Strategy development processes as determinants of B2B e-commerce performance
A comparative model in a supply chain management context

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Abstract

Purpose – The purpose of this paper is to test the relationship between the use of business to business (B2B) e-commerce enabling technologies and infrastructure, cooperative partnerships between trading partners, firm performance, and a “systems” view of strategy formulation processes.

Design/methodology/approach – A structural model has been developed from a survey of Australian companies. This survey covered a broad range of issues relating to the strategic and operational aspects of the use and implementation of B2B e-commerce technologies.

Findings – The data indicate that the process by which organisations formulate their strategic logic is an important determinant of both how resources are selected and deployed, and of business performance. At the same time, it is evident that these same resources are not likely to yield significant benefits without such a process, and in fact that their effectiveness is very much a function of the nature of this process.

Research limitations/implications – This study has been limited to organizations operating in the Australian fast-moving consumer goods sector. The results therefore need to be read in this context, and it would be useful if these findings could be compared with those from other countries and different industry sectors.

Practical implications – A practical implication of this study is that the nature and strength of the influence of this process are situational, in the case of this research due to the extent of implementation across the supply chain, and to the nature of business activity (or in other words – position in the supply chain).

Originality/value – The importance of these findings for organisations looking to implement e-commerce related methodologies for the improved management of supply chains is that focusing on developing effective methods for developing strategy can be expected to yield better ultimate performance. This highlights the need to focus on strategy rather than concentrating on the technologies, supporting infrastructures, and trading partner relationships themselves.

Keywords Electronic commerce, Corporate strategy, Supply chain management, Australia

Paper type Research paper

Introduction

The study of organisations as systems, particularly in the context of rapidly changing business paradigms driven by technological, social and economic change, has become increasingly relevant to understanding the dynamics of their interaction with the business environment. Traditional methods employed to understand the way organisations function, and can thus be best managed, have focused on analysing
individual components and developing models based on the characteristics of each separate element. Examples of this approach can be found in the fundamental principles of cost accounting, marketing theory and traditional approaches to the development and implementation of strategic policy. The focus on unit costing rather than total product/service cost, the relentless drive for sales regardless of capacity and capability of the organisation to cope with demand, and the development of strategies based on short term operational performance criteria, are common business models symptomatic of this approach to organisations as aggregates of parts. The view of organisations as systems, on the other hand, attempts to take a holistic view of the organisation as an open system in the context of it is interaction with the environment in which it operates. As such, the management of the organisation becomes focused on the processes operating within (and across) superficial functional groupings, rather than attempting to manage (and optimise) each of these in isolation. The importance of understanding and applying this systemic approach to the management of organisations is amplified in the study of techniques and methodologies being applied to the management of supply chains. In this case, the complexity of managing across organisational boundaries creates a need for developing means to coordinate an array of activities and potentially conflicting priorities. The use of technology along with the development of partnerships and cooperative business practices have been proposed as means of counteracting these complexities, and of enabling more effective business practices. On the other hand, it is perhaps useful to look past the use of these techniques and technologies, and to the nature of strategy formulation processes being used. The development of strategy within individual organisations perhaps provides a more fundamental point of comparison for the assessment of how organisational performance is determined in a supply chain context.

**Literature review**

*Supply chain management*

The aim of supply chain management is described by Kaufman (1997, p. 14) as to “...remove communication barriers and eliminate redundancies” through coordinating, monitoring and controlling processes. Clancy describes supply chain integration as:

“... attempting to elevate the linkages within each component of the chain (to facilitate), better decision-making (and) to get all the pieces of the chain to interact in a more efficient way”. And thus “…create supply chain visibility (and) identify bottlenecks” (Clancy cited on Putzger, 1998, p. 55).

Handfield and Nichols see an integrated approach to the management of the supply chain as being driven by, and an incorporation of, three major forces:

1. the information revolution;
2. increased levels of global competition creating a more demanding customer along with demand driven markets; and
3. the emergence of new types of inter-organisational relationships (Handfield and Nichols, 1999, p. 5).

As a result they describe the three primary elements of an integrated supply chain model as being information systems (management of information and financial flows),
inventory management (management of product and material flows), and supply chain relationships (management of relationships between trading partners).

Common characteristics of supply chain integration identified in the literature include cooperation, collaboration, information sharing, trust, partnerships, shared technology, and a fundamental shift away from managing individual functional processes, to managing integrated chains of processes (Akkermans et al., 1999). This process of integration has also been described as including product design, and all the steps between, leading to the ultimate sale of the item (Anonymous, 1998a, 1998b; Ballou et al., 2000). Others go further and include all activities throughout the useful life of the product including service, reverse logistics and re-cycling (Carter and Ellram, 1998; Coleman et al., 2000; Thomas and Griffin, 1996).

Cottrill (1997) sees the evolution of the integration model as moving toward a supply chain that functions as a corporate entity, spanning a virtual enterprise without reference to traditional company boundaries, and driven directly by customer demand via electronic storefronts. He believes that this will drive major changes in corporations eventually leading to greater use of outsourced services. Interestingly, he also believes that the key to implementation lies in focusing initially on introducing changes within the company, and then migrating the process outwards to suppliers and customers. The initial major benefits resulting being cost and cycle time reductions. Wood (1997) on the other hand emphasises the importance of aligning goals across functions through cooperation and collaboration, citing the traditionally poor alignment of goals between manufacturing and sales/distribution functions as an example of areas where better alignment is a pre-condition for improvement in supply chain management practices generally. This cooperative theme is further supported by other writers (Fernie, 1995; Lawrence, 1997; Morton, 1997), and perhaps best captured by Parnell when he states that supply chain integration really occurs when:

... customers and suppliers establish tight partnerships with the objectives and probable outcomes of reduced inventory, shorter lead times and better service to the customer (Parnell, 1998, p. 60).

