

E-Connectivity as an Enabler for Dynamically Networked Supply Chains – Exploratory Research Findings

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Abstract: Dynamic markets require that supply chain partners work together in a timely and efficient manner. This paper introduces e-Connectivity, a construct describing how technology and process standards enable cross-company collaboration amongst partners in the networked supply chain. The paper highlights the collaborative and often short-term relationships where partners coordinate their mutual capabilities to address a transitory, but important, business opportunity in order to achieve collectively beneficial outcomes.

Through a literature review and exploratory interviews, the paper proposes and defines the construct of the dynamically networked supply chain. It then introduces how information technology and related processes enable dynamic collaborative practices in the supply chain. Subsequently, e-Connectivity is discussed as a key success factor in the development and deployment of informally networked supply chains.

Further empirical validation and testing may reveal that informal coordination in networked supply chains, enabled by eBusiness, is an important capability that impacts the operational effectiveness and competitive advantage of a firm.

I. Introduction

Collaboration between firms is a powerful source of competitive advantage, calling for efficient ways to integrate relationships in the supply chain, including the development and maintenance of information, physical and financial flows. An operating system is said to be superior to that of a competitor if it responds better to market opportunities, and as such secures the long-term viability of the firm. This paper develops a conceptual model for analysing how e-Connectivity increases the operational effectiveness of a firm by providing the platform for dynamically linking the information flows of supply chain partners. The research focuses on short-term inter-firm supply chain relationships, and emphasizes how e-Connectivity can lead to improved customer service by improving the coordination between manufacturers, service providers, channel partners, and other partners that are involved in delivering products and services.

Based on a literature review and exploratory interviews,

initial findings suggest that supply chain theory does not sufficiently describe the interconnectedness and interdependencies between process and technology standards in a supply chain, and their effect on inter-firm coordination of supply chain resources.

Exploratory interviews were conducted between December 2004 and April 2005 with about 50 senior executives in person or by telephone. The interview panel consisted of senior management (C-Level, VP, Managing Directors, Directors) from a variety of industries. The Panel consisted of mainly European and Australian / New Zealand participants. The sample was chosen in this particular way as the researchers eventually want to compare Australian / New Zealand practices with practices in one other region of the world, and because they had access to relevant addresses and contact details. The panel composition is shown in Figure 1.

Figure 1: Exploratory interviews - Panel Setup

Expert Panel Industry	Country				Grand Total
	ANZ	EU	AMER	Asia	
Logistics Services	3		1	2	1
ICT	5	4			2
Durable Goods	3	2	1		9
Business Services	3	1	1		65
Financial Services	2	2			
FMCG	3			1	44
Automobile	3				3
Government	1	1			
Hospitality		2			2
Pharma & Chemical		2			2
Primary Industries	2				2
Utilities	1	1			2
Retail and Wholesale	1				2
Grand Total	33	15	3	3	54

In this context, there also appears to be insufficient empirical knowledge about the role that e-connectivity, i.e. technology and processes, play to enable dynamic supply chain relationships and ultimately lead to better outcomes. As such, opportunities for deploying the supply chain as a source for achieving quick response, operational effectiveness, and ultimately competitive advantage, may be lost.

We turn next to a literature review of supply chain relationships, and a discussion of dynamically networked supply chains. We introduce the role of information technology as an enabler for process change in supply chain management. We then turn to process and technology standards as the key factors driving e-Connectivity in supply chain management. This is followed by conclusions.

I. 1 Dynamically Networked Supply Chains

This research investigates market prospects that are highly dynamic and complex to execute and hence require a rapid coordination capability. Such advanced capabilities often do not exist in firms, or are inhibited because of established norms and formal approaches to managing the arrangements between the supply chain partners.

Handling complex and time-sensitive customer requirements frequently extends beyond the capabilities of a single firm [1, 2]. However, supply chain management not only needs to include the partners involved in core logistics and supply chain value adding activity, but also indirect partners such as regulators, intermediaries, financial institutions, and research and government agencies. These partners influence power, risk and knowledge structures which in turn impact on performance of supply chains. Swaminathan et al [2] define the supply chain as a network of autonomous or semi-autonomous business entities collectively responsible for procurement, manufacturing and distribution activities associated with one or more families of related products. Moeller and Halinen [3] interpret the supply chain as a network of entities where firms process information, so that they can better respond to linked partners and customers.

