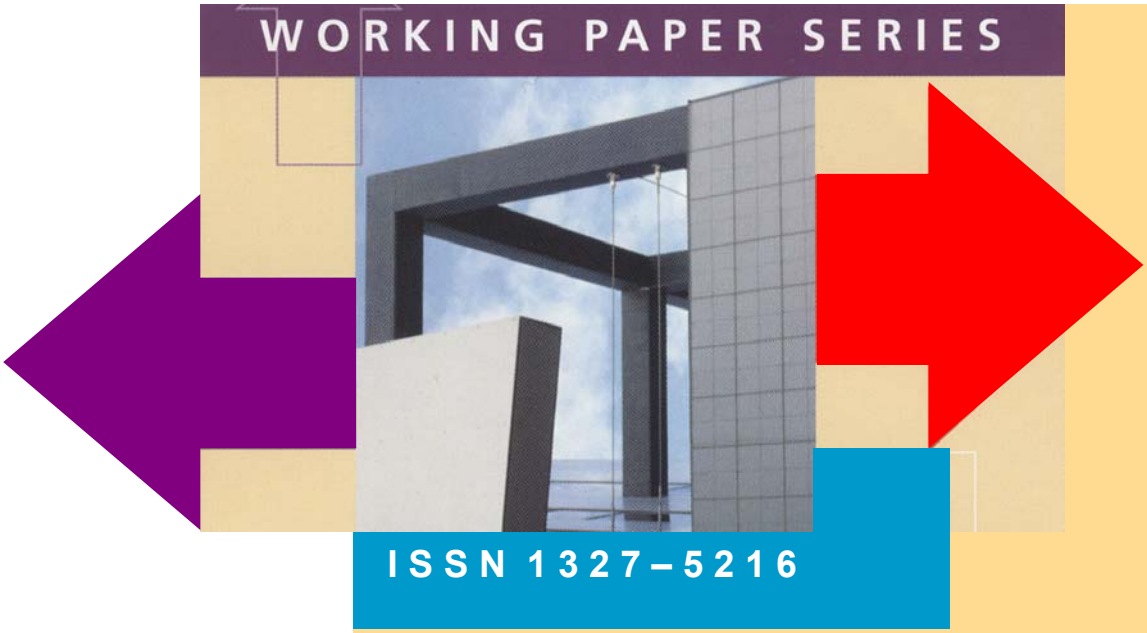
MONASH
UNIVERSITY
FACULTY OF BUSINESS AND ECONOMICS

DETERMINANTS OF B2B E-COMMERCE IMPLEMENTATION AND PERFORMANCE: A CAUSAL MODEL FROM AUSTRALIAN EMPIRICAL EVIDENCE

Damien Power

Working Paper 32/02
November 2002



Abstract

Much of the literature proposes an extensive set of benefits for organizations that choose to implement a range of B2B e-commerce technologies. Another parallel theme that emerges is that implementation has been limited for many of the established technologies and practices such as EDI. This paper seeks to address the question of what some of the determinants of implementation of these technologies could be, and how these relate to the issue of business performance. A causal model has been developed based on data from 335 Australian companies that have been involved in the use of B2B enabling technologies for the management of their supply chains. The results provide some interesting insights, particularly in clarifying the nature of the relationship between extent of implementation and performance. In the case of the former, extent of implementation has no significant direct effect on performance, although they are highly correlated. The nature of the relationship is shown to result from their shared dependence on other organizational factors such as capability, process for formulation of strategic logic and knowledge of technological options and potential.

This paper is a work in progress. Material in the paper cannot be used without permission of the author.

DEPARTMENT OF MANAGEMENT

DETERMINANTS OF B2B E-COMMERCE IMPLEMENTATION AND PERFORMANCE: A CAUSAL MODEL FROM AUSTRALIAN EMPIRICAL EVIDENCE

BACKGROUND

The complexity of the dynamics of the supply chain has led to the isolation of many different sources of demand distortion such as flows of information between and within companies, material flows between companies, and chaos theory (Evans et al., 1993; Towill, 1996; Wilding, 1998; Holweg and Bicheno, 2000). It has been the identification of this kind of distortion and inefficiency, along with the development of new technologies, that have driven many organizations to look to managing the supply chain within which they operate, rather than simply focusing on their own organization. In many supply chains, this move has been characterised by the adoption of barcode reading technology and the use of EDI to streamline paper and funds based transactions. This has led to the concept of an integrated supply chain. Hicks (p.45, 1997) describes the supply chain as: "*…a collection of all components and activities associated with the creation and delivery of a product or service*", while Bowman (1997) extends this definition to include logistics related business processes such as ordering, inbound and outbound transportation, manufacturing, warehousing and customer service. The potential for integration of the supply chain to improve both profit potential and competitive position is highlighted by Wood when he states that:

> "…..since the supply chain represents 60% to 80% of a typical company's cost structure, just a 10% reduction can yield a 40% to 50% improvement in pre-tax profits" (p.26, Wood, 1997).

This potential was identified by Forrester, and is extensively documented in the supply chain literature. (Forrester, 1958; Forrester, 1961; Bhaskaran, 1998; Ballou et al., 2000; Belyea, 2000; Cachon and Fisher, 2000; Chen et al., 2000). Despite the apparent opportunities, the adoption of technology to enable the more efficient management of supply chains has been slow, with some of this technology (e.g. EDI) having been available for more than thirty years (Johnston and Mak, 2000). Chan and Swatman (2000) have also identified, through a case study conducted in one of Australia's largest companies, that the initial motivation for EDI adoption may be cost reduction and the pursuit of internal efficiencies. In this particular case, however, there was a progression over time from this internal focus, to the use of technology for promotion of supplier partnerships and improved customer service.

The strategic nature (and importance) of supply chain management initiatives is also an issue that gains considerable coverage in the literature (Conroy, 2000; Bovel and Martha, 2000; Cunningham, 2000; Fein and Jap, 1999; Gilmour and Hines, 2000; Hicks, 1999; Horton, 1999; Lummus and Vokurka, 1999; Magretta and Dell, 1998; Magretta and Fung, 1998; Meade, 1998; Olsen, 1996; Porter, 2001; Porter and Millar, 1985; Sislian and Satir, 2000; Warnock, 1999). Content analysis of 46 empirical research based articles in the areas of business to business e-commerce and supply chain management (conducted as part of this literature review) indicated that 28 (61%) contained themes relating to strategy. Of these the predominant themes were: purchasing strategies and supplier related issues (Handfield et al., 2000; Davilla and Panizzolo, 1996; Carter and Hendrick, 1997; McCutcheon and Stuart, 1999; Min and Galle, 1999; Monczka et al., 1998; Narasimhan and Jayaram, 1998; Shin et al., 2000; Stuart, 1997; Stuart and McCutcheon, 1996); international supply chain management issues and comparisons (Akkermans et al., 1999; Fernie, 1995; Kilgore, 2000); and reengineering of supply chain processes (McCormack, 1999; Mabert and Venkataramanan, 1998; Ruetterer and Kotzab, 2000; Tan et al., 1998). One important theme that emerges from the literature, and in particular from the research conducted to date, is that there is a need for further research to capture both the characteristics of successful implementation, and the factors determining the level of implementation. This need is articulated by Akkermans when he states:

> "……the operations management literature has shown very little empirical evidence of successful strategic moves towards supply chain management"; *and later*, "……we do not yet have causal relationships between the various factors driving effective supply chain management and their interrelations with performance improvements in areas like inventory management, supply chain costs, and customer satisfaction". (p.566, Akkermans et al., 1999)

What is it about an organization that makes it look beyond the boundaries of its own enterprise to attempt to manage better the interfaces between itself and its trading partners? What differentiates an organization that is willing to try to grapple with Forrester's three elements of Structure, Delays and Amplitude (Forrester, 1958; Forrester, 1961), from one that either recognises them but avoids them, or fails to recognize their existence at all? A recent report from the Boston Consulting Group also points to the importance of what they term "infrastructure issues":

> "The success of a company's e-commerce strategy rises or falls on the company's ability to organize appropriately……..getting the structure right - the organizational design of the e-commerce unit and its linkages to the core business - is important. But getting the infrastructure right - people, mindset, culture, and processes - may be even more so." (p.1, Anonymous, 2001)

The identification of some of these "infrastructure" characteristics provides a significant opportunity for further research in this field, and is the focus of this research.

