

Performance Measurement in Corporate Governance

DEA Modelling and Implications for Organisational Behaviour and Supply Chain Management

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Chapter 2

Critical Literature Review: The Roles of Organization Behaviour, Corporate Governance and Supply Chain Management in the Measurement of Performance for Commercial Enterprises in a Global Knowledge Economy

Between knowledge of what really exists and ignorance of what does not exist lies the domain of opinion. It is more obscure than knowledge, but clearer than ignorance.

Plato 428–348 BC

2.1 Introduction: Issues and Developments in Contemporary Global Knowledge Economics and Business

This chapter will present a critical review of the contemporary literature for measurement of performance of modern commercial enterprises as they strive to succeed in the competitive global knowledge economy. The review will commence with issues and developments in the contemporary global economic and business marketplace in which commercial enterprises must now compete. This is discussed in the first section where the new business arena is preponderant of information communication technologies and their rapid evolutionary benefactions. The evidence of this is witnessed through the emergence of a global knowledge economy. With this backdrop, how management handles the task of running the firm is studied through the contribution of OB to organizational performance by the emergence of new OSTS paradigms, and is reviewed next.

This is then followed by an analysis of how the emerging issues and new developments are changing society. In particular, the research focuses on CG and citizenship and the societal pressures of external stakeholders as they impact on organizational performance. Strategic direction emanates from the highest levels of an organization's hierarchy and is translated into dictums of senior management for the organization to be profitable and competitive. These are studied through the myriad of PMS organizations use to gauge their success. Extending beyond the firm's sovereign boundaries allows us to then further study the impact of the multi-faceted supply chain interactions on organizational performance. It is the contemporary nature of these issues and emerging trends that motivates us to develop an inclusive OBPM framework which is currently absent in the literature.

The above are all elements of PM that should form part of any framework devised to give a full and coherent view of the firm's current competitive status and long term likely health. They form the construct which provides the forces that drive business. This is illustrated in Fig. 2.1 which shows the motivating forces driving competitiveness through an inter-connectedness of the elements of performance. The demands and whims of the globalized marketplace are expeditiously promulgated to all interested parties by efficient communication technologies. Knowledgeable stakeholders are thus armed to pressure companies to comply with their demands. Under an array of different demands, the senior managers of an enterprise devise strategies to meet these needs. This is the starting point for the OBPM framework as developed in the book. Consequently, it is these strategic decisions and policy directions that are disseminated to company operations and impact the supply network. Note that this diagram takes on a form analogous to the performance pyramid as it approaches the lower portion of the representation.

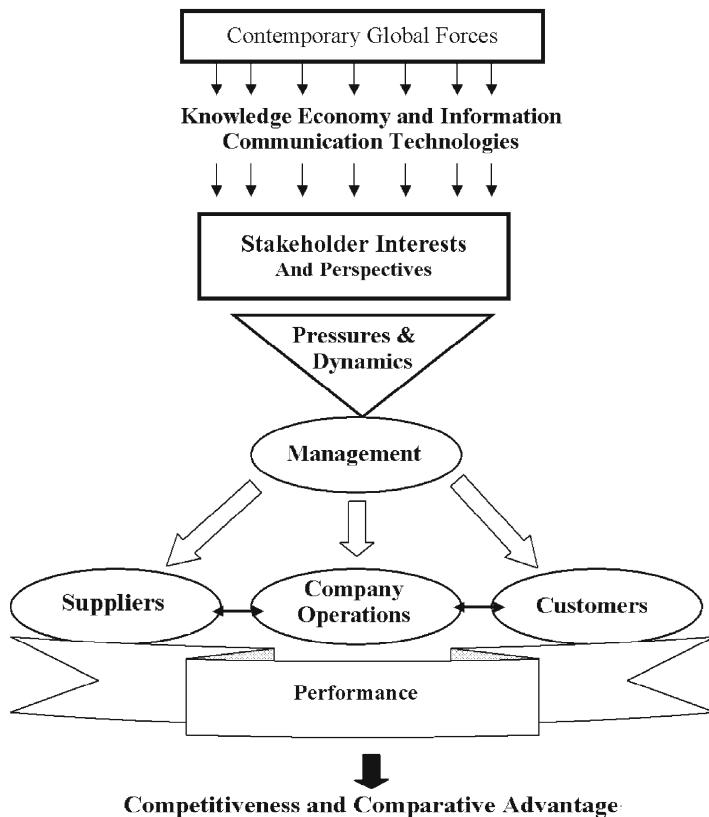


Fig. 2.1 The connected elements of PM

2.2 The Emergence of a Global Knowledge Economy

2.2.1 *Globalization of Australian Business*

The development of global networks to facilitate investment, procure resources and distribute goods and services, provides opportunities for companies to access domestic and regional markets anywhere in the world. This in turn has increased competitive pressures on local firms (Atkinson et al. 1997). Lowered barriers to entry by foreign firms have confronted incumbent organizations with new challenges, in some cases ending oligopolistic or monopolistic structures.

New reporting standards have emerged (AA 1000 2004a, b) and comparisons between competitors have been conducted. The need for PM to communicate achievements, good and poor, has never been greater.

Globalization is the economic and social phenomena which diminishes the impact of distance on trade and social cross-border interactions to the extent that inter-regional and transcontinental trade, investment and flow of capital act as if they were always part of the local economic business environment (Ricks 2003). The International Monetary Fund (IMF) describes it as the growth in interdependence of countries through the increasing cross border transactions in volumes and variety of goods and services, and international capital flows expedited through the pervasiveness of ICT. This development also means that CG mechanisms need to reflect fairness, transparency and social responsibility (Sgro 2003). To this extent it is responsible for increasing the competitive forces on business strategy to the world. In Australia for example, this trend can be traced to the unilateral lowering of tariffs in 1986 (Oxley 2000).

In simple neo-classical economic terms, the beneficiaries of capital inflow, investment, and business development, are those countries where domestic costs are lower than elsewhere. These countries have a comparative advantage (CA) and benefit at the expense of those that have lost business because they are not cost competitive. These are not necessarily only the poorer countries. Investment and international trade are seen as the engines of world growth. While it is credited that globalization has been responsible for elevation from poverty of three billion people over the last 50 years it is also estimated that if trade were liberalized further, by a reduction of 50% in protection levels, Australia, as an example, would benefit to the value of \$7 billion per year (Globalizationguide 2005). Rich and poor both benefit. Wolf (2004) sums this up by saying that never before have so many people or so large a proportion of the world's population enjoyed such large rises in their standard of living. This dictum of capitalism can only promote further globalization. It is therefore necessary to view this phenomenon as a major force in the contemporary business arena.

The fluidity of capital flow and the ease with which commercial investments can target regions has created a platform of instability for many companies.

They are constantly under scrutiny for their operational performance and liable to face closure or relocation to less costly regions. The only strategy for self preservation,

and predominantly within control of the organization, is that of performing well and adopting a 'competitive advantage' ethos.

Michael Porter's (1998) seminal work on CA has lower costs and product differentiation as locational advantages which describe the organization's leadership standing in its industry. How a company achieves an advantage pertains to the way in which it uses its resources and capabilities in the form of distinctive competencies which enables it to create value in its own activities as well as the value system of upstream suppliers and downstream channel members (Gunasekaran et al. 2001). Implicit in the processes of striving for CA are methods of comparative analyses including those referred to as benchmarking. Sometimes alternative strategies involve a rethinking of how the firm conducts business (Hammer and Champy 1993) or seeking the value streams in all company operations (Hines et al. 2000).

Benchmarking can take various forms but it generally entails making comparisons of processes or functions against recognized best practitioners. While at the higher level these comparisons can be made across industries and with competitors, there are often obstacles to disclosure of information. Subsequently, the comparisons are made at cascading lower levels where operational information is less confidential. Since the value of comparative information relates proportionally to its hierarchical level it invites organizations to aim for the highest level where meaningful and accurate information is available. Unfortunately, this often restricts the company to its own operations with some scope for including supply chain partners (McAdam and Bailie 2002). And, when access to information at this level is not hindered, it may simply not exist. Since benchmarking requires a comparison to identify the gap in performance, if a metric is missing then the comparison is not possible. This highlights the need for performance metrics for functions and processes at all levels of company operations (Grunberg 2004). Accordingly, they are created as needed and when required. They are commonly referred to as key performance indicators and are usually used to measure areas of strategic importance regarded as critical success factors (CSF) (Maull et al. 2003). The benchmarking strategy is ideally suited to DEA methodology as described in this study.

2.2.2 Competition for Australian Business in a Global Economy

While globalization has added a new element to the force of competition, it has merely strengthened the business imperative of creating wealth for the owners of commercial enterprises. Some organizations are capable of providing product differentiation through mechanisms such as brand imaging or genuine uniqueness of product or service. The majority of others are not. When the only option left is to seek a cost advantage, we see a strategy of profit maximization through cost reduction and operational efficiency improvements. Initially this attention may be inwardly focused and rewarding but as incremental improvements are achieved at diminishing rates of return on effort, the focal area broadens to include the complete supply chain in its global setting. Inefficiencies in the supply chain resulting

from firms operating in a self-centered fashion are there to be exposed and exploited to the benefit of the partners, albeit not necessarily in equal proportions.

The Australian commercial environment is based on free market economics, within government regulation, where the firm has to compete and survive on the basis of some local advantage, be it knowledge and expertise, responsiveness, service or some other feature. The transnational and global corporations that operate in Australia have, in a fashion, the luxury to respond to international pressures in a fluid and dynamic way which serves the corporation at the expense of the host nation, and avails them of a multitude of strategies to combat competition. Local industries are not so fortunate. They are impacted by the forces of international business yet limited in their response capability (Porter 2004). Most often they are not players on the international scene yet subject to some of its pressures. Their survival mechanism is to operate locally, in a cost effective and customer-service focused way, so that their product or service has a local identity attraction.

To some degree this may entail an attempt at product differentiation (as a short term strategy) but to a large extent this must be a cost neutral offering of a product that has overseas-manufactured rivals. If the product is overly costly, and hence not cost competitive, then its attractiveness can only lie in other features for which customers are willing to pay. Stability of government, reliability of supply, cheapness of resources and an educated workforce displaying a capital of knowledge, are examples of factors of attractiveness which can counter the cheaper option.

