paid an annual deferred fee on releasing capital to SASREF through the target reduction of rotating equipment inventory holding. Based on agreement, during the first 12 months of the contract, PP and SASREF will work closely to determine targets and payment methods for the reduction of rotating equipment inventory holding. PP will be paid annually based on 6.5% of year on year released capital of original identified stock holding.

While this performance-based contract relies heavily on quantitative and financial performance indicators, SASREF will also evaluate PP's success by benchmarking its performance and outcomes against "Slomon" Top 10% (a widely used measurement by oil companies to assess their performance against market). Under "Solomon" top 10%, the performance of PP will be benchmarked for indicators such as availability, utilization, manpower index, maintenance index and non-energy costs (cash). Also, SASREF, uses "Shell East Zone" top 10% that is used by the Head Office to

evaluate and measure the performance of Shell companies. This benchmarking scheme focuses on assessing compliance with the environment and local regulations where the company is located.

It is interesting to note a significant use of management accounting reporting resulting from this outsourcing activity. In addition to setting monthly, average annual and 3-year targets for rotating equipment outage for each type of equipment, actual outage performance of all machines has to be calculated on a monthly basis. Also, the total expected outage costs, average annual cost per repair and 5- year cost reduction forecast for each equipment type has to be prepared. The payment for the rotating equipment materials cost requires the company preparing the rotating equipment annual materials budget overview (on a 5-year basis), in addition to annual actual performance. The annual deferred fee payment that covers rotating equipment outage reduction and rotating equipment inventory reduction would require annual projections and data collection to report on actual performance, and hence determining shared benefits. However, despite this increase in the usage of management accounting information, the role of accountants in this respect is not clear. It appears that much of data collection and analysis, cost estimates and report preparation are assigned to project engineers from two parties in the outsourcing contract. The reason for this may be to do with the technical nature of the MRP i.e. measuring and monitoring the performance and effectiveness of the outsourcing activity is more or less an engineering activity and very much under the control of field engineers.

SCM and the Emerging Accounting Role at Aramco

The role of accountants and finance personnel, however, is more noticeable in Armco's other supply chain and collaborative activities. According to one senior accounting staff, the accounting and finance professionals "are utilized in assessing new supply chain agreements and alternatives, assessing true cost savings for proposals and actual results, analysis of customer demand and forecast, and price negotiations". Providing consultation, information and technical advice to other departments on supply chain issues has also been stressed in the discussion with the finance and accounting staff. Equally was the evaluation of suppliers' performance which was regarded as a "business requirement". The main goal of the latter is to improve supplier on-time

delivery performance for purchase order material so that all suppliers consistently achieve a score of 85% or better. In addition, suppliers with unacceptable performance (less than 40% score) are requested to provide a written explanation for their poor performance and their plans for corrective action to prevent future delivery delays. In addition to tracking on-time delivery, supplier performance metrics are being enhanced to reflect quality of materials and timely submission of relevant documentation e.g. applicable customs duty exemption, invoices and non-material requirements. Aramco also expects its suppliers to adapt and implement SCM and benchmark themselves against best industry practices in order to improve their business processes and performance. In the words of one materials supply executive "they need to invest in enabling technologies, like e-commerce, establish web sites that provide links to manufacturers' catalogs, and enhance visibility of the materials provided". When asked whether customer services have improved as a result of implementing supply chain program, one accounting staff replied that "we do not have the tool to measure this, but we have been able to reduce the percentage of stock out". Through discussion and sharing views with the finance and accounting staff useful suggestions were offered as to how their role in supply chain and collaborative activities could be expanded. For example, linking the existing KPIs and balanced scorecard schemes in some of Aramco's departments and business areas to strengthen the company's current suppliers' performance system, and develop appropriate systems to measure improvement in customer services.