It is argued that expertise in coordinating activities across different firms will become an important supply chain capability in itself. This leads to the informally networked supply chain, a concept distinctly different from a more [...] simplistic, linear and unidirectional representation of flows of materials and associated information [...] [4]. This part of the research paper identifies key relationship attributes for coordinating e-business enabled supply chain capabilities in unpredictable market environments.

A paradigm shift is underway in supply chain management from a focus on explaining only dyadic relationships, i.e. transactions and relationships, towards the investigation of multidimensional relations and networked views of supply chain interaction. This is accelerated by the notion that existing categorisations of [supply chain] networks offer limited operational assistance [5, 6] for firms in understanding the full spectrum of how to leverage their capabilities in highly dynamic demand situations. It is proposed that networked supply chains represent differentiated coordination approaches depending on form and content of the inter-organisational relationships among the firms involved. It is further argued that coordination in networks supply chains in highly dynamic market situations is more responsive to dynamic relationships, time, information and other non-linear success factors in the exchange of inputs and outputs [7].

Networked supply chains are not consistently defined in the literature and vary depending on the research objective and the choice of dimensions. For our research, a classification of different supply chain network models is proposed in relation to varying network exchange relationships, as is illustrated in Figure 2.

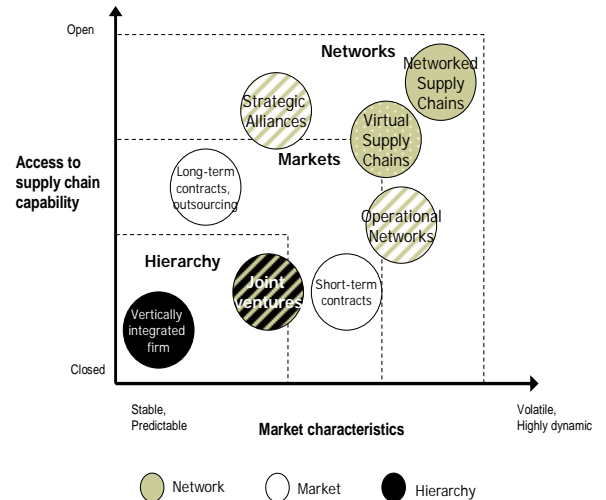


Figure 2: Landscape of supply chain networks

Formal coordination in either vertically integrated firms (internalising the coordination into the hierarchy of the own firm), through joint ventures and strategic alliances, or through long-term market contracts with 3rd party supply chain partners (using markets as the coordination mechanism) work in stable markets; while there is a risk that resources are not used efficiently in dynamic environments and stay idle most of the time. This leads to unnecessary costs and lowers operational efficiencies [8]. Examples of such rigid arrangement can be observed in the downstream mineral oil industry, which runs idle capacity for unpredictable or peak demands, or supply shortages. More flexible ways need to be introduced to cater for highly unpredictable demand.

The concept of outsourcing supply chain activities has often not produced the expected results for supply chain partners. Formalised relationships through contracts and service level agreements often increase complexities, and related efforts of coordination. Rigidity of such relationships inherent to contract specification, setup and monitoring, prevents firms to achieve competitive advantages. In particular, various ambitious new business models in the supply chain have not taken off as expected, i.e. the concept of a 4PL and e-marketplaces. Findings of a recent study on characteristics, strategies and trends for 3PL and 4PL in Australia [9] show that the benefits of inter-firm relationships have not yet materialised, although respondents confirmed the importance of such relationships for achieving better performance.

Networked supply chains display characteristics of the virtual enterprise [10],[11]. The relationship is temporary and project-like. Firms have specific capabilities, which they combine synergistically in the supply chain. The process is accompanied by an intensive use of information and communication technologies, and other network-specific coordination factors. In highly dynamic market situations, supply chain capability leverage depends on two important factors. First, generally accepted standards and methods in an industry or supply chain provide leverage for rapid

collaboration through network connectivity. Secondly, relational capability enables the rapid creation of a supply chain network for the opportunity at hand, and allows the partner to perform supply chain activities and serve the customer in highly dynamic markets.

Many firms coordinate their supply chain capabilities without formal agreements across a range of partners. As exploratory interviews reveal they anchor their activities around an understanding of dependency between business partners. Many firms have in fact indicated that they do not have any contractual relationships with their customers and suppliers for exactly the reason that their responses to market demand are highly adaptive, both in terms of response time and in terms of the breadth of solution delivered. These firms use their own and their partners' adaptable capabilities, including people, process and assets to respond to highly time-sensitive and complex customer requirements.