An Australian commercial enterprise is a valid candidate for research in this field. Australia's share of global GDP is 2% yet it has a population approaching 21 million (ESRC 2005), only a fraction of the world's 6.4 billion. It is a developed country with an advanced economy and high global trade. It thus displays many features that are common to other advanced economies, and benchmarks for developing countries. There were 610,893 operating businesses in Australia in 2001 (ABS 2006a) and growing, a 6% increase by 2003 (ABS 2006b). Large businesses contributed 38% to national income (ABS 2006c) and the manufacturing industries were the largest contributors to export earnings, 53% of total exports in 2004–2005 (Year Book Australia 2006). Many of these are foreign owned and operate globally. The other locally owned enterprises that operate in the Australian market must compete with the international best. They must operate competitively, meaning they must offer similar but preferably superior products and services. How do they do this? In the most embryonic of strategies this is done by initially comparing against the offerings of competitors and an analysis of how well the company fares (Terzvioski 2002). If this comparative analysis is taken further and to a more sophisticated level then the application of benchmarking, as an alternative strategy, is often adopted. As a comparative tool for improvement, benchmarking is well established and widely used, even though it is a 'satisficing' rather than optimizing technique. It compares performances and then identifies and measures the gap. Attempting to close this differential becomes the motivating force that drives changes in an attempt to instigate improvements. And in so doing, firms can often embrace the current fashionable management mantras which promise a 'quick fix' to their woes, or the 'technology fix', or both. Unfortunately these rarely provide

the solution and often act as mere distractions to the fundamental task of establishing a system of sound managerial control based on measures of performance.

Other times, firms may focus on process management through philosophies based on quality, teams, empowerment and continuous improvement (Evans and Lindsay 2005; Evans 2008) and benefit from such strategies.

Measuring the performance of a firm is not new (Neely et al. 1995; Carter et al. 1992; Dixon et al. 1990). In fact the financial and accounting functions that pertain to business are probably as old as business itself. Financial record-keeping and the managerial controls associated with them has been a stalwart of commerce in the modern era to the extent that they were regarded as the only measures of performance of any value. Australian businesses have been no different in this respect and have treated them as equally paramount. But, like all commerce that was managed on past performances and past successes, the rising profitable strategies of visionary competitors cannot be matched by simply adopting historically dated policies and projecting them forward (Kaplan 1990).

The comparisons that are made against market leaders show that they have had vision while the others have had established but possibly entrenched structures. Forward thinking, innovation and forecasting skills have provided successful companies with a winning formula that others have found hard to match (Kaplan and Norton 1996; Lowson 2002). And these strategies have been cemented in managerial idiom with discourses about ‘balanced’ approaches to managing and directing companies. The Balanced Scorecard of Kaplan and Norton (1992) for example, has been so prolific in this respect that it has achieved its own icon status in performance management, especially in America, while in Europe a not dissimilar approach is reflected in the Performance Prism. Financial and accounting perspectives have also been invigorated by innovations such as ABC and EVA. These are discussed in Sect. 2.6.

2.2.3 The Emergence of Global Knowledge as Capital

Thomas Friedman (1999) provides a view of globalization that is widely held. He says it is:

the inexorable integration of markets, nation-states, and technologies to a degree never witnessed before—in a way that is enabling individuals, corporations and nation-states to reach around the world farther, faster, deeper and cheaper than ever before... the spread of free-market capitalism to virtually every country in the world. (p. 7)

What has facilitated this integration? It is the advent of the enormously powerful technology of computerization and the exponential growth of the associated information technologies. Information communication technologies have witnessed a process of general cumulative advances rather than a succession of discrete unlinked innovations. It has expanded contagiously, taking an increasingly integrative form, offering substantial contributions to the systematic coordination of business functions. It is a contemporary view of an established concept in economic

geography where the ‘flattening of the world’ means that “we are now connecting all the knowledge centers on the planet together into a single global network” (Friedman 2005, p. 8). It is so pervasive that authors such as Jones (1999) claims that we are now in the post-industrial ‘information age’ of intense intellectual, cultural and political activity. It has the characteristics of a shift in employment patterns, from capital intensive employment for production to increases in services in sophisticated economies. The description of a global knowledge economy is increasingly being used to label the present economic era. In Australia more people are engaged in collecting, processing, storing and retrieving information than in agriculture and manufacturing, i.e. creating knowledge. The knowledge economy sees the emergence of new structures, arrangements, and processes for the creation, production, and distribution of goods and services. It is characterized by an intensification of knowledge globally (Houghton and Sheehan 2000) and is a contributor to increases in labour productivity as measured by value-added per employee. For example, in the Asian region, China’s productivity (real GDP/employee) grew by 7.3% per annum for the 1995–2000 period (Grewal et al. 2002).

The emergence of MNEs with their economic and knowledge power, greater than many nations, unleashed by instantaneous communication has led to an international division of labour dictating where and how business will be conducted. ‘Information rich’ employees who understand the new technology will be more valuable, while the unskilled ‘information poor’ computer illiterates will become the new *lumpenproletariat* (Marx’s ragged workers). The gap widens and knowledge becomes capital in Drucker’s (1968) knowledge economy. How has information technology contributed to this intensification of knowledge? Sheehan et al. (1995) attribute enhanced economic growth to five features of the information technology revolution.

These are:

1. Chip technology where miniaturization through micro-electronics has provided exponential increases in output at decreasing capital investment
2. Photonic communication technologies facilitated by optic fibre and wireless networks
3. Digitization of products, processes and services through open-system integrated circuits
4. A convergence of standards and protocols, supporting technologies, such as the capture, storage and display of data, augmenting other technological advances, and
5. Continuing software development to enable these technologies

Kuhn (1970) suggests that this break with continuity from the past is unprecedented in economic history and provides a ‘paradigm shift’ in the way we live, work and do business. The drop in the cost of technology while at the same time improving its reliability, capacity, and range, as depicted by ‘Moore’s Law’, will mean the simplification and integration of manufacturing, the displacement of labour and the growth of an international economy. Alvin Toffler (1971) coined the term ‘future shock’ to illustrate the impact of the ‘information explosion’ where

people are no longer capable of making rational choices from the vast array of information thrust at them. The sheer volume of information leads to 'reductionism' where the ideas are so complex that they can only be fully understood by analysing their components.

Alternatively, a greater reliance is placed on specialists who are experts in their field but who lack the wider picture. In an organizational sense, as the enterprise becomes too large and complex for decision-makers to have a synoptic vision of all factors relevant for policy-making it adopts a 'disjointed incrementalism' as its *modus operandi*. The specialists who are experts in their field but do not understand the whole, take power from the generalists who do not understand the parts but are responsible for the whole. The key is the power of information through its application as knowledge.

Information has four inherent properties that make self propagation possible and knowledge dissemination fragmented. It is inconsumable because it does not reduce or disappear with use. It is also nontransferable because while it moves from A to B it still remains at A. Information is indivisible because it can only be used as a complete unit or set, which then allows it to be accumulative. It can be used over again, be added to and to grow, as a building block of knowledge. The computer provides concentration, dispersion, circulation and feedback, all at exceptional speeds. Together with these four additional properties provided by computers it becomes the almost completely flexible tool for all configurations of communication. The technological capacity now available primes us for a 'technological determinism' where basic decisions are shaped by the technology at hand and every problem has a technological fix (Sheehan et al. 1995). The more complex the problem the more high tech the fix. For example, augmented cognition focuses on the computer deducing a decision-maker's cognitive state with the aim of somehow enhancing it because we live in an era of 'continuous partial attention' where information is flowing in faster than the person can absorb, and therefore needs programmed assistance in decision making.

Knowledge management (KM) is a term increasingly used in the literature to explain those processes of capturing or creating knowledge, storing and protecting it, updating it and using it whenever necessary. Since 1975, 2,727 authors have contributed to this discussion (Nonaka and Peltokorpi 2006). Knowledge is collected and created from internal and external sources and facilitated by ICT. As the repository for the firm's information and a vehicle for its dissemination, ICT allows knowledge to be shared between employees, customers and business partners (Lee and Whang 2000).

The payoff potential of this is huge, with improvements in customer service, shorter delivery cycle times and increased collaboration within the firm and with external partners. Knowledge can also be sold or traded, as well as shared. It is for this reason that the 'information stream' is now regarded as one of the key elements of supply networks and a critical characteristic for global supply chains (Rungtusanathan et al. 2003; Ross et al. 1998). However while information is personality-free, as a construction of data building blocks that simply reside in databases, knowledge is the human value-added interpretation of information, and resident in mortal beings

(Carr and Pearson 1999). Knowledge is thus organic, fluid and reflective, within the human vessel where it resides. It is subject to all things human and used in all ways human. It is therefore, the basis for how employees of the organization behave, individually, collectively and culturally, and a contributing factor in OB (Mitchell and Nault 2003). It is a feature of the learning organization. It is the *modus operandi* of the organization through its people and is as idiosyncratic of the organization as of its members. Organizations, like people, differ in every possible way. They have uniqueness yet commonality. Uniqueness is the synergistic sum of all the individual features of the organization while commonality is the similarity of individual characteristics. This suggests a need for the study of OB and the theories of management which explain these behaviours in the new economic era.

There are many theories of OB which attempt to explain why managers behave in particular ways, yet few ascribe styles of management to organizational performance. Those that are performance-focused appear to display a re-emerging theme, one of the importance and valued contribution of the individual employee. Recent organization theory sees a renewal in themes of 'empowerment' (Mumford 1995), collectivism, through teams such as 'quality circles', and other job-enriching policies aimed at enhancing the human resource and utilising its knowledge capital (Niepce and Molleman 1998). It is therefore imperative that OB be included in a study of organizational performance but not at the exclusion of other determinants of performance, such as technological advantages. Few theories, other than Sociotechnical Systems-type paradigms, acknowledge the symbiosis of the social and technical subsystems and their conjunctive roles (Mumford 2003).