METHODOLOGY

Background

The framework for the conduct of this research has been the membership of EAN (European Article Numbering Association) Australia. This organization administers and manages the barcoding and product numbering standard used in Australian fast moving consumer goods supply chains. It also promotes a system for the management of supply chains using business to business e-commerce enabling technologies including EDI and Web based applications.

A survey instrument was designed using data gathered from a review of current literature combined with two separate sets of case studies (a total of 15 cases). These cases were conducted in two phases. The first comprised five companies, one being a major Australian retailer, the other four being suppliers to that retailer. The second set covered ten EAN Australia member companies. The focus of these case studies was on developing a clearer view of levels of knowledge of the EAN system, processes in place in these organizations determining levels of implementation, perceived benefits derived from implementation, and impediments to further adoption.

Survey Design

The elements of the survey relevant to this analysis covered the following themes:
KNOWLEDGE OF THE EAN SYSTEM AND INTEGRATED SUPPLY CHAIN MANAGEMENT (ISCM): This section had questions relating to the level of understanding within the organization of the EAN system, areas of the company's business that could be improved by the use of the EAN system, and assessments of a "full Implementation" of the EAN system. (5 point Likert Scale – "Not at all" to "To a very large extent").
OBJECTIVES AND EXPECTATIONS OF THE EAN SYSTEM: This section contained 14 questions relating to the organization's objectives for, or expectations from, implementation of the EAN system. (5 point Likert Scale – "Not at all" to "To a very large extent").
PLANNING FOR IMPLEMENTATION: This section was made up of questions covering the planning processes employed when implementing the EAN system. (5 point Likert Scale – "Not at all" to "To a very large extent").
INVESTMENT AND TECHNOLOGIES FOR IMPLEMENTATION: Questions covering the investment priorities during implementation. (6 point Scale – 0% to 100% - assessing percentage of funds allocated to various implementation options).
EXTENT OF IMPLEMENTATION: This section contained questions relating to the extent to which organizations had implemented the EAN system across their supply chains. (5 point Likert Scale – "Not at all" to "To a very large extent").

THE BUSINESS OUTCOMES OF THE EAN SYSTEM AND ISCM: This section covered 17 questions relating to the respondent's perception of the contribution of the EAN system to a range of business outcomes. (5 point Likert Scale – "Not important" to "Extremely important").
ORGANIZATIONAL ISSUES AND IMPLEMENTATION: This group covered the extent of involvement of various employee levels in planning and implementation, and organizational attitudes to implementation of the EAN system. (5 point Likert Scales – either "Not at all" to "To a very large extent" or "Not important" to "Extremely important" depending on the nature of the question).
STRATEGY DEVELOPMENT AND CULTURAL FACTORS: This section contained four groupings. The first contained questions pertaining to the importance placed by the organization on gathering information relating to other firms in their industry. The second contained statements reflecting the level of involvement of various stakeholders in the organization. The third related to various sources of external advice used during the implementation process, and the fourth group contained questions testing for the extent of involvement of various management levels in bench marking activities. (5 point Likert Scales – either "Not at all" to "To a very large extent" or "Not important" to "Extremely important" depending on the nature of the question).

Survey Administration

The sample was drawn from the organizations who are members of EAN Australia. There were 553 responses received, indicating an estimated response rate of 16.5%. The sample size was reduced to 335 companies for the analysis using the causal 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.

Causal Model Development

Exploratory factor analysis was carried out to determine whether underlying constructs or factors could be derived from the data set. As a result 15 separate factors were extracted (comprised of 116 individual survey items). These were subsequently reduced to factor variables for use as observed variables in the causal model. In some cases two factors were combined to produce a single observed variable (where the theory justified this) to promote model simplicity.

Six dimensions comprise the model:
CAPABILITY – In the model this dimension is an unobserved variable comprising of two observed factor variables. These are comprised of three separate factors, namely; Strategic Reengineering (observed variable "streeng"); Infrastructure Spending and Technology Spending combined (observed variable "investprof").
PROCESS – In the model this dimension is an unobserved variable comprising 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").
KNOWLEDGE – In the model this dimension is an unobserved variable comprising of two observed factor variables. These are comprised of three separate factors, namely; Knowledge of Implications and Options for Implementation of the EAN System (observed variable "know1"); Understanding of Potential Benefits of the EAN System and Understanding of a "Full Implementation" of the EAN System combined (observed variable "know2").
CONTENT – In the model this dimension is an observed variable (factor variable) made up of 15 individual observed variables covering the stated objectives and expectations of the implementation strategy.
EXTENT OF IMPLEMENTATION – In the model this dimension is an observed variable made up of 1 individual observed variable measuring the degree to which implementation (i.e. of *established technologies*) has been extended beyond the enterprise to include customers and suppliers.
PERFORMANCE – This dimension of the model is made up of one observed factor variable. As a result of exploratory factor analysis of 17 variables from the survey, two factors were extracted and named Operational Outcomes and Bottom Line Outcomes. These were combined to form a single factor variable capturing perceived contribution of the EAN system to organizational performance.

Justification of the Relationships in the Model

Process as a Determinant of Capability

This relationship draws on the proposition that organizations use a number of methods for determining environmental conditions to formulate supply chain management strategies in dynamic environments (Sanchez, 1993; Sanchez, 1997; Sanchez and Heene, 1996; Sanchez and Heene, 1997b; Sanchez and Heene, 1997a; Porter, 1980; Bowman, 1997; Hines and Rich, 1997; Chase, 2000; Frye, 1997; Jutla et al., 1999). The case studies further provided evidence that the companies that used methods such as benchmarking, the development of a culture for questioning business assumptions (defined in the model as stakeholder involvement), and environmental scanning indicated higher levels of organizational capability for implementation and change. There was some indication that an external focus of this nature enhanced the capability of the organization to manage the change and implement the appropriate technologies.

Process as a Determinant of Knowledge

This relationship proposes that the process by which supply chain management strategy is formulated will have an effect on the general level of knowledge of supply chain management practices (i.e. the EAN system) within the organization. Both sets of case studies provided evidence that organizations with extended implementations had used some or all of the elements of the Process construct (benchmarking, assessment of competitor actions, consultants and/or internal resources to challenge business assumptions etc.) to improve their understanding of the potential benefits, technological options etc. available to them. The literature further supports this idea, identifying the importance of the use of these types of methods to promote knowledge transfer within organizations (Yates et al., 2000; Sanchez and Heene, 1997a; Sanchez and Heene, 1997b; Ross et al., 1998; Anonymous, 2000; Malhotra, 2000; El Sawy et al., 1999). The involvement of stakeholders as a means of ensuring appropriate technology choices is an emergent theme in the literature relating to supply chain management implementation (Arntzen et al., 1995; Carter and Ellram, 1998; Carter, 2000; Radjou, 2000). The logical extension of this view is that the better informed stakeholders are of the technological options and benefits, the more capable they will be of making better decisions (i.e. challenging cognitive frameworks from within).