Conclusion and Directions for Future Research

The inclusion of the supply chain network as a task to be managed demands that management accountants become familiar with the value chain concept (Porter, 1985), in contrast with the internal focus that is adopted in management accounting (Shank and Govindarajan, 1989). Because of the hieratical focus, traditional management accounting fails to recognize the potential for exploiting linkages and interdependencies with the firm's suppliers and customers. In this paper, an attempt was made to provide an overview of the ways in which management accounting responded to the developments in supply chains and the extent to which accounting and accountants are contributing to the effective management

of supply chains. The review focuses on the development of ideas and issues surrounding the emergence of supply chains and the impact on management accounting. The current, potential and future roles of management accountants in this area have been explored; in addition to some illustrations of emerging management accounting practices including practices evolving from a supply chain and collaborative relationships in Saudi Aramco. A more in-depth investigation and analysis is needed to understand the real involvement of the finance and accounting staff in the supply chain activities and collaborative projects in this company; in addition to the precise nature of accounting techniques in use.

In the Kingdom of Saudi Arabia as in the other GCC countries, inter-firm and collaborative relationships are widely observed and used both in private and public sectors. Despite this fact, little has been written about the accounting and management control aspects of these relationships. Indeed, little is known about how these relationships have evolved and developed and what motivated them. Also, of particular importance, are how inter-firm arrangements are negotiated, managed, and evaluated; and what are the criteria used in selecting, for example, a supplier. Academic researchers could explore and investigate these issues; in addition to the strategic, operational, and management control aspects related to these observed phenomena and the implications for management accounting. The strategic role of cost analysis, cost management, performance measurement, trust and accountability are all fertile areas for research in supply chain. Another area which could form an interesting focus for future research is the use of information technology in inter-firm relationships. Saudi organizations are just beginning to realize the vast array of benefits available from EDI, SAP, ERP, Internet technology and other advanced information systems capabilities. It will be interesting to see the role and extent of usage of information systems in Saudi companies and others in the GCC countries that have introduced supply chain programs or engaged in other collaborative relationships.

Ackowledgment:

The outhor acknowledges the financial and logistical support provided by king Fahd University of Petroleum & Minerals, and valuable comments of two anonymous reviews.

Appendix 1
Observations and Empirical Findings from a Selected Number of Inter-Firm Research Studies

STUDY	COMPANY/INDUSTRY	FOCUS ISSUES/MOTIVES/ ACTIVITIES	FINDINGS/OBSERVATIONS/ MECHANISMS/TECHNIQUEWS
Dekker (2003)	**J. Sainsbury (UK)** - retail company and the three types of its suppliers: Core suppliers Middle - large suppliers Small suppliers	Operational management issues Assessing & improving current supply chain performance Managing and coordinating interdependence in the supply chain Efficiency gains New projects and general initiatives for supply chain improvements Sharing of costs, benefits and investment resulted from supply chain projects & initiatives Exchange of sensitive cost information Development in the supply chain network Monitoring of supply chain performance	Value Chain Analysis (VCA) using an ABC model Analysis of activity costs by supplier network, geographical location and store category Cost comparisons between networks, regions and store types Average cost per activity (e.g. average cost per delivery) Measuring suppliers' relative performance against the network average cost performance Benchmarking to compare suppliers' activity costs with the average of their network Analysis of suppliers' performance Strategic what - if analysis to analyze the effects of changes in the supply chain on supply chain costs Trend analysis to monitor the development of supply chain costs over time, and to intervene when necessary Sainsbury's logistics operations department used the outcomes of the cost analysis to initiate discussions with suppliers about the cost performance of the supply chain and its processes The development of internet-based "WEB-EDI"-System Sainsbury Information Direct (SID) for exchanging information with supply chain's members (e.g. reports, results and opinion) about projects being conducted