Strategic issues in supply chain management
Hicks identifies the goal of strategic supply chain planning as being “...to arrive at the most efficient, highly profitable supply chain system that serves customers in a market” (Hicks, 1999, p. 26). As such, he states that these types of decisions are characterised by high expenditures and significant risk. He identifies two separate paradigms for supply chain improvement, centred on information technology and logistics. The former sees information as the key to supply chain improvement, with the primary focus being on “...collaborative planning, sharing information and getting companies synchronised with suppliers and customers” (Hicks, 1999, p. 26). The second, more traditional paradigm, is more internally focused and is concerned with quantitative analysis of complex logistical problems. He states that the future of supply chain strategy lies in the convergence of these two paradigms. It is also apparent that for organisations to develop a competence in the management and integration of supply chains, logistics and supply chain management need to be given a higher level of strategic importance (Meade, 1998; Natarajan, 1999; Philip and Pedersen, 1997). Unfortunately, much of the evidence indicates that the development of
this competence is not a widespread phenomenon. Natarajan (1999) states that this is due to three major factors:

1. lack of a logistics strategy;
2. lack of alignment between logistics strategy, overall business strategy and supply chain strategy; and
3. lack of integration with other functional area strategies and proper deployment of the logistics strategy.

This view is supported by Philip and Pedersen who concluded after studying EDI implementations in Ireland that:

Most companies have introduced EDI at an operational level only with no clearly identifiable view to obtaining strategic benefits from its implementation (Philip and Pedersen, 1997, p. 357).

Bakos and Treacy (1986) developed an early model examining the relationship between information technology and corporate strategy in the mid-1980s. They proposed that competitive advantage was determined by a combination of bargaining power and comparative efficiency. They also proposed that the use of information technology for developing innovative products could affect comparative efficiency (through reduced operating costs) or bargaining power (by promoting differentiation and customer switching costs). In discussing the impact of the internet on competitive advantage Porter (2001) states that operating efficiencies can be improved by the use of internet technologies, but that this improvement may not be sustainable. He attributes this to the open nature of internet technologies, and to the subsequent ease of adoption of similar technologies by competitors. This, according to Porter, will reduce the number of differentiation opportunities, and reduce switching costs.

Open systems models

The importance of understanding and applying a systemic approach to the management of supply chains is amplified in an operational environment characterised by rapid technological change, the need for organisations to think and operate globally, and the need for strategies to be developed that are sustainable as well as profitable. Implied in this approach is the notion of “strategic flexibility” of resources at first articulated by writers such as Penrose who developed a view of the firm as a “collection of productive resources” (Penrose, 1959). This notion was further extended by more recent authors in general terms (Sanchez, 1993, 1995; Maira and Scott-Morgan, 1996; Smith, 1997). Sanchez and Heene (1997) state that “Strategic Flexibility” is made up of two major elements – “resource flexibility” and “coordination flexibility”. Flexible resources are said to have more than one use and are able to be used in many applications with a minimum of changeover time. The ability of managers to deploy and coordinate these resources quickly and effectively is reflected by the concept of “coordination flexibility”. Inherent in the concept of “resource flexibility” in a systems context is the likelihood of the overall flexibility of the organisation being limited by the “least flexible” resource (Sanchez and Heene, 1997). Many authors have examined the importance of such interrelationships through issues such as; the relationship between production flexibilities and product strategies (Wheelwright and Hayes, 1985; Gerwin, 1987, 1988, 1989); production and product development (Hayes et al., 1990;
Clark et al., 1992); and technological change, manufacturing flexibility and product strategies (Sanderson and Uzumeri, 1997). The model developed of an organisation as a collection of stocks and flows (Dierickx and Cool, 1989) has been further developed by Sanchez and Heene to reflect the impact on organisational change of the following issues:

Managerial cognitive processes to determine what kinds of stocks and flows an organisation should try to achieve and what uses they will be applied to.

Managerial abilities to coordinate intra-organisational and inter-organisational flows of assets and capabilities in processes of organisational change.

Managerial abilities to support organisational learning and to manage existing knowledge assets effectively in processes for qualitatively changing an organisation’s asset stocks and flows (Sanchez and Heene, 1997, p. 22).

The concept put forward by Sanchez and Heene that captures these elements is that of “higher and lower order control loops”. Higher order control loops reflect the need for managers to:

… interpret often highly ambiguous data in an effort to discover plausible interpretations about the states of the systems higher order elements (Sanchez and Heene, 1997, p. 33).