For example, it emerged from exploratory interviews that firms are reducing their assets and shift their attention to managing and controlling the access to information. This in particular seems to favour smaller players that can make an impact on supply chain effectiveness with relatively small shares of assets owned. Another example shows the electronics and automotive industries, where component suppliers are transforming into module suppliers, offering not only a narrow manufacturing expertise but a holistic service solution. This means that supply chain partners not only sell the product but provide services such as financing, maintenance, and replenishment [12].

Senior executives across a range of industries, i.e. chemicals, telecom equipment manufacturers, and fast moving consumer goods confirmed the informal coordination of supply chain capabilities to either enhance the efficiencies of operations, or to increase the effectiveness of serving the market with the 'best' combination of supply chain capabilities.

I. 2 IT - Enabled Supply Chains

Networked supply chains connect the players and their capabilities through robust information linkages. There are several factors that distinguish traditional supply chain relationships to the ones enabled by networks and technology. These factors include a reliance of supply chain partners on information infrastructures (Amit&Zott, 2001), the critical role of visibility and information transparency, the high reach and richness of information that can be exchanged rapidly [13] and network effects [14, 15].

The evolution of supply chain technology and the way it enables relationships is illustrated in Figure 3, using Gattorna's [16] supply chain capability/performance continuum, which categorises three different levels of supply chain integration and synchronisation. This framework forms the basis for further analysis of supply chain relationships and the coordination of capabilities in the context of short-term opportunities.

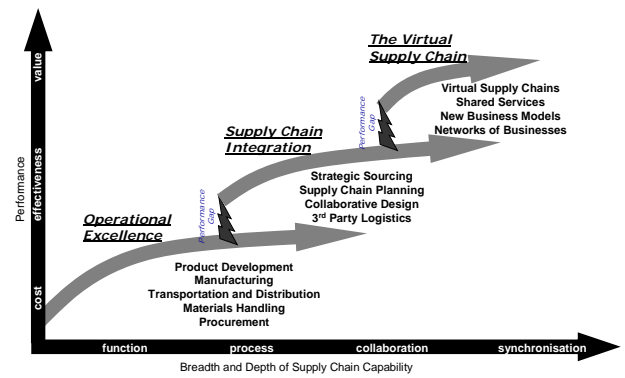


Figure 3: The supply chain capability/ performance continuum (Adapted from Gattorna, 2003)

The first curve depicts the operational and functional, and often internal, focus of coordinating supply chain capabilities with the objective to improve cost and efficiencies. Efficiencies are important, but any collaboration at this level has limited effects on overall supply chain performance. Operational efficiency by itself is rarely sufficient to create competitive advantage in highly dynamic markets. By the same token, if firms don't have their own house in order, they should not even attempt to engage in advanced supply chain activity with external partners. Efficiencies form an important prerequisite for collaborating in highly dynamic markets. For example, if IT processes and management practices are setup and maintained to industry or supply chain standards, a readiness for collaboration that adds to overall flexibility can be achieved.

The second curve shows the integration of supply chain capabilities and the impact technology makes on supply chain design. As market and customer demands evolve, supply chain managers are prompted to find innovative ways to integrate processes and technology across supply chain partners. Technology enables integrated supply chain capabilities and the process of integration creates better information, increased visibility, knowledge and learning. For example, firms may have widely applied cross-organisational business process re-engineering and implementation of ERP systems in place to achieve the benefits of integration. Some players like Walmart in the U.S. and Tesco in Europe have introduced approaches like CPFR (Collaborative Planning and Forecasting). These early attempts to leverage the integration of processes and technology resulted in significant changes to the consumer goods industry, globally. Hence, such technology availability, standards, and ease of integration become an important enabler for supply chain collaboration.

Technology and process integration across firms also leads to an increase in outsourcing, or contract logistics. These are structures where external firms perform logistics activities like warehousing, scheduling and transportation, usually based on long-term contracts and service level agreements. The integration of information flows gives the principal firm control and visibility for managing the entire

process, even though the activities and the ownership of capabilities is decentralised. Gattorna et al [9] confirm that more than half of large Australian corporations use such services, and significant and growing ratios are quoted for Europe, U.S. and other regions [17-19]. Rigid information and process integration architectures, however, have failed to provide the capability to adequately respond to highly dynamic market requirements due to inherently rigid structures [20].