Knowledge as a Determinant of Capability

This path proposes that Knowledge of the EAN system (and supply chain options / technologies / benefits) will have an effect on the Capability of an organization to implement effectively. Again, both sets of case studies provided evidence to suggest that as understanding grew, so did the capability of the organization to select appropriate technologies and effectively manage change. The reengineering literature stresses that a good understanding of the potential benefits of technology is a prerequisite for effective reengineering strategies (Edwards and Peppard, 1996; Champy, 1995; Hammer, 1990; Hammer, 1996; Hammer and Champy, 1994; Watson, 1994).

Knowledge as a Determinant of Content

This relationship indicates that the level of knowledge of the EAN system (and supply chain management options / technologies / benefits) will affect the planning processes, stated objectives and expectations of the organization. Both sets of cases again indicated that this could be the case, with organizations having more knowledge indicating a more pro-active approach to planning. As well, these companies seemed to have clearer objectives and expectations from implementation.

Content as a Determinant of Extent of Implementation

This path proposes that the planning processes, stated objectives and expectations of the organization will have an effect on the extent of implementation of the EAN system across the supply chain. Again the case studies provided some indication that organizations that were more proactive in their planning for implementation were more likely to implement more extensively. Some of these companies also appeared to have a more focused set of objectives and expectations. The relationship between planning processes and implementation of supply chain management methodologies is also a prevalent theme in the literature (Thompson, 1999; Lummus et al., 1998; LaRoche, 1998; Abcede, 1997; Arntzen et al., 1995).

Capability as a Determinant of Extent of Implementation
This relationship indicates that extent of implementation of the EAN system will be also determined by the capability of the organization to reengineer processes and select appropriate technologies. The evidence form the literature suggests that extended management of the supply chain incorporating many suppliers / customers, and using sophisticated B2B e-commerce technologies, is not easily achieved and rare in practice (Akkermans et al., 1999; Bensaou, 1997; Croom, 2001; Crum and Allen, 1997; Fernie, 1995; Handfield et al., 2000; Min and Galle, 1999; Monczka et al., 1998). One logical conclusion that may be drawn from this is that the capability of the organization will be a defining variable in determining the ability to implement the EAN system extensively. Both sets of cases also provided evidence of capability to implement being an important factor, both as an impediment (companies identifying a limited capability to implement) or an enabler (i.e. for those companies at a higher level of implementation).

Capability as a Determinant of Performance
This relationship follows from the arguments used for the path from Capability to Extent of Implementation. Indications from the literature are that implementation is historically limited, and yet the potential business benefits covered in the literature are numerous (Abcede, 1997; Frye, 1997; Gourley, 1998; Grannan, 1997; Berger, 1997; Bowersox and Calantone, 1998; Cahill, 2000). Innovation adoption theory indicates that low levels of adoption of a technology are related to low levels of perceived benefit (Suzuki and Williams, 1998). At the same time, other innovation studies have attributed low levels of adoption to either difficulty of adoption or barriers to adoption (Vandermere, 1987; Ram, 1989). The relationship between Capability and Performance follows from the notion that perhaps the level of capability required to implement results in it acting as a potential barrier to adoption (i.e. extended implementation). Otherwise it would be difficult to explain the restricted levels of adoption in the light of a high level of perceived benefit. The following quotation perhaps best captures this concept:

> "……electronic business success doesn't come simply from choosing the right technology, Web-enabling the right process, or forging the right Internet links to legacy systems. It also requires fundamental changes in organizations, corporate behaviour, and business thinking-both inside and outside IS." (p.30 Wilder et al., 1997)

Extent of Implementation as a Determinant of Performance
This final path captures the proposition that more extensive implementation of the EAN system leads to more business benefits. The extent of potential benefits are highlighted in the literature (see above), and there is an underlying theme that these benefits accrue to organizations that implement more extensively (Waller et al., 1999; Yates et al., 2000; Upin et al., 2000; Bender, 2000; Bovel and Martha, 2000; Boyd, 2001; Burnell, 1998; Chen, 2001). On the other hand, evidence from the case studies indicated that some companies derived significant benefits with limited implementations. This path provides a means of testing the nature of the relationship between Extent of implementation and Performance.

ANALYSIS AND FINDINGS

Confirmatory Factor Analysis

In order to test the integrity of the measurement model Confirmatory Factor Analysis (CFA) was carried out on the measurement model (See Figure 1 below).

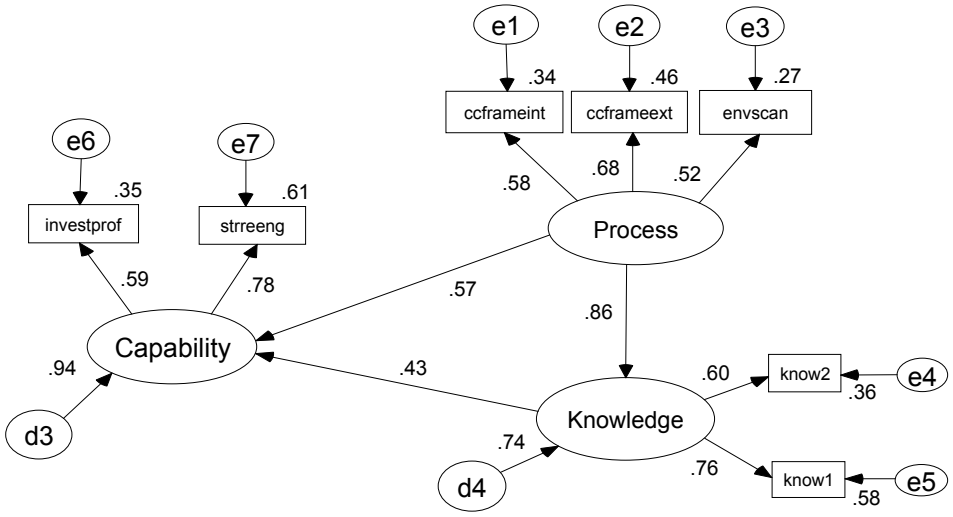


Figure 1: Confirmatory Factor Analysis – Measurement Model

The following Goodness of Fit criteria were recorded for this model:

GFI	AGFI	RMSR	RMSEA	TLI	NFI	CHI^2	DF	SIG.	N	CHI^2/DF
0.978	0.945	0.029	0.068	0.948	0.956	28.113	11	0.003	334	2.556

Table 1: Goodness of Fit Criteria - Confirmatory Factor Analysis – Measurement Model

Note: (the sample size for the Measurement Model – 334 – is different from that used in the Overall Model – 335. This is due to the elimination of a multivariate outlier exceeding the recommended Mahalonobis Distance from the Measurement Model).

The ratio of distinct parameters to be estimated to the size of the sample (334/17 = 19.6) exceeds the recommended minimum of 10 respondents per parameter.