Sanchez and Heene (1997) propose that organisational flexibility will be promoted by using such control loops comprised of three methods of challenging and/or altering strategic logic – namely benchmarking, environmental scanning and challenging cognitive frameworks. Benchmarking is seen to need to go beyond the comparison of aggregate operating data, to also focus on activities such as: product creation; organizational design; information systems, etc. Environmental scanning could include scanning the environment for the possibility of changes in available or usable technologies; innovative approaches to organising; or emerging market trends. By challenging cognitive frameworks the existing conceptual frameworks and assumptions underpinning the strategic logic employed by managers can be challenged. This could be achieved by using consultants and advisers to introduce new strategic logics and/or operating philosophies; hiring new managers or promotion of diversity based human resource management policies. The ultimate objective is the cultivation of a culture where all basic strategic assumptions are questioned. Sanchez and Heene state that organisations using current operating data (i.e. lower order control loops) to adapt to changing environments can encounter problems such as: failing to recognise deterioration in these metrics driven by environmental change; or recognising such change too late to be able to effectively respond. They note that organisations seeking effective strategic responses in dynamic environments will need to cope with the combined effects of increasing causal ambiguity and dynamic response times. In other words, strategic decision-making is subject to what Senge describes as “dynamic complexity”:

… situations where cause and effect are subtle, and where the effects over time of interventions are not obvious… When obvious interventions produce non-obvious consequences, there is dynamic complexity… The real leverage in most management situations lies in understanding dynamic complexity (Senge, 1990, p. 71).
In order to overcome this problem, Sanchez and Heene propose the use of benchmarking, environmental scanning and challenging cognitive frameworks as means of anticipating, understanding and responding to change in the environment, and of overcoming such complexity. In the context of managing supply chains and using emerging B2B e-commerce technologies, such change and ambiguity confront organisations as a matter of course.

Partnerships, alliances and cooperation

The fundamental importance of relationships for the integration of supply chains is highlighted by the following anecdote:

Consultant John Champion, vice president of Kurt Salmon Associates, relates the story of a vendor who spent a great deal of time and money to design special product packaging. When the vendor visited the retailer’s distribution centre, it was stunned to discover that the customer was simply throwing the boxes away. The moral, according to Champion: “Get together and talk” (Bowman, 1997, p. 29).

Handfield and Nichols also emphasise the fundamental nature of relationships for the effective management of supply chains. They make the point that the basic technological and physical transfer elements are relatively well understood. They see the issue of relationships as more difficult, less well understood and more fundamentally important:

... without a foundation of effective supply chain organisational relationships, any efforts to manage the flow of information or materials across the supply chain are likely to be unsuccessful (Handfield and Nichols, 1999, pp. 9-10).

Tait asserts that:

Companies that make supplier relationships a priority are rewarded with better financial performance and greater customer satisfaction (Tait, 1998, p. 21).

Despite this, the A.T. Kearney report (Tait, 1998) found that few firms really leverage their supplier relationships, with less than 20 per cent of North American and Canadian companies actively involving their suppliers in key business processes. The major issue acknowledged is the need to identify and include key strategic suppliers as early as possible in order to set joint objectives and align business goals. Traditional supplier relationships have been characterised by what Dyer et al. (1998) describe as the “arm’s length” model, incorporating multiple suppliers, avoidance of long term (or in some cases any) commitment, and regular price reviews. The rationale for this strategy has been to counteract what Porter has described as sources of bargaining power of suppliers (Porter, 1980; Porter and Millar, 1985). The partner model, on the other hand, features the sharing of information (and in some cases assets) between organisations, recognising areas of common interest and combined competitive advantage. In the context of the rapidly changing supply chain management environment, the partner model has assumed a pivotal position in implementing optimisation strategies. The need for open communication, trust and recognition of the interdependence of “individual” elements of the supply chain as technology implementations span traditional company boundaries has highlighted further the importance of cooperative strategies (Anonymous, 1998c; Barratt, 1999; Bensaou, 1999; Dyer et al., 1998; Ghobadian et al., 2000; Kaufman et al., 2000; Kulwiec, 2000; Landry,
Investment choices
Technology investment. Handfield and Nichols summarise the potential for information technology applications for supply chain integration thus:

With the emergence of the personal computer, optical fibre networks, the explosion of the internet and the world-wide-web, the cost and availability of information resources allows easy linkages and eliminates information-related time delays in any supply chain network (Handfield and Nichols, 1999, p. 6).

Bowersox and Calantone (1998) state that the notion of an integrated supply chain is not a new one, but that it has only recently become feasible as companies have access to information that is accurate, timely and affordable. They also make the point that information is the only element within the supply chain that has become less expensive over time. Advances in internet technologies and software are also having an impact on the availability and delivery of traditional technologies. The development of extensible markup language (XML) and EDI/XML (an open standard for transmission of EDI transmissions over the internet) are making connections between different information systems cost effective and more easily implemented. XML was developed in the mid-1990s out of frustration with the limitations of hyper text markup language (HTML), the basic language for internet communications (Cunningham, 1999). The advantage of XML is that it offers a flexible standard for the exchange of information between trading partners using the internet (Anonymous, 2000). As such it provides the ability to exchange rich information (previously only available through the use of EDI) at a minimal cost. XML adds meaning and semantics to text, taking it beyond mere formatting (a limitation of HTML) and allowing the content to be understood by the computer (Westhead et al., 2000). It is also scalable (able to be built upon without major modification), and requires little specialist knowledge to manipulate (Huson and Owens, 2000).

There are many software applications that have been developed to facilitate the flow of information throughout the supply chain. These have included; ERP systems (developed from MRPII systems); order management systems to automate the order fulfilment process; demand planning systems for managing and monitoring forecasts; warehouse management systems for inventory management, picking and placement; transport management systems for the planning and dispatching of shipments; advanced planning and scheduling systems for developing and managing production plans; customer relationship management systems for providing customer service, support and intelligence on customer demographics; and data warehousing applications able to store, analyse and report corporate data, held in many different systems, in customised format (Huson and Owens, 2000; Harrington, 1997; Moller, 2000). These systems have generally suffered from the fact that they have been contained within parts of an organisation, or a supply chain, and have not easily communicated with each other (Huson and Owens, 2000). Some believe a powerful emerging application for XML, enabling supply chain integration, is as a bridge builder (or “middleware” provider) between disparate legacy systems:

With the introduction of XML translation software … businesses and marketplaces now have access to software that acts as an interpreter to reconcile multiple communications
standards – allowing, for example, an EDI purchase order to be converted into an XML equivalent document that is readable by a supplier’s inventory system (Upin et al., 2000, p. 54).