2.3 The Emergence of an OSTs Approach to OB

2.3.1 *Introduction*

The competitiveness of the corporation and its performance is judged by comparison with its peers and against world best practice, but its standing is bedded in more than the governance that directs it and the global supply networks it operates in. It is genotypic organizational theory which subsumes its existence. Therefore, results of any PM study should be analysed within the interdisciplinary boundaries of organization theory, SCM and PM. Is the organization modeled on the bureaucratic ideas and formist (ideal type typologies centered on bureaucracy) images of Max Weber, or the structured functionalism of Talcott Parsons? Alternatively, does the modern version of Newton's seventeenth century mechanistic science express itself through an enriched Tayloristic 'scientific management', facilitated by advances in information technology (Niepce and Molleman 1998)? Or, does the organic metaphor of the firm provided by Henri Fayol suffice? This section traces the development of organization theory to arrive at the paradigm of OSTs as the one that has a substrate of CG which permeates the performance of organizations trading in the commercial field of global supply networks.

This section also examines the origins of OSTs through conventional organization theory, and develops a systems approach which encompasses the Human Relations 'humanistic' school of thought with the 'mechanistic' one which posits that technologically efficient processes dictate the efficient resource, information and financial flows in a supply network. An integrated approach to the application of an OSTs stance and its productive fit for the management of the supply chain is developed to address the measurement of firm performance through the adoption of a PM conceptual framework. Such a concept caters for the needs of all supply chain partners and provides a mechanism for organizations to measure performance by iterative applications of a performance pyramid.

2.3.2 The Founding Fathers; Weber, Durkheim and Pareto

Max Weber, Emile Durkheim and Vilfredo Pareto are the sociological theorists of the nineteenth Century who provide us with the legitimate cornerstone of organizational theory (Wren 1994). This intellectual triad gave us 'bureaucracy', 'organic and mechanical' societal types and the notion of 'social systems'. Weber's version of scientific management, which was being promulgated in America while he was working on his book on economics and society, was the standardization and rationalization of large scale undertakings by pronouncing management to be by position rather than by person. His conceptualization of 'bureaucracy' was posited in three types of legitimate authority: rational-legal, traditional, and charismatic, because some form of authority was a necessity for any organization. Without an authority structure the organization could not be guided to its objective. He also put forward the notion of the Protestant work ethic.

Durkheim divided societies into two types; 'organic' and 'mechanical'. Mechanical societies were characterized by friendliness, kinship and neighbourliness, and dominated by a collective consciousness, while organic ones were those characterized by specialization, the division of labour, and societal interdependence. According to Durkheim the lack of solidarity in organic organization led to a state of confusion, insecurity and normlessness which he called 'anomie'. The restoration of social solidarity in these organic societies must come from the 'collective consciousness' which created and imposed norms and values on the individual. Durkheim's idea of groups as the source of values and norms was later used by Mayo to prescribe industrial solidarity (Smith 1998).

Vilfredo Pareto provided the notion of the 'social system', a state of society which changes over time and is characterized by mutually interdependent but variable units which contribute to the goal of achieving equilibrium between the parts. Disturbances to the system would create such an imbalance that the system would work towards re-establishing the equilibrium. Talcott Parsons, George Homans, and Elton Mayo were converts to the ideas of Pareto and saw organizations as interacting social systems. A colleague of Mayo, Fritz Roethlisberger, together with the chief of employee relations research at the Hawthorne Plant, William Dickson,

gave impetus to the connection between technical efficiency and the workplace as a social system (Sonnenfeld 1985). The technical needs for efficiency and economic return should be seen as interrelated with a concern for the human aspect of organization, and these should be maintained in equilibrium. Economic goals should be achieved “while maintaining the equilibrium of the social organization so that individuals through contributing services to this common purpose obtain personal satisfaction that makes them willing to cooperate” (Roethlisberger and Dickson 1939, p. 569)

2.3.3 The Human Relations School and the Tavistock Institute

Elton Mayo borrowed Durkheim’s ‘anomie’ to develop his theory for human collaboration. He maintained that anomie represented the social disorganization in personal lives and communities which was brought about by industrialization and the technically oriented and engineering interpretation of the meaning of work. Because the social needs of the individual were pushed into the background the capacity for collaboration in work was reduced. A ‘new administrator’, being trained in understanding the social and human problem, would be able to restore collaboration by recognizing people’s need for social solidarity in work and life. He stressed the need for humanistic leadership to overcome anomie and social disorganization and reached one of the same goals as Frederick Taylor, that of collaboration and cooperation in industry. The philosophical rationale for the ensuing human relations movement was the goal of effective human collaboration as the means of restoring a social code which facilitated adjustment to industrial life (Niepce and Molleman 1998). This social concept of organization was further supported by Chester Barnard. He said that “the formal organization is that kind of cooperation among men that is conscious, deliberate, and purposeful” (Wren 1994, p. 266). The formal organization survives by maintaining an ‘equilibrium of complex character’ in a continuously fluctuating environment, examining the external forces to adjust to, and analyzing the functions of all executives in managing and controlling the organization.

Barnard’s notion of internal equilibrium and external adjustment was contrary to the traditional view at the time that organizations had boundaries and that analysis of the organization should be contained within these boundaries. His construction of the collaborative system included investors, suppliers, customers, employees and other contributors to the firm interacting in a social relationship to a community contract. This is not unlike one contemporary ‘stakeholder’, the modern Supply Chain. The Tavistock Institute (Trist 1981), through the efforts of Bamford, Trist and Emery, provided empirical support for Barnard’s theory by finding that social adaptation, facilitated by the redesign of social relationships, was necessary for the successful introduction of technological and organizational changes (Trist and Murray 1993). It was from this work that Emery coined the word ‘empowerment’ to represent the situation where workers have a greater say in how work is done and

accept a greater responsibility for its performance. This devolution of power to employees results in their ownership of these jobs and a feeling that by accepting the authority to control work related decisions they can share and contribute to the purpose of the enterprise.

2.3.4 *Systems Theory*

While the early theorists provided the seeds for current thinking on the theory of organizations, it was the biologist Ludwig Bertalanffy (1968) that observed similar characteristics of systems across various disciplines. The parallelism in systems that germinated his “general systems theory” showed the similarities to include:

1. A study of the whole organism
2. A tendency towards steady state or equilibrium, and
3. An openness of all systems in that the organism affects, and is affected by, the environment in which it operates

While the open system theory of organization may present an environment that is placid, benevolent, turbulent or even harsh, the survival of the organization depends on matching the congruent factors of organizational and environmental characteristics which best suit these settings. Organizational factors should match environmental ones. Such a congruence would suit the Darwinian analogy of ‘survival of the fittest’ without Darwin’s additional constraint imposed by the requirement of an ‘ecological niche’. Social organizations are unfettered by the niche constraint because they are able to contrive to achieve economic, social or political ends. Nevertheless there is much sympathy with the biological model of systems. In 1950 Norbert Weiner for example, coined a word ‘cybernetics’ to convey the idea that all systems are designed to control themselves through a communications loop which feeds information back to the organism so that it can adjust to the new environment (Weiner 1967). This feedback loop means organizations are able to learn and adapt to future situations. General systems theory provided the theoretical and philosophical framework for recognizing the openness of systems and their ability to achieve steady state, while cybernetics identified the mechanism by which feedback was provided. Technology would provide the means for communication and control by knowledge transfer.

Jay Forrester (1961, 1968) took general systems theory one step further. By focusing on the information-feedback system he was able to model industrial and economic systems mathematically to understand decision-making processes and gauge their impact. His ‘industrial dynamics’ is the study of information-feedback characteristics in an industrial framework to show how the structure of the organization, amplification through policies and delays in decisions and actions interact to govern the success of the firm. The interaction factors are: the information flows, materials, customer orders, human resources and capital equipment in a company, industry or economy. It is an experimental and quantitative approach to understanding

how organizational structures and corporate policies affect growth and stability. He believes that there are four foundations on which to draw an understanding of social systems as represented by organizations:

1. A theory of information-feedback systems
2. A knowledge of decision-making processes
3. Mathematical modelling of complex systems, and
4. Advances in computing speed and power

The concept of an information–feedback system is the crux of his approach so he defines it explicitly:

An information–feedback system exists whenever the environment leads to a decision that results in action which affects the environment and thereby influences future decisions (Forrester 1968, p. 14).

It encompasses every conscious and subconscious decision and through iteration leads to new decisions and new results in a way that maintains the system in a dynamic state. It is principal to the other foundations and dictates their interpretation and application. In all, if reflecting on the value of industrial dynamics to the sociotechnical theory of organization, it could be asserted that it is primarily focused on the technical sub-system without regard to its interaction with the social subsystem. This may provide an illustration of the ‘technological determinism (TD)’ of business. TD is broadly understood as the extent to which a society’s technology determines its social, cultural, political and economic form (Smith and Marx 1994).

2.3.5 *Open Socio-Technical Systems*

Contingency and other theories may have attempted to appropriate mechanistic and organic ideas into other formalisms but they purportedly lack the framework required for an analysis of the modern corporation. Open Systems Theory (OST), based on general systems theory, seems to be a more appropriate approach (Van Der Zwaan 1975; Van Der Zwaan and Vries 1999). An interpretation and development of OST forms the foundation on which this book is built.

OST in its simplistic interpretation is the metaphor provided by the reductionist labels; input-transformation-output, feedback cycles, differentiation and integration. From this perspective it is often criticized for grossly simplifying the multiplicity of incoherencies, fragmentations and pluralities of the ‘real living system’. But, these criticisms can be negated if OST is reformulated to include its social and economic origins in the sociotechnical field. Sociotechnical Systems (STS) theory predates the open systems model and is rooted in the Human Relations School which emanated from the Hawthorne Studies (Smith 1998) and earlier as discussed above. It views the social and technical sub-systems as independent constituents of complex large human-machine organizational systems which operate in ‘turbulent’ environments that change at an ever increasing pace. The technical sub-system

includes the tools, techniques and technologies needed to transform inputs into outputs in a value-adding way so that the organization is economically rewarded. The social sub-system comprises those structures created by employee stakeholders and includes the knowledge, skills, attitudes, values and personal relationships they bring to the work environment, notwithstanding that these operate within organizational authority and reward structures (Adler and Docherty 1998). By broadening the definition to include other stakeholders, i.e. customers, suppliers, regulators and the community, STS approaches the concept of 'open system'.