Absolute Fit Measures

The Goodness of Fit Index (GFI) at .978 is quite high and provides some confidence in the plausibility of the measurement model. At the same time the Root Mean Square Residual (RMSR) of .029 is low enough to provide further confidence in the absolute goodness of fit. The Root Mean Squared Error of Approximation (RMSEA) provides a measure of the expected goodness of fit for the model if it were approximated for the population, and at .068 is found to be within the recommended range of .05 and .08.

Other Measures

Both the Tucker Lewis Index (TLI) and the Normed Fit Index (NFI) are found to be well above the recommended level of .90 at .948 and .956 respectively, providing further support for the acceptance of the measurement model. The Adjusted Goodness of Fit Index is also well above the recommended level of .90 at .945. As such, there is a high degree of confidence provided in the parsimony of the model.

Overall Model Fit and Integrity of the Paths Proposed

The path parameters of the overall model are represented in Figure 2 below:

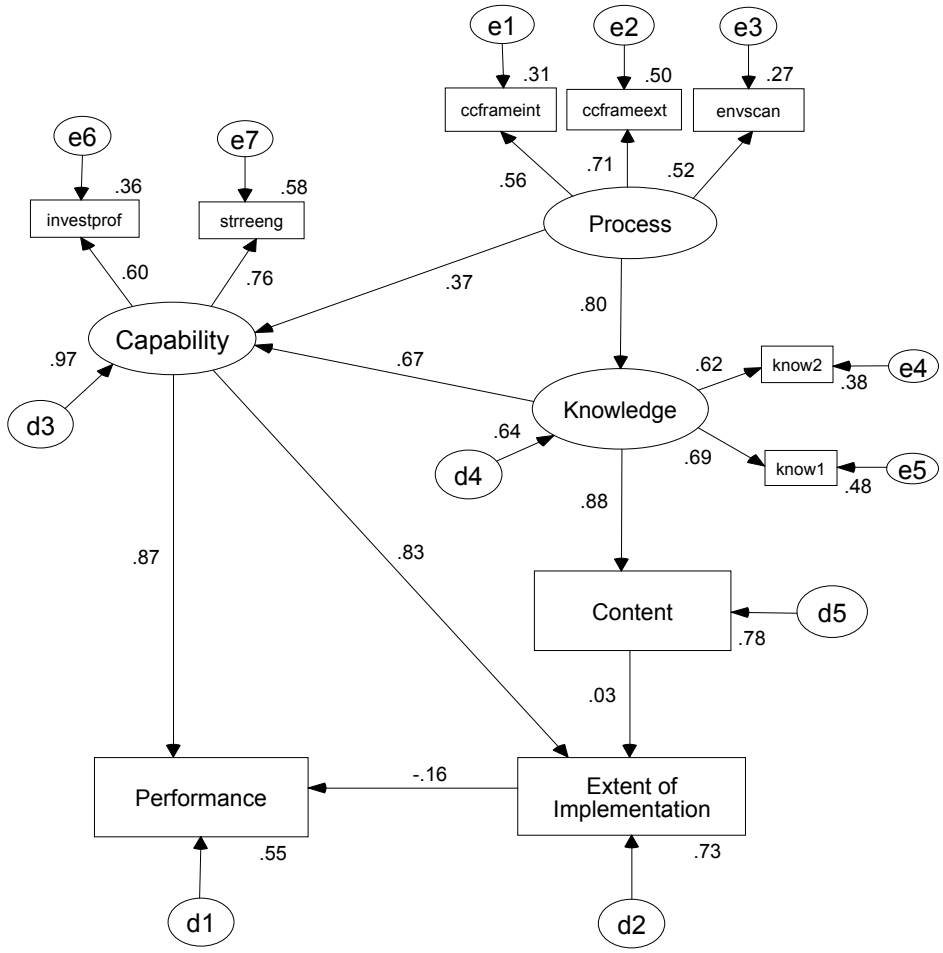


Figure 2: Overall SEM Path Model for full dataset

The following goodness of Fit criteria were recorded for the full model:

GFI	AGFI	RMSR	RMSEA	TLI	NFI	CHI^2	DF	SIG.	N	CHI^2/DF
0.948	0.905	0.035	0.077	0.940	0.942	89.570	30	0.000	335	2.986

Table 2: Goodness of Fit Criteria – Full Model

The ratio of distinct parameters to be estimated to the size of the sample (335/25 = 13.4) exceeds the recommended minimum of 10 respondents per parameter.

Absolute Fit Measures

Calculation of the Scaled Noncentrality Parameter (SNCP) indicates a value of 0.17, low enough to provide some confidence in the degree of fit of the model, although there are no definitive statistical tests for this measure. The Goodness of Fit Index (GFI) at .948 is relatively high and provides further confidence in the plausibility of the overall model, particularly given its complexity. The Root Mean Square Residual (RMSR) of .035 is also low, and provides further confidence in the absolute goodness of fit. The Root Mean

Squared Error of Approximation (RMSEA) at .077 is found to be within the recommended range of .05 and .08.

Other Measures

Both the Tucker Lewis Index (TLI) and the Normed Fit Index (NFI) are found to be well above the recommended level of .90 at .940 and .942. The Adjusted Goodness of Fit Index is also above the recommended level of .90 at .905.

Analysis of Direct and Indirect Effects

Table 3 below details the standardized direct and indirect effects measured.

IV	DV	DIRECT	INDIRECT	TOTAL
PROCESS	KNOWLEDGE	.80		.80
	CAPABILITY	.37	.54	.90
	CONTENT		.71	.71
	EXTENT of IMPLEMENTATION		.77	.77
	PERFORMANCE		.67	.67
KNOWLEDGE	CAPABILITY	.67		.67
	CONTENT	.88		.88
	EXTENT of IMPLEMENTATION		.58	.58
	PERFORMANCE		.49	.49
CAPABILITY	EXTENT of IMPLEMENTATION	.83		.83
	PERFORMANCE	.87	-.130	.74
CONTENT	EXTENT of IMPLEMENTATION		.03*	.03*
	PERFORMANCE		-.004*	-.004*
EXTENT of IMPLEMENTATION	PERFORMANCE	-.16*		-.16*

Table 3: Direct and Indirect Effects (* denotes non-significant value effect)

Determinant - Process

The standardised total effect of Process on Extent of Implementation is found to be both strong and highly significant (.770 at p<.01). This effect is delivered via three separate paths. The first of these is by way of having a direct effect on the Capability of the organization to implement, and as such reflects the need for organizations to be able to deploy resources to meet changing environmental conditions. The direct effect on Capability recorded here is moderately strong and significant (.366 at p<.01). The second is via an indirect effect on Capability via the Knowledge construct. In this case the proposition is that the process of EAN system strategy formulation determines the level of Knowledge, which in turn increases Capability to implement. The direct effect on Knowledge observed is very strong and significant (.803 at p<.01), while the indirect effect on Capability recorded is strong and significant (.536 at p<.01). The indirect effect on each of the two constructs making up Capability (Strategic Reengineering and Investment Profile) via these two paths is strong and significant in both cases (.688 at p<.01 and .537 at p<.01 respectively). The subsequent direct effect of Capability on Extent of Implementation is also very strong and significant (.832 at p<.01). The third path is via Knowledge and Content with the direct effect of Knowledge on Content being very strong (.882 at p<.01), and there being no significant effect recorded between Content and Extent of Implementation. The relationships described in the model provide significant further evidence for the proposition that the Process construct plays an important role in determining the extent to which organizations implement the EAN system. In this case, not only is Process (the means by which an organization formulates it's strategic logic) significantly associated with Extent of Implementation, but it could also be said to be (within the constraints of the model proposed) a significant determinant.