Others, however, see this as a short-term solution that has many of its own limitations such as lack of scalability, a reliance on proprietary code, and limited access to real business intelligence (Huson and Owens, 2000). The true potential of information technology to alter the way supply chain partners interact, and to enable true integration, is perhaps summed up by Christopher when he says:

The use of information technology to share data between buyers and suppliers is, in effect, creating a virtual supply chain. Virtual supply chains are information-based rather than inventory-based (Christopher, 2000, p. 38).

Infrastructure investment. Gilmour (1999) conducted a study of nine companies to assess how they add value by managing the supply chain strategically. Using a combination of surveys and in-depth workshops, he concluded that cost reduction and containment (as strategic objectives for logistics operations) were not sufficient to sustain competitive advantage. Adding value through logistics was a more effective strategy, in particular through improving organizational capabilities in the areas of information technology and organizational areas such as teamwork, performance measurement and alignment of organizational culture. Gourley (in citing the implementation of supply chain management techniques across 15 distribution centres (DC’s) of the Mopar Division of Chrysler Corporation in the US), makes the point that involvement of the DC staff, as well as suppliers, in implementation has been of critical importance (Gourley, 1998). As part of the ongoing management of the program the company actively encourages the involvement of staff in decision-making, as well as soliciting input from suppliers on potential productivity improvements. In planning for implementation of supply chain management systems, Parnell (1998) recommends the following factors that need to be taken into account:

- Ensure that both process and system improvements are covered. Expensive new tools can become worthless if business processes do not support them.
- Fix your own internal supply chain first before you attempt to do anything with trading partners.
- Education in two areas: demand management and system optimisation.
- Understand the effect on current business systems, how behaviours will need to change, and how performance measures will need to change to reinforce desired behaviours.
- Do not let “best” get in the way of “better”.

The common theme here is the need for investment in technology to be complemented by investment in infrastructure that will enable organisations to effectively leverage such technology. In fact, the issue of getting the basic business processes right has also been identified as a barrier to implementation. An Andersen Consulting report (Anonymous, 1994) has identified inaccurate data, existing systems infrastructure and entrenched business practices as the major barriers to implementation of advanced technologies and innovative management approaches.
Summary and hypothesis development

The review of the literature highlights the strategic nature of techniques and technologies for the enablement of more effective management of supply chains. These technologies are becoming cheaper, easier to apply and implement, and generally more broadly accessible. Although the potential benefits appear significant, it is also apparent that there are choices that need to be made for both investment and management emphasis. These choices need to be made against a background of rapid environmental change, and with a view toward promoting a balance between flexibility and integration of resources and capabilities. The Sanchez and Heene (1997) model suggests a framework for testing the effectiveness of strategy formulation processes in such dynamic and unpredictable environments. Against this context, the following hypotheses have developed for testing.

**H1.** The process by which an organisation develops its strategic logic is a significant determinant of extent of investment in B2B enabling technologies.

The literature review indicates that technologies enabling more effective supply chain management are becoming more accessible, powerful and easier to use. At the same time, the strategic importance of these decisions is also highlighted. The purpose of this hypothesis is to test the proposition that investment decisions related to technology selection are informed by the process undertaken to develop strategic logic.

**H2.** The process by which an organisation develops its strategic logic is a significant determinant of extent of investment in supporting infrastructure.

A recurring theme in the literature is of technology choices needing to be supported by the development of appropriate infrastructure. In order for such infrastructure choices to be optimised, it would seem logical that they need to be linked to the appropriate choice of technology, and to an effective method for determining the organisations strategic position. This hypothesis tests the proposition that decisions related to investment in infrastructure will be significantly determined by the process used to establish strategic logic.

**H3.** The process by which an organisation develops its strategic logic is a significant determinant of extent of involvement in cooperative arrangements with trading partners.

Cooperative arrangements with trading partners are promoted in the literature as being of strategic importance for underpinning effective supply chain management practices. This hypothesis is designed to test the proposition that the strategy development process will have, therefore, a significant determining influence on the nature and extent of these relationships.

**H4.** The process by which an organisation develops its strategic logic is a significant determinant of supply chain management related business performance.

The supply chain management literature promotes many benefits for organisations undertaking to manage their supply chains, rather than just their internal business operations. At the same time, there is evidence to suggest that organisations have difficulty fully realising these benefits. The purpose of this hypothesis is to test
whether there is a relationship between the process by which strategic logic is formulated and ultimate performance.