Appendix 1 Continued

STUDY	COMPANY/INDUSTRY	FOCUS ISSUES/MOTIVES/ ACTIVITIES	FINDINGS/OBSERVATIONS/ MECHANISMS/TECHNIQUEWS
Zheng et.al (1997)	16 supply networks in five industry groups: Automotive Fast moving consumer goods Electronics Pharmaceuticals Service	Mapping network together (with suppliers and customers) Common understanding of objectives, opportunities and business strategy Quality and training of people across network Cross-functional and inter-organizational networking Personal relationships Inventory management at network level Structural communication links and common data definition Sharing of information and knowledge Measuring network performance Organizational development (supply chain organization and analyzing supply chain processes)	People, organizational development, a shared holistic view and common understanding of objectives were viewed as fundamentally important Network performance measured only at dyadic level Limited understanding of appropriate performance measures across the whole network Few firms had mapped the processes across their networks Information sharing was quite deep and rich in terms of its contents Use of EDI for invoices and orders Use of Video conferencing/closed internet Use of Email for communication IT replaced routine communication and paper work IT increased quality of data and information sharing IT facilitated faster stock turnover, lower levels of inventory and higher level of service. Most firms were sharing information and knowledge with immediate suppliers Relatively few examples of strategic management of the network

Appendix 1 Continued

STUDY	COMPANY/INDUSTRY	FOCUS ISSUES/MOTIVES/ ACTIVITIES	FINDINGS/OBSERVATIONS/ MECHANISMS/TECHNIQUEWS
Mauritsen et.al (2000)	**High-Tech Firms** (Electronics Manufacturers)	Technology development and technology management Evaluation and control of suppliers' performance Outsourcing a large part of production processes (Lean-Tech) Outsourcing a large part of product development work (NewTech). Lean production and learner organization Improving and maintaining competitiveness Customer relationships Target cost management Exchange of production and accounting information Communication of standards of product functionalities with suppliers	Open book accounting (provided access to production, time and cost information e.g. suppliers' costs structures, set-up times, size of intermediate product inventory, rate of turnover) Target costs/functional analysis (facilitated assembly, service, monitoring arrangements, and better understanding of utilizing technology and competencies Establishment of virtual supply chain management (in forms of production network and product development network) Benchmarking suppliers' performance (using open book accounting information) Software based technology replaced hardware based technology (e.g. customization was reach through digital electronic set-up of the products) Existence of inter-functional grouping and coordination (between sales, development and production)
Berry et al. (2000)	**Dextron -** Designs, assembles, and builds electronic machines (A subsidiary of a US conglomerate)	Process control of production Procurement process Inventory management Outsourcing of components and sub assemblies	Tracking, analyzing and reporting standard costs of products Monthly cost management reports Benchmarking and a tear-down analysis scheme

Appendix 1 Continued

STUDY	COMPANY/INDUSTRY	FOCUS ISSUES/MOTIVES/ ACTIVITIES	FINDINGS/OBSERVATIONS/ MECHANISMS/TECHNIQUEWS
		Cost management Re-engineering of the production plant Suppliers' development and evaluation Management of supplier relationships Standardization of parts & components	Creation of a Cost Management Group (CMG) composed of a project accountant, project engineer, R&D and project designer) Some of the projects undertaken by the CMG in 1996- 1998 include: - A series of projects on Make-or-buy (of components) which led to more outsourcing and to redesign of parts into sub-assemblies - Commitment time (lead time given to suppliers for parts or components orders) - Management of premium costs (costs incurred due to having to meet shortages by special routes e.g. air freighting of special orders - Overall inventory management - Benchmarking suppliers to tackle the level of suppliers costs, changing in a number of suppliers and reducing the supplier base - Development of suppliers suggestion scheme - Total cost of ownership project (e.g. tooling, supply chain costs, premium costs, development costs, obsolescence costs) - Point of order merger (study of the geographical locus at which the customer order is assembled together) - Costs of quality projects - Supplier Management Program (managerial level analysis and the management of supplier relationships)
	Morrison Construction (UK) (International innovator in the construction/civil engineering)	Management of a network of interconnected businesses Partnership arrangements	Much of management accounting is undertaking by quantity surveyors Partnership reports on quality performance