The main tenet of STS is based on two principles; the principle that work processes are best represented by social and technical dimensions, and that these dimensions are interdependent (Cherns 1987). The second principle, named 'joint optimization', states that the reciprocally interdependent dimensions must be designed conjointly. The goal is to integrate the social requirements of people doing work with the technical requirements necessary for work processes to be viable in their operational environment. Although intuitively the attraction is to study work processes along these dimensions separately, attempts to optimize each dimension in isolation will result in the sub-optimization of the sociotechnical whole. Because each dimension also performs to fit the requirements of the other, optimal results come from the 'best fit' of these dimensions working in harmony. In this sense 'joint optimization' is an idiosyncratic concept where each situation can claim individuality.

The STS approach has had a number of criticisms, from being a reductionist set of categories, an abstract analytical construct, to a gross metaphor for a conflict-excluding ideological unitary model of organizations (Adler and Docherty *ibid*). Often, it seems that these arise because of the attention fettered to the two sub-dimensions unequally, or the subjugation of these by an overall system. For example, the social sub-system, promoted by the belief that humanistic principles and industrial democracy are paramount, competes with the technical subsystem proposition which says that efficiency attainment through technological advances is the goal.

In a case of 'technological determinism' for example, the organization is structured to meet the efficiency dictates of the current prescriptive technology. Human values versus mechanical efficiency seems to be the mantra, when in fact STS explicitly states that 'joint optimization' is the dominant goal. Additionally, modern STS theorists expand these propositions by accepting that there is an important inter-connected relationship between the two sub-systems but also one with the outside environment (Van Amelsvoort 2000). These modern versions of STS have been sometimes labeled modern sociotechnical (MTS) or sociotechnical business (SBS) systems. Consequently the OSTS, as introduced in this book, is a better description of an organization in its natural setting.

Fred Emery (1982), an original proponent of STS at the Tavistock Institute, believed that the 'turbulent environments' where most companies operated, required a 'redundancy of functions', or multi-skilling as we now know it, to enable the system to cope with unexpected occurrences and to handle change. These were later labeled 'adaptive strategic planning'. Another significant development was the concept of

Herbst's 'minimal critical specification' (Emery and Thorsrud 1976) which stipulated that over-specified work designs were obsolete, meaning that workers were the best judges of how things should be done and should be left to this task. This concept is now widespread in the fashion that work now involves work groups, matrical arrangements and networks (Emery 1995). The primary work groups are the members who can do all tasks of that group, and thus multi-skilled. The matrices are these groups when they include some tasks which are specialized and allow only certain members of the group to perform them. Networks are when the tasks require assistance from outside the group and this is available collaboratively elsewhere in the organization, where they may be considered specialists in their own field.

Albert Cherns (1987), another associate of the Tavistock Institute (same as the originators of STS), brought all the ideas associated with this approach into a set of principles:

1. Compatibility; where the process must align with its objectives.
2. Minimal Critical Specification; where only the absolutely necessary is specified.
3. Sociotechnical Criterion; where, if variances cannot be eliminated, they should be minimized as close to the point of origin as possible.
4. Multifunctionality; where work needs to be planned in the multi-skilled redundancy mode.
5. Boundary Location; where there are natural perimeters to knowledge and experience.
6. Information; where it goes and where it is needed.
7. Support Congruence; where social support must be available to reinforce desired behaviours.
8. Design and Human Values; which dictates high quality work identifying:

Jobs that are reasonably demanding

An opportunity to learn

Scope for decision-making

Social support

Relating work to social life, and

Jobs that have a future

9. Incompletion; the acceptance that this is an ongoing process of discovery.

These authors maintain that traditional organizations are designed to be overly complex, with a hierarchy that encourages greater demarcation of functions and more specialized jobs based on principles of division of labour. Consequently, this results in increases in control and a tightening of hierarchical power, more rules and regulation formalizing and standardizing procedures, creating various buffers between process links, and establishing specialist functions to expand the ever wanting problem-solving capacity. Van Amelsvoort (2000, p. 39) purports that this complexity can be measured by a relationship expressed as:

$$C = f(E, R, St, Sp) \quad (2.1)$$

Where:

C is complexity

E is the number of elements that can interact in a network
(known as intersection of interfaces in systems theory)

R is the number of relations

St is stability, the capacity for variation and predictability)

Sp is specificity (the degree of precision in timeliness, quality, reliability and completeness)

Some of these principles are evident in the characteristics of the work groups studied in this book as seen by a cursory review of the model adopted in Chap. 5, and particularly by the listed variables in Table 5.3.

Adler and Docherty (1998) note that contemporary STS seems to have evolved into three streams; the North American model with an emphasis on high commitment, high performance and empowered work groups, a human resources approach (Passmore 1982, 1988); the Dutch model with affinities to operations management, logistics and planning and control, an engineering approach, and; the Scandinavian model with a focus on worker participation and union co-determination through programs designed to encourage 'the social dialogue' (Van Amelsvoort 2000). These views are consistent with the general development of giving primary work groups increased control of the links with key groups in the organization's operational arena, of giving these primary groups discretion in decisions concerning customers, and with giving these groups discretion in learning and knowledge development. Not interfacing with customers, not having performance feedback, and not sharing information have been criticisms of STS design in the past (Passmore 1988). Adler and Docherty (1998) claim that the new STS dispels previous criticisms. They define the Sociotechnical Business Systems (SBS) as:

systems in which primary work groups have a high degree of actual control over purpose, context, and system dynamics.....which creates prerequisites for primary work groups to perform business discretion within the top management vision (p 326).

In these systems all users of technology, at all levels, will play a major role in the design of the such system ensuring that compatible, well-functioning elements form part of the design (Mumford 1995).

All businesses are subject to the powerful economic climate of the time. This greatly affects how they operate. For example, the efficient production of goods and services may come under threat by the cheaper import of such goods and services.

This may in turn entice the firm to operate more bureaucratically by enforcing greater and more defined job specifications while reducing the resources to provide them. In fact a regression to bureaucracy seems a more comfortable approach than the over-risky humanistic approaches. Evidence suggests the contrary in organizations with good governance and a trust in the workforce.

Associative democracy, seen as an extension of the humanistic values within the firm, allows the stakeholders outside the firm to have a powerful voice in how it is run. The community-oriented economy transfers powers of big government to civic groups and powers of corporations to its stakeholders. Profit-sharing, co-ownership,

and corporate citizenship demonstrate the strong links between local communities and the decisions of organizations. These links have strong bearings on the decisions made by the corporation, and not always with primacy for the shareholders. As an extension of the humanistic values of STS within the corporation these ideas become congruent with the concept of CG as we now know it (Thomsen 2004).

The organization is now seen as a system which interacts with its transactional and contextual environments (Trist 1981). The transactional environment involves those specific stakeholders who have an immediate connection with the firm, (e.g. shareholders, customers, suppliers) and those who have a relationship with the organization and expectations from it. The contextual environment involves those developments in society and the global economy in general, which are relevant to the organization but not specifically targeted to it. For example, a new foreign trade agreement may have imponderable ramifications on the organization. The OSTS organizational model now takes as axiomatic that organizations can be usefully modeled as social systems consisting of people acting in roles that allow them to use the technology and knowledge available to achieve the organizational goals of economic pursuit and the social expectations of community purpose (Pitelis 2004). Implicit in this axiom is the expectation that organizations have available to them, the resources required from the environment, the customers to export output, and a discourse with the many stakeholders.

The true OSTS organization is one that recognizes it has multiple stakeholders and therefore multiple relationships and responsibilities. Not the least of these is the supply network in which it has traditionally operated and which is becoming increasingly important for the firm's global competitiveness. There are many parallels between the way in which an organization's philosophy on the conduct of business governs its internal operations and how it deals with its supply chain partners and other stakeholders. In all organizations the philosophy, vision, mission and strategic directions emanate from the highest level of management, usually the board of directors, as stewards for the owners. This field of study with origins possibly in the seminal work of Jensen and Meckling (1976) has been of academic interest for well over 25 years (Denis 2001) and is described as CG.

2.4 The Corporate Governance and Social Responsibility Approach to Organization Performance Strategy

2.4.1 *Introduction*

CG is a system. It consists of those formal and informal institutions, laws and rules that determine those organizational forms which assign ownership, delegate power and monitor decision-making, while auditing and releasing information and distributing profits and benefits (Cornelius and Kogut 2003). Australia has adopted a 'market-centric' framework modelled on the styles of CG practiced in the UK and USA where ownership of equity is diffused across a variety of shareholders while

its control is severed from them. This detachment of the ownership of the corporation from the running of it has spawned many treatises on the efficacy of its operations. Agency theory, stewardship, director board composition and executive compensation, stakeholder engagement to mention a few, have attempted to provide an explanation of those organizational mechanisms which impact on corporate efficiency and sustainability. And, with the emergence of MNEs, the globalization of trade and the reduction or elimination of trade barriers, these issues have also drawn the attention of important global economic organizations such as the World Trade Organization, World Bank, the International Monetary Fund and the OECD (Sgro 2003). Often however, studies of these issues have only provided myopic exegeses.

2.4.2 The Current Corporate Governance Forum

There are many ways in which CG can be studied. Its scope is so broad that a review of all important theories of CG is beyond this book, but a working model can be adopted. As a system of controls, it adopts certain standards, including business ethics, which regulate how the enterprise functions in the wider socio-economic community.

Firms are being forced to recognize a 'triple bottom line' of financial, environmental, and social performance (Cornelius and Kogut 2003, p. 19).

To the extent that sound CG is now viewed in the broader social context where performance is monitored and deviant behaviour ostracized by affected stakeholders (Fitzgerald and Storbeck 2003), while still maintaining the more traditional financial view (Williamson 1988). It is however, also viewed in the context of global economics (Business Sector Advisory Group 1998). The stakeholder perspective provides a useful basis for the taxonomy of research to date. The groupings are the economic shareholder studies with a grounding in agency theory, the political and regulatory enforcements of responsible authorities, and the societal and community pressures of the environment in which the firm operates. The author believes that an appropriate breakdown may be subsumed under six dimensions, of which one will be the subject of this study:

1. Legal and regulatory compliance.
2. Equity and ownership structures.
3. Profitability and performance.
4. Control mechanisms.
5. Operational processes.
6. CSR, the dimension analysed in this book.

The legal and regulatory compliance factors dictating CG standards can include the impact of authorities such as CLERP9, the ASX (2003) principles, the Investment and Finance Services Association, Australian Council of Superannuation

Investors and the external impact of requirements as set out by the Sarbanes-Oxley Act (2002), as well as the Heugens and Otten (2005) review of global reforms.