**Methodology**
A survey was conducted within Australian companies that are members of EAN Australia. As members of this organisation (EAN Australia is the local organisation that administers and controls the European article numbering standard) these companies are involved in the use of B2B e-commerce technologies and methods (at least to a minimum level). This survey covered a broad range of issues relating to the strategic and operational aspects of the use and implementation of B2B e-commerce technologies. There were 553 responses received, indicating an estimated response rate of 16.5 per cent. This response rate, although lower than anticipated, was deemed to be acceptable based on the results of a survey of 1,707 non-responding organizations. This survey indicated that there were no significant differences between the two groups based on either company size or primary business activity. The sample size was reduced to 335 companies for the analysis using the structural model. This was done in order to reduce the proportion of missing data for some constructs, as the AMOS package used for this model requires a complete data set. The components of a structural model were initially developed using exploratory factor analysis. From this process the composition of the factor variables making up the observed and unobserved variables within the model was determined. Confirmatory factor analysis was conducted to establish the integrity of the unobserved construct “Process” (representing the Sanchez and Heene model elements), and the structural model formed based on the hypothesised relationships.

**Structural model**

**Rationale**
A model was developed for testing incorporating an unobserved construct (named “Process”) capturing the “higher order control loops” proposed by the Sanchez and Heene model. Three other constructs capturing the propensity for organisations to invest in both technology and infrastructure, and extent of involvement in cooperative arrangements with trading partners, were also included. These were placed in the model on the basis of being indicative of typical methodological elements of supply chain management implementations. The final construct captured business outcomes perceived to be accruing from the use of these methodologies. The rationale for this model was to test the relative importance of each of the constructs as determinants of the performance construct, and to find to what extent the process construct determined involvement in each of the B2B methodology elements. The purpose was to gain some insight into the relative importance of higher order control loops in the context of supply chain management implementation. The structural model was tested initially using the full data set. Subsequently, it was also tested based on four moderating factors. These factors covered two demographic variables (company size and primary business activity), and two implementation variables (extent of use of the technologies and extent of implementation across the supply chain). These were used to ascertain whether the relationships in the model were subject to significant situational and organisational variation.
Factor variables – components of the structural model

Process. In the model this dimension is an unobserved variable made up of three observed factor variables. These are comprised of four separate factors, namely; challenging cognitive frameworks using external resources (observed variable “ccframeext”); environmental scanning (observed variable “envscan”); benchmarking and stakeholder involvement combined to create the construct challenging cognitive frameworks using internal resources (observed variable “ccframeint”).

Challenging cognitive frameworks using external resources (code in model “ccframeext”): $\alpha = 0.8596$

The three factors making up the unobserved variable process draw on the Sanchez and Heene (1997) model. This model proposes three dimensions used by managers to overcome causal ambiguities (between strategies and outcomes) in highly dynamic environments. The first of these dimensions is challenging cognitive frameworks using external resources, and it captures the need for companies to use outside sources (such as consultants), to question basic business assumptions in order to remain flexible. Exploratory factor analysis found 11 variables coming together to form a single construct covering many ways in which organisations may seek new ideas from outside sources.

Environmental scanning (code in model “envscan”): $\alpha = 0.9344$

The second element of the Sanchez and Heene model captures the need for organisations to scan their environment in order to be as aware as possible of impending change, and how that change could affect competitive positioning. As a result of exploratory factor analysis nine variables loaded together to represent a range of issues in a firm’s competitive environment that could typically be considered important. In this case the nine items making up this scale had a particular focus on the competitive environment of the firm, and specific competitor activities.

Benchmarking (code in model “ccframeint”): $\alpha = 0.8687$

Benchmarking is the third dimension of the Sanchez and Heene model, and it covers the gathering of information on “best practices” from within (as well as beyond) a firms industry. This construct was made up of four variables measuring benchmarking activities at different levels of the organisation.

Stakeholder involvement (code in model “ccframeint”): $\alpha = 0.8614$

The 11 variables capture the construct labelled stakeholder involvement based on the fact that they represent degrees of involvement of customers, suppliers and internal stakeholders (e.g. employees).

These final two factors were combined in the model to capture a broader concept of combining benchmarking and involvement of stakeholders to create the construct challenge cognitive frameworks using internal resources, rather than using external resources as captured by the first construct in the group. There was also found to be a high degree of covariance evident between them during model testing, indicating some degree of overlap between the two constructs in the context of the model. The combination of these two factors attempts to capture the idea from the Sanchez and Heene model of challenging cognitive frameworks from within as well as from external means (Sanchez and Heene, 1997; Sanchez, 1997), and extends the concept of benchmarking to a broader one of organisation wide stakeholder involvement.

Cooperative arrangements $\alpha = 0.7354$
This dimension of the model is made up of one observed factor variable. This factor variable is composed of two individual survey variables covering the degree to which respondents have cooperative partnership arrangements with suppliers and customers.

Infrastructure investment $\alpha = 0.6867$

Seven questions from the survey related to the percentage allocation of expenditure to a range of areas during the implementation process. After exploratory factor analysis two factors were extracted. Four variables loaded together to form a factor variable, and this was labelled on the basis of each variable representing non-technical or “soft” aspects of implementation. This construct was felt to be of importance for capturing the propensity for an organisation to invest in the necessary infrastructure (human and human process-based) to support effective implementation.

Technology investment $\alpha = 0.7088$

The other half of the spending equation relates to expenditure on computer related software and hardware – the technical or “hard” side of the spending mix. It was judged to be an important indicator of organisational capability for implementation.

Performance. This dimension of the model is made up of one observed factor variable. As a result of exploratory factor analysis of 17 variables, two factors were extracted and named operational outcomes and bottom line outcomes.

Operational outcomes: $\alpha = 0.9700$

Bottom line outcomes: $\alpha = 0.8540$

These two variables were combined to create one factor variable capturing a wide range of performance outcomes. This element of the model covers many of these areas, and draws on both operational and bottom line (or profit/revenue) related issues.