Appendix 1 Continued

STUDY	COMPANY/INDUSTRY	FOCUS ISSUES/MOTIVES/ ACTIVITIES	FINDINGS/OBSERVATIONS/ MECHANISMS/TECHNIQUEWS
		Measurement & evaluation of suppliers' performance Development of partnerships with contractors and subcontractors	Construction site budget (linked into concept of target cost) and an agreed method of sharing savings with partners Open book accounting Management accountants tended only to get involved in the wider business decisions and not the operational aspects of specific projects Partnership arrangements have significantly reduced build times, improved project quality and the effective use of personnel Balance scorecard to measure performance High level of trust and mutual goodwill among the members of the partnership
Smith et al. (2005)	**Carco** - A long established multinational automotive producer operating in a number of locations in the Uk, but reporting to a European Division	Intense competition which led to major financial losses, stemming from (e.g. overcapacity in the industry, new entrant 'producers, other automotive multinational corporations' building capacity in low cost eastern European countries such as Poland, Hungary and the Czech Republic Rationalization of supplier base Outsourcing complex activities Lean production techniques	The reasons for outsourcing parts and components are related to core competencies and cost savings The company followed the principle of 'total value management' Lean production techniques were introduced, copied from a Japanese car producer in which Carco took a major financial stake The supplier base was rationalized, with a systematic grading system introduced for individual suppliers New accounting systems that fit with other automotive systems were introduced e.g. a parts co-ordination system and a parts controller system Introduction of a scorecard system based on quality, safety, delivery, cost, morale and environment to evaluate parts' suppliers

Appendix 1 Continued

STUDY	COMPANY/INDUSTRY	FOCUS ISSUES/MOTIVES/ ACTIVITIES	FINDINGS/OBSERVATIONS/ MECHANISMS/TECHNIQUEWS
	Retail UK - A large UK super market	Strategic goals e.g. building lifelong brand loyalty in its customers through improving quality and efficiency Investment in the supply chain function Improving relationships with suppliers	Major activities outsourced were facilities management, catering, cleanin and related peripheral activities The motivations for outsourcing were in line with company's philosophy of improving efficiency and keeping costs down The supply chain function was developed by the introduction of electronic point of sale (EPOS) A program of continuous replenishment with store managers reporting twice a day on sales information. Deliveries are adjusted to more accurately reflect actual, as opposed to projected, demand. This has resulted in more frequent deliveries and a greater need for accuracy and co-ordination across the supply chain Increased pressure on suppliers to ensure their information's correct and their servicing accurate and on-time Introduction of new supply chain practices e.g. new automation systems to co-ordinate deliveries direct to stores Each piece of outsourced work is measured as a separate cost center A number of accounting measures are used for subcontracting services e.g. in transport and distribution, including a return on investment calculation, payback period and qualitative measures Management accounting is organized around the principles of the 'balanced scorecard' approach implemented with the help of a management consultant with accounting metrics were revised in order to measure more transparently aspects of performance and service provision including those of suppliers

Appendix 1 Continued

STUDY	COMPANY/INDUSTRY	FOCUS ISSUES/MOTIVES/ ACTIVITIES	FINDINGS/OBSERVATIONS/ MECHANISMS/TECHNIQUEWS
	Trust Hospital - A large UK teaching NHS Hospital	Cutting costs and improving the quality of health care delivery Meeting the nationally tight performance indicators targets Restoring the public and institutional lost confidence and improving its ratings Outsourcing some non-core activities	Contracts with suppliers proved to be difficult to oversee and monitor for reasons such as loss of staff who were involved in developing and finalizing these contracts, many of the contract clauses were found to be quite vague and the cultural gap between the public sector ethos and the private sector focus on profits The development of six key performance indicators (KPIs) to judge the performance of their suppliers The KPIs reflect the desired benefits from outsourcing, including an improvement in flexibility and quality of service The accounting system used in Tuststar collates and then traces out costs to individual operating theatres and other major functions using activities as cost drivers Because of the UK government's private finance initiative (PFI), the Trust hospital a number of activities were outsourced

References

Abdullah Al-Ahmari. 2000. Supply Chain Management Completed Phase I Master Data Conversion, Saphere, 1 (8), Nov. 29, 2000: 1-2.