The equity and ownership structures dimension has roots in the whole principal-agent debate (Jensen and Meckling 1976) where owners' control of the organization is severed and management of the firm is delegated to a board of directors duly authorized to act on behalf of the best interests of the owners (stockholders) and parties with financial interests in the organization (Hirschey 2003; Agrawal and Knoeber 1996; Keasey and Wright 1993). For example, Stapleton (2005) asks: how does a Packer family 37% ownership of PBL, a 50.1% Government ownership of Telstra, or a 34% ownership of Coca Cola Amatil by Coca Cola affect the CG of the company? Ownership is a core issue (Caplan 2002).

Profitability and performance are well analysed and widely discussed dimensions. They are typically summarized in the mandatory annual reporting of performance in financial and accounting statements. These public documents invite scrutiny, analysis and debate about how well the company is performing. But, it is the question of how much CG contributes to organization performance that is widely debated (Leblanc 2005; Donaldson 2005; Alves and Mendes 2004; Bradley 2004; Brown and Caylor 2004; Letza et al. 2004; Young 2003; Morin and Jarrell 2001; Keasey and Wright 1993). The contribution debate is also viewed from the stance of major corporate failures. In Australia of recent times, HIH Insurance, OneTel and Harris Scarfe are examples of companies that have failed because of poor CG (Buchanan 2004).

The control mechanisms that organizations institute are those processes which give feedback to the ultimate authority, the board, so that it can judge performance against established standards or goals. Thus studies focusing on the Board are prevalent (Conger et al. 1998; Core et al. 1999; Duleweiz and Herbert 2004). As a mechanism for the management of risk it is also responsible for the conduct of audits and other similar activities. It also debates the value of diverse participants in the auditing function as it does the composition of the board itself. There are various debates about the independence of directors, conflicts of interest, the number and status of the directors and how they should be remunerated to undertake their duties diligently (Leblanc 2005). Their roles, abilities and contributions are often debated.

Further into the functioning of the organization are the operational processes which impact CG (Bhasa 2004; Grant 2003; Bain and Band 1996). The level, depth and intensity of communication with all parties, the transparency of processes, and the varying degrees of employee satisfaction, as well as the appreciation and development of knowledge capital, are reflections of a corporate culture which dictates CG at the grass roots level. Technological responsiveness at this level for example, may be an indicator of an innovative and learning organization in phase with economic, social and environmental trends. As an entrenched corporate reality CG factors now invite measurement (Sonnenfeld 2004), with attempts to even use scorecard metrology (Strenger 2004).

The final dimension that has come to the forefront in recent times is that of CSR (Maignan et al. 1999; Hirschey 2003). In the socio-political and economic global

environment that a corporation operates in, the CSR of the corporation is seen as its ability to fulfill its financial and legal responsibilities to all stakeholders (Evans 2004) and how well it manages the workplace, the environment, and its supply chain relationships (Gettler 2005a, b). There is a sound business case for acting in publicly socially-responsible ways (Arthur D Little 2003), just as there is for social cohesion amongst the stakeholders (Oketch 2004). Even though there are international differences ascribed to CSR in different countries, there is nonetheless an increasing interest in the firm's social and environmental actions (Aguilera et al. 2006). There are also "socially responsible" investors who could enhance the stakeholder accountability of the firm by pressuring it to engage in stakeholder-oriented governance (McLaren 2004). The reputation the organization has for conducting business is integral to sustainable wealth creation (Pitelis 2004). CSR is often regarded as an indicator of competitiveness and firm performance (Brown and Caylor 2005; Bradley 2004; OECD 2006b). The reputation and performance of the organization is often publicized (Larker et al. 2005) through a number of independent indices (Sherman 2004). The St James Ethics Centre (2005) for example, publishes yearly a corporate responsibility index (CRI 2004, 2005, 2006) for Australian companies and the perennial winner of this award (Zonneveldt 2004) is the subject of this book. The British have an equivalent in the Business In The Community (2003) rating, as well as the FTSE (2005), while others include the Governance Metrics International (2005) index and the Dow Jones Sustainability Index (DJSI 2005).

As CSR is now widely accepted as an index of corporate performance, it is not unexpected that it has drawn academic attention (Batten and Fetherston 2003) and the attention of business consultancies (Arthur D Little 2003; Ernst and Young 2005).

2.4.3 *Ethics and Morality in Business*

The moral problems in business are complex and difficult to resolve because business actions can inherently hurt or harm individuals and groups associated with the firm. Managers faced with course of actions that can cause hurt often rely on their view of what is "right", "just" and "firm" but these moral standards are subjective and personal (Hosmer 2000). They are the way individuals intuitively feel about standards of behaviour and differ between people because the goals, norms, beliefs and values on which they are premised differ because of variations in cultural and religious traditions as well as social and economic situations in individual's environment. In business these are the ethical duties incumbent on all company employees, and displayed by the behaviour of managers (Ethics Digest 2006). As Hosmer (2006) would argue, it is leadership that is essential for ethics in business, and this is reflected in six universal conditions:

1. Personal virtues, from Aristotle (384–322 BC), which can be expressed as "never take any action that is not honest, open and truthful, and that you would not be

proud to see reported widely" (p. 14). These arise from normative philosophy, how we think and should behave, and the incontrovertible principles of right and wrong, justness and fairness established since the time of Socrates.

2. Religious injunction, from St Augustine and St Thomas Aquinas, which can be expressed as "never take any action that is not kind, and that does not build a sense of community, a sense of all of us working together for a commonly accepted goal" (*ibid*).
3. Utilitarian benefits, where the action is right if it leads to greater net social benefits than social harms, also known as "the greatest good for the greatest number".
4. Universal rules (Kant 1723–1804), which state that net social benefit theory is elegant but should 'universalized' by eliminating self interest of the decision maker.
5. Distributive justice. Do not take any action which will harm the least of us. In economic theory this is often referred to as Pareto Optimality, a condition in which scarce resources of production and the distribution of them is done so efficiently that it would be impossible to make any single person better off without making some other person worse off. With this concept the theory provides a means of achieving the social goal of the maximum benefit of most wanted goods and services produced at the minimum cost of least wanted resources.
6. Contributive liberty. The freedom to follow one's self interest within the constraints of the law and social contract and which does not interfere with others' rights to do the same.

First however, we must distinguish between morality and ethics. While morality refers to the standards of behaviour by which people are judged, particularly in relation to others, ethics encompasses the system of beliefs which supports a particular view of morality (Beauchamp and Bowie 1993). Since ethics is the basis for morality it follows that business ethics is the determinant of moral standards for business decisions.

Ethics is the system of interrelated beliefs that supports an acceptance of particular behaviours and should thus form part of a CG model (Ernst and Young 2005). Beliefs themselves are idiosyncratic to the time and place. Different groups, in different countries and various locations, at different stages of social, economical and political development and in different eras will have different beliefs. These will be reflected in their ethics and the behaviours they instigate. Consequently the quest for universal principles to construct a system of ethics applicable to all groups concludes that the concept of 'ethical relativism' works against an attempt at unifying competing moral standards. However, there is one principle that seems to exist across all situations mentioned above, and which forms part of every ethical system.

It is the belief that members of a group do bear some responsibility for the well-being of other members of that group. It is acknowledged across cultures and across time that cooperation is necessary for survival. This is no less applicable to the transactions between internal and external groups of the corporation and relationships

with its stakeholders. There are established standards which attempt to achieve this (SA 8000 2004). It therefore seems logical that a ‘business ethics’ aspect be included in a PM framework.

2.5 The SCM Approach to Organization Performance

2.5.1 *Introduction*

SCM provides a framework for businesses and their suppliers to bring goods, services and information efficiently and effectively to customers by firms collaborating to improve operational efficiencies and to leverage strategic positioning (Soonhong et al. 2005). For each SC member the B2B relationship represents a strategic choice of position in the supply channel, based on acknowledged dependency and the requirements of domestic and global customer accommodation (Gardner 2004). This SCM is heavily dependent on ICT/internet and the instantaneous and inexpensive transmittal of information which economizes the conduct of business (Frohlich and Westbrook 2002). Increasingly it is also having to deal with global CG differences (Neef 2004), as well as cultural and ethical issues that arise from global alliances (Kidd et al. 2003). In concept, SCM can be a highly efficient and effective network of business linkages which serve to improve efficiencies by eliminating duplication and non-productive, non value-adding work. It is seen by many senior managers as a strategic approach to competitive success (Keah et al. 2002). In practice however, this is a challenge.

In the integrated supply chain model there are generally three related flow streams. The first is usually the *material flow* stream which involves the purchase of materials, components and services from external suppliers.

This is followed by the transformation of these supplies into manufactured and assembled finished goods. The final stage in this stream is the distribution of the finished product to customers. Note that it is not a major step in applying this description of supply chains to service industries where suppliers may provide data services as well as materials, and the transformation is the conversion of data to a form suitable for distribution. The supply network can be very complex with many suppliers and subcontractors, and even more customers. The network of SCs comprises the B2B links and the relationships that ensue. The second flow stream is that of *information flow* which operates to a great extent in reverse to the physical flow. This B2B link is facilitated by electronic data interchange (EDI) and the internet (Sanders and Premus 2005). It has become increasingly important because advances in the necessary technologies have provided expediency and economy. Communication channels have become ‘information superhighways’. The third flow stream in the SC is *financial flow*. The payment to suppliers and subcontractors and the receipts of payment from retailers and customers, as well as internal financial flows have equally been affected by advances in global information

communication technologies. The integrated SC model requires management and leadership (Bowersox et al. 2007).

In the past SCM has not provided fully the benefits promised. Traditionally the B2B groups were linked loosely and independently with often multiple arrangements with many different firms. The greater the independence of the operation the greater the possibility the group had a 'fragmented supply chain'. A common approach to handling these multiple arrangements and containing any fragmentation was to establish specialized functions with specific roles in the SC. Relationships were maintained by incumbents of these specialized positions and it was implicit in their duties that their primary objective was to 'get the best deal' for their employer (Carr and Pearson 1999). Consequently, the adversarial nature of negotiations perverted the possibility of collaborative relationships and corrupted the structure that they operated in. Different firms were treated discriminately, based on the nature of the relationship and the power base (Cox 1999). Not uncommonly, issues that arose included questions of loyalty, confidentiality, and conflicts of interest. Another approach was to outsource 'non core' functions.