**Confirmatory factor analysis – measurement model**

In order to test the integrity of the unobserved construct “Process”, confirmatory factor analysis was conducted. Figure 1 shows a graphic of this part of the model, and Table I provides some of the major goodness of fit statistics.
**Structural model**

Figure 2 shows the full structural model, while Table II contains the goodness of fit statistics for the full model.

**Analysis**

*General discussion*

The goodness of fit statistics for this model indicate that it is a plausible representation of the theoretical relationships proposed. Table III shows direct and indirect effects from the model.

These results indicate that the construct “Process” is a strong and significant determinant of business outcomes (as captured by the construct “Performance”) within this group of companies. By comparison, the three constructs “Technology Investment”, “Infrastructure Investment” and “Cooperative Arrangements” have no

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<th>GFI</th>
<th>AGFI</th>
<th>RMSR</th>
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<td>0.997</td>
<td>0.991</td>
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*Table I.* Goodness of fit statistics for CFA

![Figure 2. Structural model](image-url)
significant direct effect on this construct. There is, however, a moderately strong and highly significant correlation recorded between each of these three constructs with “Performance” (Table IV).

“Process” is also observed to be a significant determinant of each of these three constructs in the structural model. In the context of the Sanchez and Heene model, the strength of the effect of the “Process” construct on business outcomes indicates the importance of effective strategy formulation. At the same time, this process is found to be important in determining whether organisations will invest in technology, and whether they are inclined to become involved in cooperative arrangements with suppliers and/or customers. The literature (i.e. in supply chain management and/or B2B e-commerce) stresses the combination of technology and partnerships as being critical for extracting value from supply chain management implementations. This model indicates that business performance will more likely be determined by what Sanchez and Heene describe as “higher order control loops”, rather than by the technology, it is supporting infrastructure or by the nature of arrangements with trading partners. This is not to say that these are not important factors (as shown by their significant correlation with “Performance”), but rather that they will not of themselves provide significant results without effective strategy formulation processes. In other words, organisations that derive significant benefits from business to business e-commerce implementations can be also expected to be involved in cooperative partnerships, as well as investing in technology and infrastructure – but that these benefits derive not from these activities themselves, but from the strategy development processes that led to them.

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<th>Table II. Goodness of fit statistics for the structural model</th>
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<td>GFI</td>
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<th>Table III. Direct and indirect effects from the structural model</th>
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<td>Infrastructure investment</td>
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<td>Infrastructure investment</td>
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<td>Cooperative arrangements</td>
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Note: * denotes significant effect at $p < 0.05$ or higher

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<th>Table IV. Correlations between e-commerce enablers and business outcomes</th>
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<td>Technology investment</td>
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</table>

Note: ** denotes significant at $p < 0.01$
The model also provides some evidence to support the notion that “resource flexibility” and “coordination flexibility” are mutually dependent and complementary concepts. The direct relationship between the “Process” construct and “Performance” could be interpreted as being indicative of the coordination flexibility provided by using “higher order control loops” for strategy development. The fact that the elements making up this construct appear to directly determine performance (in the context of this model) may be partly explained by them providing effective and timely data that can be applied within organisational decision processes. The relationship between this same construct and the three supply chain management related elements could also be interpreted as representative of “higher order control loops” enabling resource flexibility by informing resource selection, management and deployment processes. The fact that these three resource related constructs are found to have no direct determining influence on business outcomes also indicates the importance of organisational cognitive processes in determining the effective deployment of resources. The resources do not add any significant value of themselves, but can do if guided and driven by effective strategic logic.

Further analysis

Analysis on the basis of use of the technologies. In order to further examine the nature of these relationships the structure of the model was compared on the basis of the extent to which organisations were using a range of technologies to enable more effective management of supply chains (B2B e-commerce technologies). These technologies included application of barcodes to outward goods, WIP and inwards goods; use of product numbering to identify retail, non-retail and internal items, as well as locations; use of application identifiers, container codes and logistics labels; and use of EDI for receiving incoming orders, advance notification of shipment, remittance advice, invoicing, receipts settlement, sales and stock data, and for transmission of purchase orders. Table V shows the 21 items used in the survey for this analysis and the mean score across the full data set.

The data file was divided into two groups on the basis of a mean score of more or less than two for the 23 variables covering the use of these technologies (Likert Scale: 1 = “Not at All” to 5 = “To a Very Large Extent”). As a result, 110 cases were identified as “Leaders in the use of the technologies”, and 225 cases as “Laggers in the use of the technologies”. Using a stacked modelling strategy the structural model was run for both groups to test for any significant differences between them. There was no significant difference found between the two groups on the basis of the $\chi^2$ statistic ($\chi^2 = 29.863$; degrees of freedom = 20; $p = 0.072$). As a result of this finding it could be concluded that use of the technologies does not have a significant moderating effect on the relationships between the variables in the model. This finding indicates that extensive use of the technologies for enabling improved supply chain management is not a significant issue in the context of the model. Irrespective of whether companies are high or low users of the technologies, they appear to still be subject to the same strategic constraints. In other words, the need for resource deployment decisions to be driven by effective strategy development processes is reinforced.

Analysis on the basis of extent of implementation. A similar stacked model strategy was used to compare the model on the basis of the extent of implementation across the
supply chain and between trading partners. The data file was partitioned into two groups on the basis of a mean score of greater or less than three (Likert Scale: 1 = “Not at All” to 5 = “To a Very Large Extent”) for nine questions relating to these issues. Table VI shows the 12 items used in the survey for this analysis and the mean score across the full data set.