The third level suggests the emergence of virtual supply chains, i.e. the virtual networking of supply chain capabilities enabled by new technologies like the Internet. The activities are integrated and synchronised in real-time using open and closed platforms with associated standards. A range of vertical and horizontal e-marketplaces are examples of formalised virtual supply chain structures. These virtual supply chains promise new value creation and efficiency opportunities, but often fail to deliver the benefits due to complexities of contracting, coordination, and monitoring of agreements. Consequently, companies have now started to seek for new dynamically networked supply chain designs that allow for ad hoc coordination of capabilities across supply chain partners. Dell and Cisco are often quoted as examples that such designs are designs are feasible and illustrate the effectiveness of such models.

In interviews senior executives confirmed that the ability to dynamically network with business partners in the supply chain will be a key driver of profitability. Indeed, asked about the how revenue and profit attributable to the ability to dynamically work in networked supply chain relationships would change in the coming three years an overwhelming majority believed that it would increase.

I. 3 E-business Enabled Supply Chains

E-business can be loosely defined as a business process that uses the Internet or other electronic medium as a channel to complete business transactions. E-business has brought new opportunities and challenges to supply chain management [21]. The Internet, a global matrix of interconnected computer networks, is emblematic of the power of information flows, and intra- and inter-firm linkages in knowledge-intensive industrial development.

Firstly, the Internet has facilitated increased information sharing within and across company borders through use of enterprise resource planning (ERP). Other supply chain technologies have developed around the linkages of distributed systems. Traditionally information and geographically distributed applications were only available to internal users, or users of supply chain partners subscribed to a closed and relatively costly intra-net or value-added network (VAN).

As decentralised supply chain technology evolved information architectures were held together by systems such as electronic data interchange (EDI), electronic funds transfer (EFT), and more recently by internet based systems using extensible mark up language (XML) [2]. There has been a proliferation of technology platforms, using lighter-weight protocols for creating electronic bonds, such as e-

marketplaces (e.g., E-Steel) or hubs (e.g., Covisint), as well as tools for inter-enterprise integration (e.g., Webmethods).

Secondly, the ability to obtain real time information and access to large computer systems is enabling firms to optimise business processes across company boundaries, and make real-time decisions on a supply-chain level. The application architectures included internet based versions of ERP systems, best-of-breed applications connected through middleware, and advanced planning and optimization solutions (APS), all transcending traditional company boundaries.

Further, there are a number of industry and IT vendor-driven efforts to standardize business processes and data exchanges between enterprises, which are expected to yield network externality benefits in easing partnering across enterprises, as well as dealing with change in existing partnerships. Interoperability frameworks have been developed for vertical markets (such as the Information and Content Exchange and RosettaNet specifications) and horizontal markets (such as Microsoft BizTalk), but have not been widely deployed [22]. In this context the Internet has created opportunities to integrate information and decision making across different business organisations and functional units, thereby creating the possibility to build and scope the extended enterprise – a virtually integrated set of applications and processes permeating traditional company boundaries [23].

Lastly, technology integration remains a challenge. A number of organisations are trying to overcome integration challenges by focusing on the development of process and technology standards [24].

Extant studies suggest that, the greater the degree of coupling or integration between the information systems of trading parties, the greater the degree of coordination and collaboration that can be achieved [25]. This suggests that firms wishing to improve the performance of their supply chain operations should invest in establishing closely coupled links between themselves and their trading partners.

In the electronic environment, customer expectations have increased as to quick and timely delivery. At the same time, the Internet has opened up opportunities for firms to share information, and efficiently coordinate their activities with other entities in the supply chain. This has created alternate avenues in traditional supply chains for doing business. For example, in supplier selection and procurement, firms have to decide whether they should join private or public exchanges, or develop highly-integrated supply partnerships. They need to determine if they should use auction and bidding for contracts and, if so, which type would be most beneficial. In distribution, decisions need to be made whether the firm will offer products through the Internet channel and, if so, how this method would differ from the traditional channel. This raises the question of how the synergies would be realized in terms of inventory, transportation, and distribution. Similarly, the availability of real-time information has raised important questions such as the degree to which the information sharing protocol should

be standard or proprietary; the amount and type of information that should be shared with other supply chain partners; and the types of collaborative processes that may be beneficial. The degree of change in issues related to the supply chain spans a huge spectrum from concepts and issues that have been marginally affected, to a whole set of new issues that have emerged as a result of e-business [26].

These outcomes support the proposition that if relationships in the supply chain become more dynamic and, more importantly, contribute significantly to companies' results, then attention must be given to the prerequisites for integration and connectivity. The following paragraph discusses this notion in the context of eBusiness.