Not only does this tend to insulate the buying company from poor supplier behaviour and negate the responsibility for their egregious violations, it further fragments the supply chain eroding any competitive operational advantage this strategy held.

Difficulties in achieving efficiencies in the SC were recognized. One approach used to overcome them was to vertically integrate the organization so that SC members all belonged to the same corporation. Benefits of this arrangement are intuitive; functional responsiveness and accountability was kept within the corporation, financial sophistication, transfer pricing, and the ability to control and shift costs became available, and transfer of information could be conducted without loss of integrity. Additionally, the corporation was able to operate globally and employ improvement techniques such as Just-in-Time (Arnheiter and Maleyeff 2005; deWaal 2004; Crawford and Cox 1990) to achieve strategic advantage. However, practices such as stockpiling inventory to insure against unpredictable markets were maintained, and remained unchallenged because no viable alternatives existed. As consumer affluence increased, this long standing passive acceptance of service changed to an expectation that there would be active involvement in design and delivery of products and services (Dornier et al. 1998). This too was facilitated by the expediency of communication facilitated by the internet. But, if the supply chain is seen as catering only for a particular product group, as in a single path through the supply network from suppliers to distributors, then pockets of inefficiencies and waste can still exist.

In terms of operational performance of the supply chain, the logic that prevailed assumed that, if the individual members of the SC were efficient, then the whole supply chain would benefit. Overall chain process efficiency was considered to be the sum of the individual efficiencies of members of the chain. Hence PM focused on the individual components of the SC (Grunberg 2004; Gunasekaran et al. 2001). For example, cost/unit to manufacture and cost/unit to transport were analysed independently and not as part of the complete SC. Sometimes this invited an

accounting game where spreading and sharing of costs through overhead allocations and burden rates were used to diffuse the true costs of non-viable operations. This is contraindicative of the objective which should be to achieve performances that provide the overall lowest cost for the total supply chain.

The quest for integrated SCM is to provide mechanisms where the cost of product is reduced, the quality maintained or exceeded, and the expectation of ultimate consumers satisfied. This can only be achieved by collaboration of partners within the supply network, extending the enterprise beyond traditional organizational boundaries, and integrating the services of all providers by the facilitation of ICT (Sanders and Premus 2005). It is this ICT that has manifested a paradigm shift in thinking about the possibilities; the move from a supply chain to a value chain to a network (VN) has significant strategic advantages (Towill 1997). It is more pragmatic to regard these chains as networks because of the myriad of complex structures that describe the direct and indirect elements of transactions in the inter-dependent relationships between firms. There are technical and social content in these relationships. The technical ones are the mechanisms that control supply functions while the social ones involve trust, commitment, collaboration and power. Good relationships may be an asset (Kanter 1994) because the time spent on activities of both parties can be optimized by minimizing pre-qualification and credential checking and process auditing, while accessing the pooled resources of both parties to allow a division of tasks and a reduction in duplication. On the other hand, the disadvantage of this closeness is a restriction on company autonomy, resources to maintain the relationship and coordinate ongoing processes, and the real possibility of future indebtedness to the other. There is also the cost of termination of the relationship should it be unmanageable. However, the relationships between firms that interconnect to form networks display common characteristics which feature in collaboration:

1. Reciprocity – each partner is expected to contribute some balanced share to the specific transactions. This may include different proportions at different periods of time and at different stages in the supply process.
2. Interdependence – the parties are knowledgeable of each others' capabilities and operations and may draw on these to help solve process problems.
3. Loose coupling – while maintaining rudimentary legal formal obligations there is a reasonably stable framework for interaction and communication.
4. Power – a supply chain has inherent power relations which can be exploited positively or negatively, usually to the whim of an 'orchestrating' key partner.
5. Boundedness – boundaries of the network are defined by the demarcation of operations of individual partners within the common supply chain.

These characteristics highlight the necessity for communication and collaboration in the relationship with a commitment to trust, shared values and aligned goals.

The fundamental rationale behind collaboration is that a single company cannot successfully compete by itself. Customers are more demanding; competition is escalating. Thus many firms seek to coordinate cross-firm activities and work reciprocally over time to produce superior performance (Min et al. 2005, p. 238).

Collaboration is important to the extent that along with the other variables it has been studied by various researchers (Simatupang and Sridharan 2002). These researchers for instance (2004), have developed a collaboration index (CI) which has the three dimensions of information sharing (10 items), decision synchronization (9 items), and incentive alignment (6 items). They structure the quantitatively validated relationship as:

$$CI = f (IS, DS, IA) \quad (2.2)$$

Traditional ‘anticipatory-based’ business practices can now be surpassed by ‘response-based’ business models. The anticipatory model required a forecast to initiate material purchases, program manufacturing, and plan warehousing and distribution, at high cost, in the expectation of those forecast sales. It was based on a ‘push’ strategy. The alternative response-based model works on a ‘pull’ strategy. In this approach customer requirements are not misjudged by questionable forecasts because the orders are confirmed. The response-based business model is the fruit of low cost information. Managers can share information rapidly to improve forecasts or eliminate them in an effort to minimize inventories (Basu 2001). By reducing the reliance on forecasts because of speedy accurate information, the response-based model mimics the traditional ‘build-to-order’ manufacturing without its disadvantages (Holweg 2005). The contemporary response-based system operates faster than build-to-order and gives meaning to the oxymoron ‘mass customization’. Direct connectivity with end users via web-based communications allows such customization with the added benefit that the customer is no longer simply a passive participant (Fundin and Bergman 2003).

While these in themselves are noteworthy achievements the benefits expand. Manufacturing postponement, delayed logistical fulfilment and the financial sophistications of cash-to-cash conversion, dwell time minimization, and cash spin are at the heart of response time based capabilities. A manufacturing postponement strategy reduces the anticipatory risk in traditional SCs because the working arrangements available through response-based orders allow the postponement of final manufacture or shipment of product until the receipt of the customer order. The operational tactic allowed by this strategy is to maintain the product in a non-committed or neutral state as long as possible, thus allowing economies of scale while accommodating a variety of product configurations to satisfy individual customization. The result is a reduction in the number of stock-keeping units in logistics inventory while supporting broad product variety. Delayed logistical fulfilment through logistics postponement works contrary to manufacturing postponement in that the full line of inventory is built but stocked at one or few strategic locations and available for accelerated delivery upon receipt or customer order. This is also known as geographical postponement and often suited to products such as service and replacement parts. This approach reduces overall inventory investment yet achieves reliable customer service (Beamon 1998).

What are the financial benefits of time-based strategies for SC operations? The financial benefits are straightforward; speedy delivery means less inventory and

reduced distribution facilities, and quicker to customer means less working capital in the supply chain. These are expressed in the financial sophistications of cash-to-cash, dwell time minimization, and cash spin. Cash-to-cash conversion is the time taken for the conversion of raw material to sales and relates to inventory turn. The higher the 'inventory turn' the faster the cash conversion.

This can be achieved by designing the SC so that the cycle time from receipt of customer order to the delivery of goods is reduced. Reducing cycle time can be achieved by minimizing dwell time. Dwell time is the ratio of time that an asset waits idly to the time required to complete the cycle or parts of the cycle being measured. Reducing the assets across the SC also provides a benefit referred to as cash spin.

If some asset in the SC is eliminated or reduced by re-engineering existing processes, the capital freed by their absence becomes available for other investment. Such changes are reflective of trends in the new operating environment (Bamford and Forrester 2003).

An alternative to 'anticipatory-based' and 'response-based' business models is the 'process-oriented' framework. Lambert et al (2005) evaluate the framework of The Global Supply Chain Forum (GSCF) against that provided by the Supply-Chain Council (SCC). The former classifies SC processes as; customer relationship management, customer service management, demand management, order fulfillment, manufacturing flow management, supplier relationship management, product development and commercialization, and returns management. The SCC has five supply chain operations references; plan, source, make, deliver and return, which can be analysed on four levels with each level based on the three components of process reengineering, benchmarking and best practice. Lambert et al. conclude that the differences are merely a distinction between a strategic approach to SCM versus a tactical approach, and both are applicable to any firm depending on its requirements at a particular time.

The financial attractiveness of strategic and tactical changes to SC operations should be sufficient to stimulate collaboration between member firms and an impetus to challenge tradition (Duffy and Fearne 2004; Basu 2001). The arguments for collaboration as a mutually beneficial strategy in network relationships are often presented as compelling (Manzoni and Islam 2006a, b, c). However, the obstacles to cross organizational collaboration are many. The issues include management and leadership, confidentiality, trust and loyalty, reward and risk sharing, and measuring the performance of the supply chain.

A collaborative framework requires good management, integrative leadership and an acceptance that the framework is unique to that particular supply chain (Lambert et al. 2004). Since the primal issues are ones of power and risk, the integrative leader will be the supply chain partner that has significant power through its role in the SC or delegated power from other members that are willing to allow this firm to act as the collaborative leader.

One challenge for the collaborative leader is to distribute equitably the rewards and risks. If process innovation is successful what is a fair share of benefits? If a venture fails, what is a fair apportionment of risk absorption? In traditional modes,

one method of sharing risk and rewards is transfer pricing. It is guided by market forces and works for transaction-driven business relationships. The collaborative SC works at a higher level of commitment and on a different basis to transaction driven business. Confidentiality, trust and loyalty are higher parameters, as is joint strategic planning to achieve future goals of survival, growth and profit. The collaborative SC will have participant firms that are simultaneously engaged in other networks and commonly with direct competitors. There is genuine overlap and potential for conflict and breaches of confidentiality. The conceptual simplicity of neat linear supply chains quickly dissolves into a quagmire of competitive complexity and a maze of operational interactions. It is in these relationships that integrative leadership can launch, nurture and sustain collaborative initiatives. Management of the relationships in multiple supply chains with these potentials for damage can be achieved by 'partitioning' organizational structures to specifically focus on particular collaborative relationships (Doran 2003). The cross functional integration and optimising of the supply chain is an evolution which needs to be 'orchestrated' (Schmitz and Platts 2003). Orchestration is the role of the partner in the dyad that makes the key decisions but not on the basis of a power game (O'Reagan and Ghobadian 2004), rather on the basis of mutual benefit to the whole SC. Whereas integration was once discussed as an inter-departmental and intra-firm objective it is now openly accepted that it extends beyond the firm itself (Daugherty et al. 1996). Once integration is under way, the common interest in measuring performance may commence with choosing information reporting capabilities which align with the needs of the SC partners (Griffis et al. 2004).