As a result, 123 cases could be classified as “More Extensive Implementers”, and 212 as “Less Extensive Implementers”. When the model was tested comparing these two categories, a significant difference was found between the two groups on the basis of the $\chi^2$ statistic ($\chi^2 = 40.181$; degrees of freedom = 20; $p = 0.005$). On comparing the path coefficients between the two groups, it is apparent that there is a shift in emphasis from an internal to an external focus. For the “Less Extensive Implementers”

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent of application of EAN product numbering and barcodes to: outward goods</td>
<td>4.01</td>
</tr>
<tr>
<td>Extent of application of EAN product numbering and barcodes to: work in progress</td>
<td>1.67</td>
</tr>
<tr>
<td>Extent of application of EAN product numbering and barcodes to: incoming goods</td>
<td>1.75</td>
</tr>
<tr>
<td>Extent of application of EAN ID numbers to: retail items</td>
<td>3.89</td>
</tr>
<tr>
<td>Extent of application of EAN ID numbers to: non-retail items</td>
<td>1.86</td>
</tr>
<tr>
<td>Extent of application of EAN ID numbers to: locations</td>
<td>1.45</td>
</tr>
<tr>
<td>Extent of application of EAN ID numbers to: internal items</td>
<td>1.36</td>
</tr>
<tr>
<td>Extent to which application identifiers are used</td>
<td>1.52</td>
</tr>
<tr>
<td>Extent to which serial shipper container codes are used on trade units</td>
<td>1.80</td>
</tr>
<tr>
<td>Extent to which serial shipper container codes are used on pallets</td>
<td>1.44</td>
</tr>
<tr>
<td>Extent of use of EAN logistics labels</td>
<td>1.46</td>
</tr>
<tr>
<td>Extent of use of EAN location and electronic commerce numbers to identify: legal entities</td>
<td>1.68</td>
</tr>
<tr>
<td>Extent of use of EAN Location and electronic commerce numbers to identify: functional entities</td>
<td>1.26</td>
</tr>
<tr>
<td>Extent of use of EAN location and electronic commerce numbers are used to identify: physical entities</td>
<td>1.33</td>
</tr>
<tr>
<td>Extent of use of EDI for: incoming sales orders</td>
<td>1.76</td>
</tr>
<tr>
<td>Extent of use of EDI for: advanced shipment notices (ASNs)</td>
<td>1.63</td>
</tr>
<tr>
<td>Extent of use of EDI for: remittance advice</td>
<td>1.63</td>
</tr>
<tr>
<td>Extent of use of EDI for: invoices</td>
<td>1.60</td>
</tr>
<tr>
<td>Use of evaluated receipts settlement (for enabling EFT)</td>
<td>1.45</td>
</tr>
<tr>
<td>Extent of use of EDI for: sales/stock on hand/stock on order data</td>
<td>1.51</td>
</tr>
<tr>
<td>Transmit purchase orders to suppliers via EDI</td>
<td>1.45</td>
</tr>
</tbody>
</table>

Table V. Mean scores for use of technologies items
group, the two significant paths in the model are between process and infrastructure investment, and process and performance. For the “More Extensive Implementers”, on the other hand, process is again a significant determinant of performance, but is no longer so for infrastructure investment. This relationship has been replaced by it becoming a strong and significant determinant of cooperative arrangements. Companies that are proactive about extending implementation across their supply chains appear to be more focused on channelling the strategy development process toward development of cooperative programs with trading partners, and less toward internal infrastructure. Another interesting point of comparison to emerge is that in neither case is the path from process to technology investment strong or significant, indicating perhaps the relatively minor role of technology investment in the context of extensive implementation. In other words, the extent of implementation appears to be less a function of investment in technology and infrastructure, than of the extent (and quality) of trading partner relations. Figure 3 compares the two groups.

**Analysis on the basis of company size.** The relationships in the model were further compared on the basis of company size. The data set was divided into two groups according to the number of employees in Australia (“Small Companies” = 19 or less employees; “Medium to Large Companies” = 20 or more employees). There was no significant difference found between the two groups using the $\chi^2$ statistic ($\chi^2 = 26.891$; degrees of freedom = 20; $p = 0.138$). Company size does not appear to be a significant moderator using these criteria. It should, however, be noted that a larger sample would enable the models to compare across a wider range of companies, with (say) a separate category for companies employing 200 or more employees.

**Analysis on the basis of major business activity.** It was also decided to compare the models based on the nature of the major business activity they were engaged in. The dataset was partitioned again into two groups representing the major business activity organisations were involved in. As a result the two groups were labelled

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean score</th>
</tr>
</thead>
<tbody>
<tr>
<td>We receive extra information from customers (e.g. better forecast demand) as a result of implementation</td>
<td>1.84</td>
</tr>
<tr>
<td>We have used implementation as an opportunity to extend the use of some techniques to internal processes</td>
<td>1.80</td>
</tr>
<tr>
<td>We have extended implementation throughout the organisation and its supply chains</td>
<td>1.58</td>
</tr>
<tr>
<td>Implementation applies to finished goods as well as to internal processes</td>
<td>1.74</td>
</tr>
<tr>
<td>Implementation applies to finished goods, internal processes and incoming goods from suppliers</td>
<td>1.68</td>
</tr>
<tr>
<td>There has been cross-functional involvement in the implementation process</td>
<td>1.88</td>
</tr>
<tr>
<td>Suppliers have been involved in implementation</td>
<td>1.75</td>
</tr>
<tr>
<td>Implementation is critical to the competitiveness of our organisation</td>
<td>2.74</td>
</tr>
<tr>
<td>Implementation is seen to be a strategic opportunity for our organisation</td>
<td>2.54</td>
</tr>
</tbody>
</table>