Determinant – Knowledge

The causal model expresses the relationship between Knowledge and Extent of Implementation as being an indirect one comprising two paths. The first of these is via Capability, indicating that the extent of knowledge of the EAN system will be a determinant of capability to implement, thus ultimately affecting the extent of implementation. The second is via Content, indicating that levels of Knowledge will be a determinant of the content of an organization's strategic objectives and plans when implementing, and thus influence extent of implementation. A strong and highly significant (.579 at $p<.01$) indirect effect is recorded between the Knowledge construct and Extent of Implementation via these paths. In the context of this model this provides evidence to the effect that the extent of implementation is not only positively associated with (a) the level of understanding of the range of options, (b) potential benefits and (c) the range of applications available for implementation, but that the Knowledge construct is a significant determinant.

Determinant – Capability

Capability is observed to be a significant and strong determinant of Extent of Implementation (.832 at $p<.01$), and as such emphasises the importance of the ability to strategically reengineer business processes as a determinant of extended implementation. At the same time, Capability is a strong and significant determinant of Performance (.872 at $p<.01$), in this case pointing to the importance of being able to manage change effectively, and at the same time maintaining an appropriate and balanced investment profile.

Determinant – Content

There is no significant causal path found linking Content to extent of implementation. This lack of association is indicative of the fact that perhaps content of strategic objectives and plans is associated with extent of implementation by way of it's association with other factors such as the construct Knowledge. The indirect effect of Knowledge on Extent of Implementation, through the effect it has on both Capability and Content, is both strong and significant (.579 at $p<.01$). At the same time, Content has no significant determining effect on Extent of Implementation, despite the fact that they are very strongly associated (0.645 at $p<.01$). In this sense, Content could be seen as a hygiene factor in terms of it's effect on the extent to which companies implement the EAN system. As a result of higher levels of Knowledge of the EAN system, companies are more likely to formulate specific objectives and expectations, and at the same time formulate strategic plans for implementation. The indications are, however, that this process has little or no impact on the extent to which they implement, but is rather the outcome of the other factors preceding it in the model (i.e. Process of strategy formulation and Knowledge of the EAN system). This does not mean to say that the formulation of objectives and plans is not important, but rather that the plans and objectives of themselves will have little impact on extent of implementation. It was apparent from some of the cases that the planning process (and by extension the development of objectives and expectations) was "evolutionary" rather than "revolutionary". The finding that the Content construct has little or no impact on Extent of Implementation, and that it appears to be heavily determined by growth in Knowledge, provides some further evidence to support this.

Determinant – Extent of Implementation

On the face of it there is a very strong relationship recorded between Extent of Implementation and Performance for the surveyed companies (.563 at $p<.01$). Further analysis using the causal model, however, indicates that the relationship may be more the result of common association, rather than a causal one. The causal model expresses the relationship between Extent of Implementation and Performance as being a direct one, with Extent of Implementation determining Performance. In the context of the model the path from Extent of Implementation to Performance is weak and not significant, indicating that although the two variables are highly associated (as reported above), Extent of Implementation does not have a determining effect on Performance. In this model, the true determinants of Performance are Capability (directly), and Process and Knowledge (indirectly). The direct effect of Capability on Performance is very strong and significant (.872 at $p<.01$), while the indirect effects of Process and Knowledge are also strong and significant (.666 at $p<.01$ and .491 at $p<.01$ respectively). Capability is also observed to have a very strong determining effect on Extent of Implementation (.832 at $p<.01$), while Process and Knowledge are also strong and significant indirect determinants (.770 at $p<.01$ and .579 at $p<.01$ respectively). It is these shared relationships that perhaps provide some of the explanation of the relationship between Extent of Implementation and Performance. Companies that report extensive implementation of the EAN system also

appear to report higher levels of performance, but it would appear to be a mistake to conclude that one will automatically lead to the other, or that in fact one determines the other. The nature of the relationship (in this model) is a function of the sharing of common determinants. In practical terms, this could be interpreted to mean that extensive implementation unsupported by a valid strategic formulation process, sufficient knowledge of technologies, applications and benefits, and the capability to implement, will not be sufficient to guarantee improved performance. The nature of these relationships are supported in the literature, particularly in relation to the adoption of EDI. The importance of Capability, Process and Knowledge in the model is consistent with the low adoption rates of established technologies (such as EDI), despite many benefits being proposed (Adams, 1997; Barber, 1997; Barua and Lee, 1997; Bytheway and Braganza, 1992; Cash and Konsynski, 1985; Iacovou et al., 1995; Lee and Clark, 1999; Ramamurthy et al., 1999; Rassameethes and Kurokawa, 2000). Many organizations find it difficult to be able to combine these three factors and produce a coordinated and coherent implementation strategy (Gourley, 1998; Hammant, 1997; Larkins and Luce, 2000; Moller, 2000a; Moller, 2000b). In this sense the relationship between these three factors and both Performance and Extent of Implementation represent an impediment to extended adoption. As such, the spotlight moves from the EAN system per se (and the technologies), and onto the organization itself. Here again, the literature provides some support for this, particularly in terms of the importance of understanding how best to apply the technology, and developing an organizational capability for implementation and effective operation (Parnell, 1998; Tyndal et al., 2000; Froehlich et al., 1999; Gilmour, 1999; Carter and Hendrick, 1997; Hewitt, 1999; Mohanty and Deshmukh, 2000; Coates, 1999; Lee and Billington, 1995). In essence this result points to both the potential benefits of the technology (in this case the EAN system), and at the same time the inherent limitation of technology that is, after all, simply a set of tools and applications. The important role decision making in individual firms can have on the overall efficiency of supply chains has been a theme recurring in the literature over many years (Forrester, 1961; Forrester, 1958; Hines et al., 1999; Sterman, 1989; Handfield and Nichols, 1999; Holweg and Bicheno, 2000). The implications go beyond the individual enterprise, and to the heart to improving the operations of supply chains through the application of e-business enabling technologies.

CONCLUSIONS

The literature emphasises the strategic nature of supply chain management initiatives, and the results observed provide some confirmation of this. The Process of formulating an organization's strategic logic will be a strong determinant of both the level of Knowledge of the EAN system, and the Capability to implement it. Capability is seen to be a strong determinant of Extent of Implementation. At the same time, Knowledge has a strong effect on the Content of plans, objectives and expectations from implementation, but this Content has little or no direct impact on Extent of Implementation. This is despite the fact that Content is strongly associated with Extent of Implementation, indicating that of the three sets of relationships hypothesised (i.e. Process with Extent, Capability with Extent, and Content with Extent), Process and Capability are the determining factors. Content, on the other hand, can be perhaps seen as a requirement rather than a determinant. In this sense it can be important to define Extent of Implementation, but will not determine what actually happens. The causal model provides evidence that Process and Capability represent the ability to implement, while Content represents a blueprint of how this may be achieved. The nature of the relationship between Extent of Implementation and Performance further highlights the importance of Process, Knowledge and Capability. In terms of Forrester's model of industrial dynamics based on information feedback systems, delays in the system (the supply chain), can be amplified depending on the policy responses of individual trading partners (Forrester, 1961; Forrester, 1958). As such, the application of improved information technology will provide a potential source of improvement, but cannot be expected to act as a technological "silver bullet" eradicating all sources of inefficiency. The solution appears far more likely to originate within the individual organizations, with the efficiency and effectiveness of the supply chain more a function of the sum total of the capabilities of trading partners.