Albright, T. and Davis, S. 1999. The Elements of Supply Chain Management. *International Journal of Strategic Cost Management*, Autumn: 49-65.

Al-Khuwaiter, A. 2004. Towards Successful Partnership: Outsourcing Inventory and Warehousing. www. Saudiaramco.com.

Al-Assaf, K. 2005. Customer Partnership Insight. www. Saudiaramco.com.

Atkinson, A. A., Kaplan, R. S. and Young, S.M. 2004. *Management Accounting*, 4th ed., Upper Saddle River, New Jersey: Pearson: Prentice Hall.

Berry, T., Ahmed, A., Cullen, J., Dunlop, A., Seal, W., Johnston, S. and Holmes, M. 1997. The Consequences of Inter-Firm Supply Chains for Management, *Management Accounting,* November, 74-75.

Berry, A. J., Cullen, J. Seal, W. B., Ahmed, M.. N., Dunlop A. 2000. *The Consequences of Inter-Firm Supply Chains for Management Accounting,* London:CIMA.

Bromwich, M. and Bhimani, A. 1994. *Management Accounting: Pathways to Progress,* London: CIMA.

Borys, B. and Jemison, D. 1999. Hybrid Arrangements as Strategic Alliances: Theoretical Issues in Organizational Combinations. *Academy of Management Review*, 14 (2): 234-249.

Carr, C. and Ng, J. 1995. Total cost control: Nissan and its UK Supplier Partnerships, *Management Accounting Research*, 6: 347-365.

Chan, F. T., Chan, H. K. and Q. H. J. 2006. A Review of Performance Measurement Systems for Supply Chain Management. *International Journal of Business Performance Management*, 8 (2/3):111-131.

Christopher, M. 1998. *Logistics and Supply Chain Management - Strategies for Reducing Cost and Improving Service*. London: Pitman Publishing.

Cooper, R. and Slagmulder, R., 1997. *Target Costing and Value Engineering*. Portland, OR, Oregon, Productive Press.

Cullen, J., Seal W., Berry, T., Dunlop, A. and Ahmed, M. 1998. *The Consequences of Inter-Firm Supply Chains for Management Accounting*. Paper presented to the 40th Operational Research Society Conference, Lancaster (8-10 September).

Das, T. and Teng B. 2001a. Trust, Control and risk in strategic Alliances: An Integrated Framework. *Organization Studies*, 22 (2) 251-283.

Dekker, H. 2003. Value Chain Analysis in Inter-firm Relationships: A Field Study. *Management Accounting Research*, 14:1-23.

DTI/Supply Chain Networks Group. 1997. Supply Chain Management Attitude Survey. Report of the Supply Chain Working Group.

Ellram, L. and Cooper, M. 1993. Characteristics of Supply Chain Manage-

ment and the Implications for Purchasing and Logistics Strategy. *International Journal of Logistics Management*, 4 (2): 1-10.

Frances, J. and Garnsey, E. 1996. Supermarkets and Suppliers in the United kingdom: *System Integration, Information and Control. Accounting, Organizations and Society*, 21(6): 611-626.

Gregory, L. 1995. Make Supply Chain Technology Work for You. *Works Management* (July): 37-41.

Harland, C. M. 1996. Supply Chain Management: Relationships, Chains, and Networks. *British Journal of Management*, 7: 63-80.

Hergert, M. and Morris, D. 1989. Accounting Data for Value Chain Analysis. *Strategic Management Journal*, 10: 175-188.