Table VI. Mean scores for extent of implementation items
Figure 3.
Structural model compared by extent of implementation
“Manufacturing” (170 cases), and “Wholesale/Retail” (131 cases). When the two groups were compared using the structural model, a significant difference found between the two groups using the $\chi^2$ statistic ($\chi^2 = 40.354$; degrees of freedom $= 20$; $p = 0.005$). The major differences apparent were in the strength and significance of the relationships between process and technology investment, and process with performance for both groups, process is a significant determinant of performance, but in the case of manufacturers was found to be substantially stronger (regression weight of 0.88 as against 0.66 for the wholesale/retail group). Process was also found to be a significant (though weak to moderate) determinant of technology investment for the wholesale/retail group, while this path was not significant for the manufacturers. This is another interesting finding, as it indicates that the process by which strategic logic is formulated informs technology investment decisions in the wholesale/retail group. Independent samples $T$-tests indicated that this group was also found to be a significantly higher ($p < 0.05$ or greater) user of many of the technologies such as EDI and product numbering. The model indicates, however, that this increased level of use can (at least in part) be explained by the process by which they develop strategy. By extension, this could be seen to indicate that investment in supply chain management enabling technology is perceived to be more strategically significant by wholesalers and retailers, than it is by manufacturers. Figure 4 shows the comparison between the two groups.

Assessment of the hypotheses

$H1$. The process by which an organisation develops its strategic logic is a significant determinant of extent of investment in B2B enabling technologies.

The structural model indicates that this process has a significant effect on technology investment choices, if only a moderately strong one. This relationship was found to be significant for the wholesale/retail group, but not so for the manufacturing companies. It was found to be non-significant when tested for the moderating effect of extent of implementation across the supply chain. The overall model therefore provides evidence that the strategy development process (as represented in this research by the Sanchez and Heene model) is an important factor in determining technology choices. The further testing, however, indicated that this was subject to the moderating influence of both primary business activity, and extent of implementation across the supply chain. This would indicate that the hypothesis can be, in general terms, accepted, but that this effect is subject to the influence of organisational and situational factors.

$H2$. The process by which an organisation develops its strategic logic is a significant determinant of extent of investment in supporting infrastructure.

The process construct was found to be a significant and moderately strong determinant of infrastructure investment in the overall model. When tested on the basis of primary business activity, there was no important difference found. There was, however, a significant difference observed on the basis of extent of implementation, with companies reporting more extensive implementations also showing no significant relationship. For these companies, the strategy development process shifts in its influence from promoting investment in infrastructure, to the
Figure 4.
Structural model compared by primary business activity
development of cooperative arrangements with trading partners. In this case also, this hypothesis can be accepted in general terms, with the evidence suggesting that the strategic logic development process is a significant determining influence on investment in infrastructure. There is evidence also, however, that this is not the case under all circumstances, with the relationship becoming less important in companies involved in extensive implementations with multiple trading partners.

**H3.** The process by which an organisation develops its strategic logic is a significant determinant of extent of involvement in cooperative arrangements with trading partners.

Cooperative arrangements with trading partners were found to be subject to a significant and strong influence from the process construct. As with the previous hypothesis, this relationship was observed to change when tested for the moderating influence of extent of implementation. In this case, for companies involved in less extensive implementations, the relationship was found to be weak and non-significant, with the focus moving toward investment in infrastructure. As with the previous two propositions, these results indicate that in general this hypothesis can be accepted, but that it is also subject to situational variance. In this case, for organisations with less extensive implementations, the process construct is exerting more influence on the development of internal capabilities rather than on trading partner relations.

**H4.** The process by which an organisation develops its strategic logic is a significant determinant of supply chain management related business performance.

Based on all the tests conducted, the process construct was found to be a strong and significant determinant of supply chain management related performance in all cases. The only difference observed was in the strength of the observed relationship. The direct effect was found to be weaker (though still strong) in companies with less extensive implementations, and for those from the wholesale/retail sector. Otherwise, the results indicate that the hypothesis can be accepted in the context of this research project, and of the model constructed.

**Conclusions**
The importance of organisational cognition being informed by the use of “higher order control loops” (as proposed by the Sanchez and Heene model) is highlighted in this research. The data indicates that (within the limitations of this model) the process by which organisations formulate their strategic logic is an important determinant of both how resources are selected and deployed, and of business performance. At the same time, it is evident that these same resources are not likely to yield significant benefits without such a process, and in fact that their effectiveness is very much a function of the nature of this process. In dynamic environments, there is also some evidence suggesting that the strategy formulation process provides a basis for promoting flexibility in both development and deployment of resources. It is also apparent that the nature and strength of the influence of this process is situational, in the case of this research due to extent of implementation across the supply chain, and to the nature of business activity (or in other words – position in the supply chain). The implication for organisations looking to implement e-commerce related methodologies for the
improved management of supply chains, is that focusing on developing effective methods for developing strategy can be expected to yield better ultimate performance, rather than concentrating on the technologies, supporting infrastructures, and trading partner relationships themselves.

References


Sanderson, S.W. and Uzumeri, M. (1997), Managing Product Families, Urwin, Chicago, IL.