Once issues of jurisdiction are resolved there remains the question of how to measure the performance of the supply chain. There are no conventional measurement devices for supply chains, accepting that the performance of the SC is not simply the summation of individual firms' performances, and that it operates in a globalized knowledge economy. There are however, concepts of functional integration which approach SCM from a systems perspective, not dissimilar to this book. Min and Mentzer (2004) propose a system where 'supply chain orientation', expressed through trust, commitment, cooperative norms, organization compatibility and top management support, is a precursor to the upstream and downstream performance of the SC, where the customer focus is captured as equally important in the long-term relationships of partners. The measurement metrics must assess performance as the collective synthesis of the synchronized SC while being able to isolate and identify individual contributions. Min and Mintzer suggest metrics such as growth, profitability, timeliness, availability, and product/service offerings. Other approaches to measurement may be quantitative. Li et al (2002) build a 'scenario model' which defines organizational entities as supply chain nodes, distinguished from each other by the attributes of product/service, organization specialization and location, which are engaged in a complex set of multi-layered interdependencies, represented by numerous equations of mathematical integration. Alternatively, Chan and Qi (2003) use fuzzy logic to build a PM hierarchy of judgments in the supply chain with inputs such as time, labour and capital costs, and outputs such as value of finished and semi finished product, as a quantitative approach to SC measurement.

Most companies realize that in order to evolve an efficient and effective supply chain, SCM needs to be assessed for its performance (Beach and Muhleman 2000) but it is notable that the development of meaningful performance metrics for supply chains is in its infancy (Cigolini et al. 2004).

2.6 The Measurement of Organization Performance

2.6.1 *Introduction*

PM is a diverse and debatable subject which crosses disciplines and offers perspectives from various specializations. Traditionally the accounting framework has been the mainstay of quantitative PM but in recent times it has been severely criticized for being inadequate. In particular, financial planning and control has maintained its central role so that managers can deliver returns to shareholders and other stakeholders.

Financial control requires monitoring and corrective action and is thus ‘backward-looking’. The major criticism of this traditional approach is paraphrased in the question “How can the firm go forward if it is always looking backwards?” In fact, as commentary on the accounting approach Otley (2002) states that:

There is no definitive set of financial ratios that can be said to measure the performance of a business. Rather, a set of measures can be devised to assess different aspects of financial performance from different perspectives (p. 8).

He maintains that there is still a need for these financial measures since they provide tools for the efficient use of resources, provide measures against organizational objectives, act as motivation and control mechanisms in the organization, and assist in achieving the needs of outsiders (to the organization) such as shareholders, bankers, etc. Through audited financial statements there is also the opportunity to comply with CG requirements as encapsulated in agency theory. And, while financial specialists are aware of the criticisms they are actively trying to introduce new means of economic PM. The EVA model, and ‘triple bottom line’ are examples of this, just as ABC was earlier.

If the task is simply to provide measures then the objective is obscured. Meyer (2002) identifies a total of 117 top level measures comprising 17 financial, 17 customer related, 19 internal processes, 35 renewal and development, and 26 human resources. This may be symptomatic of what Neely and Austin (2002) note as “we measure everything that walks and moves, but nothing that matters (p. 48)”.

In addressing SC performance, from customers to suppliers, customer satisfaction attracts a large and continuing academic interest (Hill and Alexander 2000). While the underlying notion is that customer satisfaction is about meeting expectations from services and products, and performance is how well these expectations have been met, this may be a distraction from a true measure of performance of the SC. The research on this paradigm of ‘disconfirmation-of-expectations’ has had mixed

results with the consequence that the quest is to find what really affects cash flow and what really matters to performance.

While there is a richness of sophisticated measures of market performance, this richness brings with it confusion as researchers and managers struggle to find a set of measures that is comprehensive enough to be accurate, yet simple enough to be usable (Clark 2002, p. 36).

In the analysis of supply chain performance, the literature abounds with measures that apply to the central orchestrating firm, the main player. Measures for the operations of individual firms, viewed in isolation of the supply chain, have congregated around the concept of the balanced scorecard applications (Kaplan and Norton 1993) because it is credited with structuring an array of performance measures (Amaratunga et al. 2001). These include; the explicit link between espoused strategies and the performance measures for these, the four major areas of measurement which match stakeholder concerns, the main drivers for future performance (unlike simple financial measures), and the key success factors being limited to only four performance areas rather than the prolific KPIs of other measurement systems. It is even possible that the EVA metric could be used as one of the financial measures in a BSC formulation. This interest in a BSC as a PM metric is emphasized by the increasing availability of enterprise resource planning (ERP) software with the capability of reporting on these scores (Curran and Lald 2000). For example, SAP, Oracle, Peoplesoft and Baan have such software modules. Programs such as these should simplify the process of designing an optimal PM system. Such a system would have relatively few measures, three financial and three non financial for example, with the financial ones as backward performance indicators and the non financials as forward performance indicators.

These measures should pervade the supply network uniformly to permit comparison across organizational units, and should be stable enough to reveal true performances at focal points in time yet responsive enough to evolve as the integrated network of firms does. The intuitive reasoning for a minimum of three indicators for financial and non financial is that the supply chain can be broadly viewed as the three parties; suppliers, orchestrating firm, and customers with each segment having a financial and non financial metric. Non financial measures have oft been shied away from because they were considered intangibles (Eskildsen et al. 2003).

The financial and non-financial dyad can be further supported by viewing the progress through the SC as a generic three stage causal model with foundations (suppliers), processes (orchestrating firm), and outcomes (consumer product), as represented by the 'performance tree' of Lebas (1995). The tree analogy was chosen to illustrate process complexity entwined with growth and change. The generic model incorporates traditional conceptualizations from the economic and financial requirements of shareholders and company stewards, as well as other conceptualizations from the perspective of non-fiduciary stakeholders such as social, environmental and political or regulatory organizations. Modelling performance as a tree offers the scope to visualize performance as a complex concept which both defines and legitimizes it as a social construct. This allows the articulation of performance

as a set of propositions pronounced by various researchers in recent times and enunciated by Lebas and Euske (2002). One proposition is that performance can only be expressed as indicators of processes through which various outcomes are achieved. The next proposition is that performance exhibits a causal relationship. Actions today influence results in the future. The third proposition is that performance is user-defined because as a social construct its application depends on the user's objective. For example, the acceptability of an organization's performance could be assessed diametrically opposite by shareholders and environmental groups. This suggests that another proposition supposes performance is different when evaluated from inside and outside the firm. The fifth proposition is that performance is always connected to a domain of responsibility. The domains in an organization are the teams, functional specializations, or departments, and other sub-models within the greater structural hierarchy.

The Taylorist view, still widely held, is that these sub-models are additive while the contemporary view is that they overlap in networks of cross-functional processes represented by 'domains of responsibility'. Since Lord Kelvin said "if you cannot measure it, it does not exist" then Lebas and Euske's proposition six states that performance only exists if it can be described or measured (2002, p. 74). Proposition seven requires that the model needs to be continuously validated to remain relevant and proposition eight states that these metrics should be accepted as being only partially descriptive of performance, while their final proposition is that performance is a relative concept requiring judgment and interpretation...[and]... contradictions among temporal measures and other indicators are inevitable (p. 77).

An acceptance of these performance propositions can be productive in establishing a set of basic principles for PM. Austin and Gittell (2002) list three:

1. Performance should be clearly defined in advance and to agreed criteria.
2. Performance should be accurately measured, in a way to convey maximum information.
3. Rewards should be contingent on measured performance.

These principles can be perfunctorily applied in balanced PM systems so that decisions made and actions taken in the past are quantifiably expressed as efficiencies and effectiveness of the results in the present. These organizational results would be the aggregation of PM for the individual domains of responsibility and reflect the ability of the ICT infrastructure to enable data acquisition, collation, analysis, interpretation and dissemination to be exploited. In an economic fashion this has been achieved by models such as Dupont's pyramid of financial ratios.

How can existing knowledge of PM help in attaining practical metrics in supply networks? Surprisingly, a comparison of the popular measurement frameworks reveals a congruence among models which can be drawn on. Deficiencies in the Dupont pyramid, particularly the focus on historical financial performance and its prodigy 'short-termism', has led to models which pronounce a more balanced approach with the inclusion of non-financial indicators.

The Matrix Model (MM) of Keegan et al. (1989) provided a simple framework with cost, non-cost, and external and internal dimensions to give greater balance.

Lynch and Cross (1991) similarly provide for internal and external measures with ‘cascading’ measures down the organization to departmental and work centre levels, similar to the domains of responsibility mentioned earlier. The balanced scorecard of Kaplan and Norton (1992; Appendix K), widely adopted since the 1990s, has a similarity to and a development from the Tableau de Bord (Epstein and Manzoni 1997) established in France earlier last century and still widely applied.

But, contemporary thinking (Kennerley and Neely 2002, 2003) has criticized these models on a number of shortcomings (Krause 2003), in particular the need to address the increasing demands of stakeholder satisfaction. The Cranfield University model (Appendix L) that adopts the stakeholder-centric view is the Performance Prism (Neely et al. 2003; Adams and Neely 2000). It recognizes the growing power and importance of regulators and significant pressure groups by attributing two of the five facets of performance to stakeholder issues.

An in-depth analysis of the above models allowed Bitici et al. (1997) to identify common features and study the dynamics of PM systems (Bitici et al 2000). From a review of over 260 publications across many disciplines Bitici et al. (2002) uncovered numerous fragmented concepts and principles of PM but

very few publications provided a complete and structured view for an integrated PM system.. [and].. none of the existing models or approaches completely addresses the requirements identified (p. 177).

This then, provides an opportunity to develop a framework which addresses these deficiencies. This is the aim of this book.