REFERENCES

Abcede, A., (1997) "EDI, Internet connect as data goes electronic", *National Petroleum News*, 89, 11, pp. 110-114.

Adams, E. J., (1997) "Second coming for Electronic Data Interchange", *World Trade*, 10, 11, pp. 36-38.

Akkermans, H., Bogerd, P. and Vos, B., (1999) "Virtuous and vicious cycles on the road towards international supply chain management", *International Journal of Operations & Production Management*, 19, 5-6, pp. 565-581.

Anonymous, (2000) *Survey of Technology and E-commerce in Australian Small and Medium Business*, National Office for the Information Economy / Telstra Corporation Limited, Accessed 10/09/2000, On Line Report, http://www.noie.gov.au/publications

Anonymous, (2001) *Organizing for e-Commerce*, Boston Consulting Group, Accessed 08/01/2001, On Line Report, www.bcg.com/p...h_view_perspectives.asp?pubID=547

Arntzen, B. C., Brown, G. G., Harrison, T. P. and Trafton, L. L., (1995) "Global supply chain management at Digital Equipment Corporation", *Interfaces*, 21, 5, pp. 69-93.

Ballou, R. H., Gilbert, S. M. and Mukherjee, A., (2000) "New managerial challenges from supply chain opportunities", *Industrial Marketing Management*, 29, 1, pp. 7-18.

Barber, N. F., (1997) "Will EDI survive?", *Transportation and Distribution*, 38, 9, pp. 39-45.

Barua, A. and Lee, B., (1997) "An economic analysis of the introduction of an Electronic Data Interchange system", *Information Systems Research*, 8, 4, pp. 398-422.

Belyea, K., (2000) "How Electrolux takes cost out of the chain", *Purchasing*, 128, 5, pp. 59-65.

Bender, P. S., (2000) *How information technology is transforming global logistics*, In Katayama, H., Global logistics for the New Millennium - Proceedings of 5th International Symposium on Logistics, Iwate, Japan, Waseda UP Ltd., pp. 309-316.

Bensaou, M., (1997) "Inter-organisational cooperation - The role of information technology - An empirical comparison of US and Japanese supplier relations", *Information Systems Research*, 8, 2, pp. 107-124.

Berger, M., (1997) "Can you supply in time?"*, Sales and Marketing Management*, 149, 10, pp. 99-101.

Bhaskaran, S., (1998) "Simulation analysis of a manufacturing supply chain", *Decision Sciences*, 29, 3, pp. 633-657.

Bovel, D. and Martha, J., (2000) "From supply chain to value net", *Journal of Strategic Management*, July-August, pp. 24-28.

Bowersox, D. J. and Calantone, R. J., (1998) "Executive Insights: Global Logistics", *Journal of International Marketing*, 6, 4, pp. 83-93.

Bowman, R. J., (1997) "The state of the supply chain", *Distribution*, 96, 1, p. 28.

Boyd, T., (2001) "Forget ERP - They want e-strategies", *Australian Financial Review*, Melbourne, 6 April, p. 82.

Burnell, J., (1998) "Technology tames logistics"*, Automatic I.D. News*, March, pp. 40-42.

Bytheway, A. and Braganza, A., (1992) "Corporate information, EDI and logistics", *Logistics Information Management*, 5, 4, pp. 10-18.

Cachon, G. P. and Fisher, M., (2000) "Supply chain inventory management and the value of shared information", *Management Science*, 46, 8, pp. 1032-1048.

Cahill, J. M., (2000) "Virtual supply chains drive e-business", *Transportation and Distribution*, 41, 5, pp. 30-32.

Carter, C. R., (2000) "Ethical issues in international buyer-supplier relationships: A dyadic examination", *Journal of Operations Management*, 18, 2, pp. 191-208.

Carter, C. R. and Ellram, L. M., (1998) "Reverse Logistics: A review of the literature and a framework for future investigation", *Journal of Business Logistics*, 19, 1, pp. 85 -102.

Carter, C. R. and Hendrick, T. E., (1997) "The development of a time-based construct and its impact on departmental design and structure", *International Journal of Purchasing and Materials Management*, 33, 4, pp. 26-34.

Cash, J. I. and Konsynski, B. R., (1985) "IS redraws competitive boundaries", *Harvard Business Review*, March-April, pp. 134-142.

Champy, J., (1995) *Reengineering Management*, Harper Collins, London.

Chan, C. and Swatman, P. M. C., (2000) "From EDI to Internet commerce: The BHP Steel experience", *Internet Research - Electronic Networking Applications & Policy*, 10, 1, pp. 72-82.

Chase, R. L., (2000) *2000 most admired knowledge enterprises*, Teleos, Accessed 15/10/2000, Web page, http://www.knowledgebusiness.com

Chen, F., Drezner, Z., Ryan, J. K. and Simchi-Levi, D., (2000) "Quantifying the bullwhip effect in a simple supply chain: The impact of forecasting, lead times, and information", *Management Science*, 46, 3, pp. 436-443.

Chen, S. K., (2001) "Advancing your supply chain with e-business", *The Journal of Enterprise Resource Management*, 6, pp. 43-49.

Coates, S. V., (1999) *Supply chain reengineering in Franklins Ltd.*, In Proceedings of International Conference on Logistics and the Management of the Supply Chain, Sydney, Australia, LAA/APICS/MHD Magazine, pp. 41-43.

Conroy, F., (2000) "The strategic advantage of advanced supply chain management", *The Journal of Enterprise Resource Management*, 2, Second Quarter, pp. 1-6.

Croom, S., (2001) "Restructuring supply chains through information channel innovation", *International Journal of Operations and Production Management*, 21, 4, pp. 504-515.

Crum, M. R. and Allen, B. J., (1997) "A longitudinal assessment of motor carrier-shipper relationship trends, 1990 vs. 1996", *Transportation Journal*, 37, 1, pp. 5-17.

Cunningham, M., (2000) *e-Commerce - Defining Business Strategies*, The Harvard Computing Group, Accessed 14/08/2000, On Line Report, www.harvardcomputing.com

Davilla, F. and Panizzolo, R., (1996) "Buyer - subcontractor relationships in the Italian clothing industry", *International Journal of Operations & Production Management*, 16, 7, p. 38.

Edwards, C. and Peppard, J., (1996) Implications of Experiences with Business Process Reengineering for IS/IT Planning, In *Managing Business Processes: BPR and Beyond*, (Eds, Armistead, C. and Rowland, P.), John Wiley and Sons, Chichester, pp. 189-213.

El Sawy, O. A., Malhotra, A., Gosain, S. and Young, K. M., (1999) "IT-intensive value innovation in the electronic economy: Insights from Marshall Industries", *MIS Quarterly*, 23, 3, pp. 305-335.

Evans, G., Naim, M. and Towill, D., (1993) "Dynamic supply chain performance: Assessing the impact of information systems", *Logistics Information Management*, 6, 4, pp. 15-25.

Fein, A. J. and Jap, S. D., (1999) "Manage consolidation in the distribution channel", *Sloan Management Review*, 41, 1, pp. 61-72.

Fernie, J., (1995) "International comparisons of supply chain management in grocery retailing", *Service Industries Journal*, 15, 4, pp. 134-147.