Horngren, T., Datar, S. and Foster, G., 2006. *Cost Accounting: A Managerial Emphasis* 12th ed., Pearson: Prentice Hall.

Hope, T. and Hope, J. 1995. *Transforming the Bottom Line: Managing Performance with the Real Numbers*. London: Nicholas Brealey Publishing.

Johanson, J and Mattsson, L.G. 1987. Interorganizational Relations in Industrial Systems: A Network Approach Compared with the Transaction Cost Approach. *International Study of Management Organizations,* 17 (1): 34-48.

Langfield-Smith, K and Smith, D., 2003. Management Control Systems and Trust in Outsourcing Relationships. *Management Accounting Research*, 14: 281-307.

Lamming, R. 1993. Beyond *Partnership: Strategies for Innovation and Lean Supply Prentice*, New York: Prentice Hall.

Lamming, R.. 1996. *Squaring Lean Supply with Supply Chain Management. International Journal of Operations and Production Management*, 16 (2):183-196.

Lere, J. and Saraph, J. 1995. Activity Based Costing for Purchasing Managers' Cost and Pricing determinations. *International Journal of Purchasing and Materials Management,* Fall. 25-31.

Lockamy, A and Smith, W. 2000. Target Costing for Supply Chain Management: Criteria and Selection. *Industrial Management & Data Systems, 100 (5):210-218.*

Lummus, R. and Vokurka. 1999. Defining Supply Chain Management: A Historical Perspective and Practical Guidelines. *Industrial Management & Data Systems*, 99 (2): 11-17.

Kaplan, S. and Cooper, R. 1997. *Cost and Effect: Using Cost Systems to Drive Profitability and Performance*, Harvard Business School Press, Boston, Massachusetts.

Kato, Y. 1993. Target Costing Support Systems: Lessons from Leading Japanese Companies. *Management Accounting Research*, 4: 33-47.

Marson, J. and Massey, P. *The Strategic Use of IT in the Supply Chain*. Paper Presented to the Financial Information and Systems Conference, Sheffield, July 2nd 1998.

McFarlan, F. W. and Nolan, R. L. 1995. How to Manage an IT Outsourcing Alliance. *Sloan Management Review*, Winter: 9-23.

Mouritsen, J., Hansen, A. and Hansen, C. 2001. Inter-organizational Controls and Organizational Competencies: Episodes around Target Cost Management/Functional Analysis and Open Book Accounting. *Management Accounting Research*, 12: 221-44.

Mukhopadhyay, T., Kekre, S. and Kalathur, S. 1995. Business Value of Information Technology: A Study of Electronic Data Interchange. *MIS Quarterly*, 19(2): 137-156.

Nishiguchi, T. 1994. *Strategic Industrial Sourcing*, Oxford & New York: Oxford University Press.

Partridge, M. and Perren, L. 1994. Cost Analysis of the Value Chain: Another Role for Strategic Management Accounting. *Management Accounting*, July/August: 22-28.

Peppard, J. 1993. IT *Strategy for Business*. Pitman Publishing.

Porter, M. E. 1985. *Competitive Advantage: Creating and Sustaining Superior Performance*. New York: The Free Press.

Purchasing Policies and Registration Procedures: Saudi Aramco. www.saudiaramco.com.

Olorunniwo, F. and Hartfield, T. 2001. Strategic Partnering when the Supply Base is Limited. *Industrial Management and Data Systems*, 101 (1): 47-52.

Sako, M., 1992. *Prices, Quality and Trust: Inter-Firm Relationships in Britain and Japan*. Cambridge University Press, Cambridge.

SAP Customer Success Story (Oil and Gas). www.saudiaramco.com.

Seal, W., Cullen, J., Dunlop, A., Berry, T., Ahmed, M. 1999. Enhancing a European Supply hain: A case Study on the Role of Management Accounting. *Management Accounting Research,* 10: 303-322.