II. E-enabled Supply Chain Coordination Through Standards

II.1 Coordination Standards

Technical and process standards are a major enabler for ad hoc and efficient supply chain collaboration. Networked supply chains connect the players and their capabilities through robust information linkages. There are several factors that distinguish traditional supply chain relationships to the ones enabled by networks and technology. These factors include a reliance of supply chain partners on information infrastructures [27], the critical role of visibility and information transparency based on reliable data, and the high reach and richness of information that can be exchanged rapidly [13].

Unlike traditional supply chains where activities and transactions are tied to specific physical assets and locations, electronically enabled infrastructures are designed to replace physical exchanges by information, thus creating virtual business models [29]. Electronic information exchange allows firms to arrange commercial transactions that bypass significant portions of traditional business transaction costs typically incurred at various stages of value chain activities, such as delivering tangible products between buyers and suppliers, managing inbound logistics, and controlling distribution channels.

The possibilities of electronic coordination also help firms speed up traditional business transactions. Thus, in the virtual supply chain, information and information processing capabilities that increase efficiency and/or convenience in networked supply chain relationships requiring coordination, become a critical source of competitive advantage. These capabilities often become tools to reduce transaction costs [30-32].

The Internet can be used to establish direct contact over a widely dispersed set of customers. Dell Computer's well-documented direct marketing experience indicates how the clever use of an interactive electronic channel allows an industrial marketer to bypass traditional distributors. In this sense, the Internet and the emerging e-commerce solutions may rapidly change the power position between current distributors and marketers, and facilitate the appearance of

virtual firms that have externalized value activities such as product development, production, and logistics, customer creation, and customer portfolio management through databases. In addition, the standard aspects of these "virtual competencies" may very well be handled through supplier partnerships with competitive service providers.

The Internet allows for standardized transacting procedures shared by many partners, and an open architecture of connection known as the World Wide Web [33]. Internet procurement has emerged with the help of "orchestrated" markets called business-to-business (B2B) exchanges. B2B exchanges create an electronic marketplace with low-cost entry and standardized transactional procedures – e.g., the display of buyer's specifications, bidding procedures, market clearing, safeguarding, and so on. Interdependencies are pooled because the bidding process is impersonal and carried out by autonomous suppliers.

II.2 Information Exchange Standards

Standardization of process and content interfaces refers to explicit or implicit agreements on common specifications for information exchange formats, data repositories, and processing tasks at the interfaces between interacting supply chain partners.

Standardization of process and content interfaces would require business partners to agree on the syntax, semantics, and pragmatic aspects of documents that are to be exchanged for the specific process being coordinated. The lack of standardization means that exchanges are idiosyncratic to each relationship. For example, a distributor in the IT industry reports spending \$17 per SKU (stock keeping unit) by having to manually update information on the 100,000 SKUs it manages yearly, due to different reporting formats used by manufacturers. On the other hand, the use of standards, such as UCCnet standards for product data in the grocery industry, is expected to cut costs by as much as \$40 billion by providing a common business language [30].

Standards play an important role in structuring relationships between companies—they help reduce the extent to which market exchanges are personalized and the scope for unethical and opportunistic behaviour. Coordination theory suggests that standardization allows for management of interdependencies, making the infrastructure more flexible and capable of supporting change. The effect of standardization on partnering flexibility is expected to be positive, given that standardization creates network effects, reduces the variety of asset and informational specifications, provides for a wider set of users, increases frequency of transactions, and reduces market uncertainty. The effect of standardization of interfaces on offering flexibility is also expected to be positive, as it helps in the establishment of a technical grammar that reduces the amount of information that needs to be exchanged between enterprises, and enables social conventions to be established to facilitate coordination in the face of change [30].

Open technology standards, particularly the ones related

to the Internet, greatly reduce marginal transaction costs of information for additional users or products, resulting in network effects. The ROSETTANET consortium, for example, is a non-profit group of more than 400 companies in the information technology and electronics domain, which aims at standardizing the trading networks between these companies by providing standards for business documents (e.g. purchase orders), as well as so-called partner interface processes (PIPs), which define process interaction between trading partners (e.g. acknowledgement of receipt etc.) [34].

Standardised application of software and hardware has improved the visibility of activities performed in supply chains across organisational boundaries. In particular, the advent and proliferation of enterprise resource planning (ERP) software supported rapid process integration within, and later across, companies. Wal-Mart's RetailLink is a buyer-based Internet exchange which connects Wal-Mart with more than 2,000 suppliers. Sales, inventory, production schedules, and demand forecasts are shared through the exchange, which is a key enabler for helping Wal-Mart achieve its supply chain excellence. Another example is Taiwan Semiconductor Manufacturing Corporation (TSMC), which is one of the world's largest contract manufacturers for integrated circuits. Through its private exchange with its customers, TSMC shares forecasts, order management information, WIP updates, and engineering specifications, allowing it to reduce customer lead times while lowering its inventory carrying costs.