Forrester, J., (1958) "Industrial dynamics, a major breakthrough for decision makers", *Harvard Business Review*, July-August, pp. 37-66.

Forrester, J. W., (1961) *Industrial Dynamics*, MIT Press, Cambridge, MA.

Froehlich, G., Hoover, H. J., Liew, W. and Sorenson, P. G., (1999) "Application framework issues when evolving business applications for electronic commerce", *Information Systems*, 24, 6, pp. 457-473.

Frye, C., (1997) "The supply chain's missing link", *Software Magazine*, 17, 11, pp. 81-85.

Gilmour, P., (1999) *The use of supply chain activities to add value in leading Asia Pacific countries*, In Proceedings of the International Conference on Logistics and the Management of the Supply Chain, Sydney, Australia, LAA/APICS/MHD Magazine, pp. 227-231.

Gilmour, P. and Hines, P., (2000) *The impact of the industrial sector on the strategic use of supply chain operations: An empirical study of the Automotive and FMCG sectors in Australia and the United Kingdom*, In Katayama, H., Global Logistics in the New Millennium - Proceedings of the 5th International Symposium on Logistics, Iwate, Japan, Wased UP Ltd., Tokyo, pp. 78-85.

Gourley, C., (1998) "What's driving the automotive supply chain?", *Warehousing Management*, 5, 10, pp. 44-48.

Grannan, P. P., (1997) "Electronic commerce today; financial EDI solutions for tomorrow", *Management Accounting*, 79, 5, pp. 38-41.

Hammant, J., (1997) *Implementing a European supply chain strategy: Turning vision into reality*, In Proceedings of the International Conference on Logistics and the Management of the Supply Chain, Sydney, Australia, AIMM/LMA/APICS/AIPMM, pp. 95-100.

Hammer, M., (1990) "Reengineering work: Don't automate, obliterate", *Harvard Business Review*, July-August, pp. 104-112.

Hammer, M., (1996) *Beyond Reengineering: How the Process-Centred Organization is Changing Our Work and Our Lives*, Harper Collins, London.

Hammer, M. and Champy, J., (1994) *Reengineering the Corporation: A Manifesto for Business Revolution*, Brearley Publishing, London.

Handfield, R. B., Krause, D. R., Scannell, T. V. and Monczka, R. M., (2000) "Avoid the pitfalls in supplier development", *Sloan Management Review*, 41, 2, pp. 37-49.

Handfield, R. B. and Nichols, E. L., (1999) *Introduction to Supply Chain Management*, Prentice Hall, New Jersey.

Hewitt, F., (1999) "Information technology mediated Business Process Management: Lessons from the supply chain", *International Journal of Technology Management*, 17, 1-2, pp. 37-53.

Hicks, D. A., (1997) "The manager's guide to supply chain and logistics problem solving tools and techniques - Part 1: Understanding the Techniques", *IIE Solutions*, 29, 9, pp. 43-47.

Hicks, D. A., (1999) "The state of supply chain strategy", *IIE Solutions*, 31, 8, pp. 24-29.

Hines, P. and Rich, N., (1997) "The seven value stream mapping tools", *International Journal of Operations & Production Management*, 17, 1-2, pp. 46-64.

Hines, P., Wilding, R. and Holweg, M., (1999) *Dynamics, Dimensions and Directions - Making sense of linear supply chain thinking*, Logistics Research Network Conference, Newcastle Business School, University of Northumbria

Holweg, M. and Bicheno, J., (2000) *The reverse amplification effect in supply chains*, In Katayama, H., Global logistics for the new millennium - Proceedings of the 5th International Symposium on Logistics, Iwate, Japan, Waseda UP Ltd., pp. 549-554.

Horton, J., (1999) *Supply chain strategy in Australian Industry*, In Proceedings of the International Conference on Logistics and the Management of the Supply Chain, Sydney, Australia, LAA/APICS/MHD Magazine, pp. 75-77.

Iacovou, C. L., Benbasat, I. and Dexter, A. S., (1995) "Electronic Data Interchange and small organisations: Adoption and impact of technology", *MIS Quarterly*, 19, 4, pp. 465-485.

Johnston, R. B. and Mak, H. C., (2000) "An emerging vision of Internet-enabled supply-chain electronic commerce", *International Journal of Electronic Commerce*, 4, 4, pp. 43-59.

Jutla, D., Bodorik, P. and Wang, Y., (1999) "Developing internet e-commerce benchmarks", *Information Systems*, 24, 6, pp. 475-493.

Kilgore, S. M., (2000) *Delivering the Global Goods*, Forrester Research, Accessed 17/10/2000, On Line Research Report, www.forrester.com

Larkins, M. and Luce, K., (2000) "Business & IT work together to plan and support supply chain management initiatives - Implementing a supply chain management process does not need to be difficult or complicated", *Pulp & Paper - Canada*, 101, 4, pp. 12-14.

LaRoche, M., (1998) *Synchronising the supply chain through integrated supply chain planning*, In Proceedings of the APICS International Conference, Gold Coast, Australia, APICS, pp. 124-131.

Lee, H. G. and Clark, T. L., (1999) *Business value of Electronic Data Interchange: The critical role of organisational process innovations*, In Despotis, D. K. and Zopounidis, C., Proceedings of the 5th International Conference of the Decision Sciences Institute, Athens, Greece, New Technologies Publications, pp. 358-360.

Lee, H. L. and Billington, C., (1995) "The evolution of supply chain models and practice at Hewlett Packard", *Interfaces*, 25, 5, pp. 42-63.

Lummus, R. R. and Vokurka, R. J., (1999) "Defining supply chain management: A historical perspective and practical guidelines", *Industrial Management and Data Systems*, 99, 1, pp. 11-17.

Lummus, R. R., Vokurka, R. J. and Alber, K. L., (1998) "Strategic supply chain planning", *Production and Inventory Management Journal*, 39, 3, pp. 49-58.

Mabert, V. A. and Venkataramanan, M. A., (1998) "Special research focus on supply chain linkages: Challenges for design and management in the 21st century", *Decision Sciences*, 29, 3, pp. 537-552.

Magretta, J. and Dell, M., (1998) "The power of virtual integration: An interview with Dell Computers' Michael Dell", *Harvard Business Review*, 76, March - April, pp. 72-84.

Magretta, J. and Fung, V., (1998) "Fast, Global, And Entrepreneurial - Supply Chain Management, Hong Kong Style: An Interview With Fung,Victor", *Harvard Business Review*, 76, September/October, pp. 102-114.

Malhotra, Y., (2000) "Knowledge Management for e-business performance: Advancing information strategy to "Internet Time".", *Information Strategy: The Executive's Journal*, 16, 4, pp. 5-16.

McCormack, K., (1999) "What really works", *IIE Solutions*, 31, 8, pp. 30-32.

McCutcheon, D. and Stuart, I. F., (1999) "Issues in the choice of supplier alliance partners", *Journal of Operations Management*, 18, 3, pp. 279-301.

Meade, L., (1998) "Strategic analysis of logistics and supply chain management systems using the analytical network process", *Transportation Research Part E-Logistics & Transportation Review*, 34, 3, pp. 201-215.

Min, H. and Galle, W. P., (1999) "Electronic commerce usage in business-to-business purchasing", *International Journal of Operations & Production Management*, 19, 9-10, pp. 909-921.

Mohanty, R. P. and Deshmukh, S. G., (2000) "Reengineering of a supply chain management system: A case study", *Production Planning & Control*, 11, 1, pp. 90-104.