Seal, W. and P. Vincent-Jones. 1997. Accounting and Trust in the Enabling of Long-Term Relations. *Accounting, Auditing and Accountability*, 10 (3): 406-431.

Shank, J. K. and Govindararajan, V. 1992. Strategic Cost Management and the Value Chain. *Journal of Cost Management*, 5 (4): 5-21.

Shank, J. K. 1989. Strategic Cost Management: New Wine, or Just New Bottles? *Management Accounting Research,* 1: 47-65.

Shank, J. K. and Govindararajan, V. 1993. *Strategic Cost Management*. The Free Press, New York.

Smith, J. A., Morris, A and Ezzamel, M. (2005). Organizational Change, Outsourcing and the Impact on Management Accounting. *The British Accounting Review*, 37: 415-441.

Tomkins, C., 2001. Interdependence, Trust and Information in Relationships, Alliances and Networks. *Accounting, Organizations and Society*, 26 (2): 161-191.

Turnbull, P., Oliver, N., and Wilkinson, B. 1992. Buyer-Supplier Relationships in the UK Automotive Industry: Strategic Implications of the Japanese Manufacturing Model.

Strategic Management Journal, 13:159-168.

Quillian, L. 1991. "Curing Functional silo syndrome" with Logistics Total Cost Management. *CMA Magazine*, June: 9-14.

Supply Chain Council. 1997. http// www.supply-chain.com/inf/ faq.html, 11/20/97.

Van Deer Meer-Kooistra, J. and Vosselman, E. 2000. Management Control of Inter-Firm Transactional Relationships: The Case of Industrial Renovation and Maintenance. *Accounting, Organizations and Society,* 25 (1): 51-77.

Vosselman, E. and Van Deer Meer-Kooistra, J. 2006. Efficiency Seeking Behavior in Changing Management Control in Inter-Firm Relationships. *Journal of Accounting & Organizational Change*, 2 (2): 123-143.

Womack, J. P., Jones, D. T. and Roos, D. 1990. *The Machine that Changed the World.*: The Story of Lean Production, New York: Macmillan International.

Zheng, J., Harland, C., Johnson, T. and Lamming, R. 1997. Features of Supply Networks. Paper Presented at the British Management Association Conference. London.

الملخص

إدارة سلسلة الإمداد: رؤية لدور ومساهمة المحاسبة الإدارية

ميرغني نمر أحمد
جامعة الملك فهد للبترول والمعادن

أبرز النمو المتسارع والاستخدام المتزايد لعلاقات الشراكة والتضامن بين المنظمات خلال العقدين الأخيرين تحديات جديدة للمحاسبة الإدارية. وتتمثل إحدى هذه التحديات في إيجاد الآليات وإعداد المعلومات لتنسيق وإدارة النشاطات بين المنظمات عبر سلسلة الإمداد. وتهدف هذه الدراسة إلى مراجعة السبل التي تصدت بها المحاسبة الإدارية للتطورات في علاقات سلسلة الإمداد، ومدى مساهمة المحاسبة والمحاسبين في الإدارة الفعالة لسلسة الإمداد. كذلك تشمل الدراسة استعراض للأدوار الحالية والمستقبلية للمحاسبين الإداريين في هذا الإطار، بالإضافة إلى نماذج من الممارسات العملية التي تتضمن بعض الممارسات المحاسبية والتي بدأت بالظهور نتيجة لتطبيق نظام إدارة سلسلة الموارد وبعض أشكال الشراكة الإستراتيجية بإحدى المنشآت السعودية.

Mirghani N. Ahmed (Ph.D in Accounting, University of Manchester, U.K, 1992), Assistant Professor at the Department of Accounting, College of Industrial Management, King Fahd University of Petroleum and Minerals, Saudi Arabia. His Research areas and Interests Include Cost Allocation Theory and Practice from Economic and Behavioral Point of View, History of Management Accounting, and the Consequences of Inter-Firm Supply Chains for Management Accounting.