2.7 DEA and the Measurement of Efficiency

2.7.1 *Introduction: Background and Brief History of the Model*

The term data envelopment analysis (DEA) was first used and reported in the European Journal of Operations Research by Charnes et al. (1978) based on Rhodes' PhD dissertation research “A DEA Approach to Evaluation of the Program Follow Through Experiment in U.S. Public School Education”. It was the failure of all the statistical-econometric approaches tried previously that led Rhodes to suggest Farrell's (1957) work “The Measurement of Productive Efficiency” as an alternative to analyzing efficiency as a measure of performance expressed in a ratio of single output to single input. Farrell identified two components of efficiency; a *technical efficiency* (TE) which showed the ability to maximize output from given input and a *price efficiency* which reflects the use of inputs allocated in optimal proportions (and hence also referred to as *allocative efficiency*). See Chap. 4. Considered together these measures provide an overall (or economic) efficiency. These ideas were developed further in later DEA models and explained well in texts by Cooper et al. (2000, 2006), and Zhu (2003), as well as the milestone text by

Charnes et al. (1994). The Australian contributions include Coelli et al. (2005), and Avkiran (2006). These are reviewed later in this section.

At this time the concept of efficiency as a ratio of the output goods and services to input resources, to be termed productivity, was gaining credence. It was the work of the Organization for European Economic Cooperation (OEEC) in the 1950s to promote productivity that led many European and Asian nations to establish Productivity Centres and Councils (Sumanth 1984). As a concept it became an economic tool for the measurement and comparisons of productivity at international, national, and industrial levels, but only to a minor degree was it used at the company level.

The obstacle to general acceptance was the difficulty in arriving at a productivity ratio which could include all the different input resources and the various outputs and being universally accepted or having comparability (Nyhan and Martin 1999). The productivity ratio takes the form of three different types; *partial productivity* (PP) which is the ratio of output to a single selected input, e.g. units per labour hour, units per tonne, etc., *total-factor productivity* (TFP) which is the net output to the aggregated labour and capital inputs and, *total productivity* (TP) which is the ratio of all outputs to the sum of all inputs (Sumanth 1984).

The partial productivity ratio has become the most widely used because of its ease to calculate, understand and obtain data, especially because it relates output to a single input. However it may mislead and fail to give a true picture of the situation. Total factor productivity, as defined in the early literature, is less meaningful to operational managers because only labour and capital inputs are represented. This may not always be appropriate, for example when there is a large materials input. This meaning seems to have waned and been replaced what was originally total productivity, a measure representative of the organization's true economic position.

The measurement of total factor productivity (total productivity) is quite difficult to achieve because of the quantity and availability of the information required and also because TFP is not able to quantify important intangible factors of input or output. Nevertheless the concept that efficiency can be expressed as a ratio of all output goods and services to the sum of the total inputs (beyond only tangible resources) is widely accepted and rarely challenged. In commercial spheres for example, the financial index of the aggregated dollar value of sales to the aggregated dollar value of inputs is often calculated and used in some fashion, but global measures such as this provide little insight into the firm's efficiency at the operational level and a better diagnosis of the output:input relationship would be helpful. The contemporary generally agreed measures of productivity are PP and TPF, noting that the latter is now regarded as inclusive of all inputs and all outputs. These distinctions become important in later research because they are tied to efficiency and performance.

Charnes et al. (1978) were able to by-pass the shackles of financially focused metrics and partial productivity measures by optimizing individual ratios, as defined by the researcher, to generalize from single outputs/inputs to multiple outputs/inputs by the use of 'virtual' surrogate units that represented multiple outputs

and multiple inputs. The discrete units to be measured are those DMUs that are defined by the researcher according to the output–input relationship that warrants investigation (Gass and Harris 2001). In fact all DMUs in DEA are the discretionary inputs and outputs as assigned by the researcher.

By 1992, 14 years later, 472 publications on DEA reflected a growing interest in this tool. Its rapid acceptance was attributed to the development of extensions to the original model, and variations to it, when problems in its application were encountered (Charnes et al. 1994). By 1999, over 800 citations were recorded, and by 2001 the publication list stood at more than 3,200 (Tavares 2003 cited in Avkiran 2006 and Cooper et al. 2006). These publications have addressed a great variety of research interests by over 1,600 authors in 42 countries. Yet this field is barely tapped. Emrouznejad and Podinovski (2004) for example, report that at the fourth International Symposium of DEA there were more than 190 papers, spanning the boundaries of academic disciplines, submitted. Sixty of these are published in their text on the proceedings.

Manzoni and Islam (2006a, b, c) have added to this by presenting DEA applications of PM, SCM, and CG to a number of international and national conferences (Manzoni and Sadler 2005). The volume of work reflected in the above figures and the diversity in applications reported suggests strong support for the technique as a diagnostic instrument and one with broad applicability. Additional bibliographic listings are available at DEAzone (2005) and, Emrouznejad and Thanassoulis (2005).

2.7.2 Recent Research and Model Development

Some recent studies show the potential for future research. Sarkis (1999) applies DEA in the study of environmentally friendly manufacturing, while Tone (2001) shows how to deal with undesirable outputs in DEA, other than treating them as negative inputs. Eilat et al. (2006) show how an extended DEA can be used to quantify some qualitative concepts embedded in R&D project portfolios. Quantification of qualitative concepts was earlier discussed in the generalized multiple criteria model of Greenberg and Numaker (1987).

Efficiencies in the Australian finance sector are studied by Brown (2001) while the Industry Commission (1997) shows how DEA can be applied to measure Commonwealth/State government service provision. Rickards (2003) used DEA to evaluate benchmarks and balanced scorecards

The DEA literature is diverse because of all the disciplines it transcends, being a quantitative diagnostic instrument. In very broad terms however, DEA research may be categorized as; learning and technical development of the mathematical model, joining it with complementary mathematical techniques, traditional widespread and popular applications, and emerging novel applications. Some themes naturally, become more popular as new research is published and applicability established, and many overlap categories.

The technical development has seen many versions and new variations to the Charnes Cooper Rhodes (CCR) model (Charnes et al. 1985; Seiford and Lewin 1997; Zhang and Bartels 1998; Frei and Harker 1999; Pastor and Sirvent 1999; Ahmad et al. 2006). Those that have passed academic scrutiny have usually been expanded in specialized texts.

For example, the recent text of Zhu (2003) develops DEA so that managers can conduct performance evaluation and analyze decision alternatives by the easy use of spreadsheets. DEA Excel Solver is supplied to calculate 150 different model versions providing various contexts to allow benchmarking. The Cooper, Seiford and Tone (2000, 2006) texts are similar in that they provide instruction and software but also build on the earlier work of Charnes et al. (1994) which provided a multitude of examples of application in very diverse fields, including a valuable DEA bibliography from 1978 to 1992. The included software in the recent text is for limited use by its reader to test the DEA application, while the advanced professional version for purchase, is provided for real-world larger applications. This is the DEA Solver Pro used in this book. The text also explores some developments in theory and methodology including sensitivity analysis, statistical approaches such as OLS regressions, stochastic frontier regressions and window analysis, to name a few. The 2000 text of Cooper et al. adds to the earlier version by providing additional material from more recent developments. The concept of 'super-efficiency' where $E > 1$ for example, makes it possible to ascertain the consequences of eliminating a complete DMU—especially an efficient one.

Avkiran (2006) provides an Australian text with DEA as the productivity analysis technique which captures the complex interplay between multiple inputs and outputs. It is designed as an introductory text, suitable for the classroom, with case studies from the services sector. It presents the areas of banking, education and research centres, hospitality and tourism, public transport, police stations, telecommunications, Olympics, public libraries, and others. This list draws on work in journals, monographs, conference proceedings and other sources, identified by Avkiran, other researchers and by this researcher. It is not a comprehensive list but it does illustrate the diversity of the DEA applicability. Another Australian text by Coelli et al. (2005) is the second edition of a book written for people wishing to study efficiency and productivity analysis by four different methods; econometric estimation of average response models, index numbers, DEA, and stochastic frontiers. It starts with the basic concept, gives simple examples, then extends the method with a number of detailed empirical applications using real-world data.

The Sengupta (2003) monograph integrates the theory of firm efficiency and industry equilibrium, emphasizing a dynamic setting, and incorporating uncertainty of market demand and prices. It also discusses the implications for shared investments, all of these with the parametric and semi-parametric methods of estimating production and cost frontiers using DEA. The Ramanathan (2003) text, on the other hand, is a tool for practitioners who need to know the merits and pitfalls of the technique but must first gain an understanding of the algorithm. Another basic explanation for practitioners is provided by Anderson (2005).

Many facets of DEA have been debated but a recurring one is how to allocate the correct weighting to the DMU's input and output factors. While there is general acceptance that the algorithm performs satisfactorily with its self assignment of weights thus providing a conservative result, there has been ongoing attention to the best approach. Golany and Roll's (1989) procedure for DEA discusses this and introduces the idea of using Analytical Hierarchy Process (AHP) for assigning weights. Cheng and Li (2001), Yurdakul and Ic (2005), and Sarkis (1999) for example, use AHP to assign weights. Entani and Tanaka (2006) however, demonstrate how the bounds of efficiency can be changed by adjusting weights on non-efficient DMUs, in particular by adjustments to inputs and outputs, while Troutt et al. (2007) propose a 'winner-take all' optimization for determining the most productive unit. They simultaneously assign input and output factor weights along with optimal intensity values for the virtual composite unit to achieve the 'maximally productive input-output units'.

2.8 Conclusion

This chapter presented a review of the contemporary literature on the various topics encompassing this book. It reviewed the emergence of a global knowledge economy as the foundation for new management theory and PM practices. In particular, it studied the impact of the global knowledge economy on Australia in recent times and the emergence of a new system of OB through OSTs. This system was presented as a development from established contemporary theories of management with ideas from more recent schools of thought. General systems theory and its developments were incorporated with STS to present OSTs as a theory for the management of the whole supply network in the twenty-first century. The SN was described in terms of the over-riding system in which the organization operates, and therefore its performance is contingent on the performance of this bigger system.

This was followed by a review of previous and recent methods of measuring performance, with an analysis of their successes and limitations, thus providing a basis for the positivistic methodology of DEA. DEA is an established technique for making efficiency comparisons and was reviewed from its origins in 1957 to the present time. This review covered the historical development of the technique with some specific issues relevant to that period. The next chapter presents the conceptual framework and research methodology for the model developed in this research.