Moller, C., (2000a) "SCM in the extended enterprise: Implementation of APS systems", *The Journal of Enterprise Resource Management*, 4, Fourth Quarter, pp. 29-35.

Moller, C., (2000b) "Supply chain operations review and evaluation (Score) - A methodology to approach supply chain analysis", *The Journal of Enterprise Resource Management*, 3, Third Quarter, pp. 1-4.

Monczka, R. M., Petersen, K. J., Handfield, R. B. and Ragatz, G. L., (1998) "Success factors in strategic supplier alliances: The buying company perspective", *Decision Sciences*, 29, 3, pp. 553-577.

Narasimhan, R. and Jayaram, J., (1998) "Causal linkages in supply chain management: An exploratory study of North American manufacturing firms", *Decision Sciences*, 29, 3, pp. 579-605.

Olsen, R. E., (1996) *Supply Chain Management: A competitive global strategy*, In Proceedings of the APICS Conference and Exhibition, Melbourne, Australia, APICS, pp. 84-87.

Parnell, C., (1998) "Supply chain management in the soft goods industry", *Apparel Industry Magazine*, 59, 6, p. 60.

Porter, M., (1980) *Competitive Strategy*, The Free Press, New York.

Porter, M., (2001) "Strategy and the Internet", *Harvard Business Review*, March, pp. 63-78.

Porter, M. E. and Millar, V. E., (1985) "How information gives you competitive advantage", *Harvard Business Review*, July-August, pp. 149-160.

Radjou, N., (2000) *Manufacturing Deconstructed*, Forrester Research, Accessed 17/10/2000, On Line Research Report, www.forrester.com

Ram, S., (1989) "Successful innovation using strategies to reduce consumer resistance: An empirical test", *Journal of Product Information Management*, 6, 1, pp. 20-34.

Ramamurthy, K., Premkumar, G. and Crum, M. R., (1999) "Organizational and inter-organizational determinants of EDI diffusion and organizational performance: A Causal Model", *Journal of Organizational Computing and Electronic Commerce*, 9, 4, pp. 253-285.

Rassameethes, B. and Kurokawa, S., (2000) "EDI performance in the automotive supply chain", *International Journal of Technology Management*, 20, 3/4, pp. 287-303.

Ross, A., Venkataramanan, M. A. and Ernstberger, K. W., (1998) "Reconfiguring the supply network using current data", *Decision Sciences*, 29, 3, pp. 707-728.

Ruetterer, T. and Kotzab, H. W., (2000) "The use of conjoint analysis for measuring preferences in supply chain design", *Industrial Marketing Management*, 29, pp. 27-35.

Sanchez, R., (1993) "Strategic Flexibility, Firm Organisation, and Managerial Work in Dynamic Markets: A Strategic Options Perspective", *Advances in Strategic Management*, 9, pp. 251-291.

Sanchez, R., (1997) "Preparing for an Uncertain Future: Managing organisations for Strategic Flexibility", *International Studies of Management and Organisation*, 27, 2, pp. 71-95.

Sanchez, R. and Heene, A., (1996) A Systems View of the Firm in Competence-based Competition, In *Dynamics of Competence-Based Competition*, (Ed, Sanchez, R., Heene, A., Thomas, H.), Elsevier, Oxford, pp. 39-62.

Sanchez, R. and Heene, A., (1997a) Competence-based strategic management: Concepts and issues for theory, research and practice, In *Competence-based Strategic Management*, (Eds, Heene, A. and Sanchez, R.), John Wiley and Sons, pp. 3-42.

Sanchez, R. and Heene, A., (1997b) "Managing for an Uncertain Future: A systems view of strategic organisational change", *International Studies of Management and Organisation*, 27, 2, pp. 21-42.

Shin, H., Collier, D. A. and Wilson, D. D., (2000) "Supply management orientation and supplier/buyer performance", *Journal of Operations Management*, 18, 3, pp. 317-333.

Sislian, E. and Satir, A., (2000) "Strategic sourcing: A framework and a case study", *The Journal of Supply Chain Management*, 36, 3, pp. 4-11.

Sterman, J., (1989) "Modelling managerial behaviour: Misperception of feedback in a dynamic decision making environment", *Management Science*, 35, 3, pp. 321-339.

Stuart, F. I., (1997) "Supplier alliance success and failure - a longitudinal dyadic perspective", *International Journal of Operations & Production Management*, 17, 5-6, pp. 539-557.

Stuart, F. I. and McCutcheon, D., (1996) "Sustaining strategic supplier alliances: Profiling the dynamic requirements for continued development.", *International Journal of Operations and Production Management*, 16, 10, pp. 5-21.

Suzuki, Y. and Williams, L. R., (1998) "Analysis of EDI resistance behaviour", *Transportation Journal*, 37, 4, pp. 36-44.

Tan, K. C., Handfield, R. B. and Krause, D. R., (1998) "Enhancing the firm's performance through quality and supply base management: An empirical study", *International Journal of Production Research*, 36, 10, pp. 2813-2837.

Thompson, W., (1999) *Rebuilding supply chain planning in a consumer goods business*, In Proceedings of the International Conference on Logistics and the Management of the Supply Chain, Sydney, Australia, LAA/APICS/MHD Magazine, pp. 123-126.

Towill, D., (1996) "Industrial dynamics modelling of supply chains", *International Journal of Physical Distribution and Logistics Management*, 26, 2, pp. 23-43.

Tyndal, G., Gopal, C., Partsch, W. and Kamauff, J., (2000) *Making it happen: The value producing supply chain*, Ernst and Young, Accessed 10/01/2001, On Line Report, http://www.ey.com/global/gcr.nsf/US/Supercharging_Supply_Chains_-_Think_Tank_-_Ernst_%26_Young_LLP

Upin, E. B., Beckwith, M. J., Jennings, C. L., Chen, B. Y. and Schaeffer, K. B., (2000) *B2B: Building technology bridges outside the four walls of the enterprise*, Robertson Stephens Research, Accessed 20/09/2000, On Line Research Report, www.rsco.com

Vandermere, S., (1987) "Diffusing new ideas in-house", *Journal of Product Information Management*, 4, 4, pp. 256-264.

Waller, M., Johnson, M. E. and Davis, T., (1999) "Vendor managed inventory in the retail supply chain", *Journal of Business Logistics*, 20, 1, pp. 183-203.

Warnock, J., (1999) *Intec's supply chain planning: A strategic solution*, In Proceedings of the International Conference on Logistics and the Management of the Supply Chain, Sydney, Australia, LAA/APICS/MHD Magazine, pp. 67-69.

Watson, G. H., (1994) *Business Systems Engineering: Making Breakthrough Changes for Productivity and Profit*, John Wiley and Sons, New York.

Wilder, C., Caldwell, B. and Dalton, G., (1997) "More than electronic commerce", *Informationweek*, 661, pp. 30-40.

Wilding, R., (1998) "Chaos Theory: Implications for supply chain management", *International Journal of Logistics Management*, 9, 1, pp. 43-56.

Wood, A., (1997) "Extending the supply chain: Strengthening links with IT", *Chemical Week*, 159, 25, p. 26.

Yates, S., Rutstein, C. and Voce, C., (2000) *Demystifying B2B Integration*, Forrester Research, Accessed 11/10/2000, On Line Report, http://www.forrester.com/ER/Research/Report/0,1338,10423,FF.html