Information exchange is a characteristic of networked supply chains. Through connectivity critical participation within a supply chain can be enabled. Connectivity can be defined by how many supply chain partners a business can connect with, and how comprehensively information can be exchanged. Standards are a key prerequisite for achieving connectivity.

Messaging standards integrate corporate information across the supply chain through mechanisms such as EAI middleware, based on the existing infrastructure. While a number of interoperability issues remain, a consolidation of the number of standards is very likely. Approaches such as SOAP, ebXML, ROSETTANET and WSDL have found widespread acceptance, and form a complementing framework of XML standards for inter-organizational messaging applications [34]. The operational aspects of business-to-business interactions are quite well defined, and the generation of analytical data from the operational processes provides a standardized foundation.

EDI is one such messaging standard that involves computer-to-computer exchange of information between buyers and suppliers [29]. Early (or closed) EDI systems, which gained momentum especially in the 1990s, are associated with specifically negotiated codes and a proprietary, or closed, electronic architecture to transfer information. According to Holland et al. [29], early EDI systems are "used to encourage close trading relationships with a smaller number of suppliers." As such, early EDI systems involved investments by both parties in private

computer connections and training, implying a closed architecture of connection and agreements specifying information transfer codes [35]. Many authors document two main advantages of early EDI systems: a potential reduction of transaction costs, including procurement and monitoring expenses [35], and the optimization of production through information sharing [29], shortened lead times [36], inventory reduction, and increased product quality [32]. These sources of value are strongly associated with sequential interdependencies. Additionally, private communication systems are commonly implemented by a systems initiator (e.g., a buyer), "who deploys a proprietary [system] to expand the scope of hierarchical control" to a particular firm (e.g., a supplier), "which exercises the choice between accepting or rejecting" the new system [24]. This has clearly a flavour of plan-based coordination.

At a major router manufacturer, it was observed that specific inter-enterprise IT characteristics may hinder the ability to quickly link up with new partners:

"We are in the continuous process of evaluating who can best meet our needs. If a new third-party logistics provider becomes available, how can our company get up to speed to using them? In the past, the problem was predominantly defined by physical changes, such as location, system changes, and interface changes, which can take as much as six months. The current strategy for coordination with our partners, however, relies on hardwired APIs (application interfaces). When anything changes, they falter. We need to move toward more abstract specifications that will enable us to handle changes much better."

II. 3 Process Standards

Flexibility to build ad hoc relationships represents the ease of changing supply chain partners in response to changes in the business environment. Flexibility in terms of the ability to change partners quickly corresponds to an ability to work out how the new partner's capabilities can be quickly accessed and deployed. This can be done by a redesign of partner-linked processes and systems. In EDI implementations, it has been found that adoption requires substantial investment and integration effort, resulting in high switching costs and transaction specificity, which in turn undermines flexibility. On the other hand, open EDI systems increase market coordination by reducing asset specificity and by making additional partners available. Whereas information systems improve the efficiency of coordination between buyers and suppliers, managerial innovations—such as modular product designs, "quick-connect" interfaces, and use of IT to support concurrent processes and real-time acquisition of market information—significantly improve a firm's coordination flexibility.

In order to enable transparency and visibility in the supply chain, standards have emerged through advances in and proliferation of information and communication technology. Connectivity enables transparency, i.e. the ability to access relevant supply chain information. Transparency can be achieved through standardization of the

data, information and process models.

Connectivity reduces barriers and associated transaction costs for establishing supply chain linkages. In networked supply chains, the internet and open technology standards greatly reduce transaction costs of information. For instance, travel agencies which have the ability to quickly tap into a broader range of relevant information through suites of freely available and contracted online services (i.e. Gallileo and Amadeus, country and tourist information web sites and accommodation information), can serve more customers, provide greater selection, and more complete services.

Process standards create better information, increased visibility, knowledge and learning. Process standards across firms enable network capabilities. Firms can access the capabilities of another firm to perform logistics and supply chain activities like warehousing, scheduling and transportation. While this has usually been based on long-term contracts and service level agreements (outsourcing), shorter-term, interimistic arrangements are feasible.

The integration of standardised processes and information flows gives the principal firm control and visibility for managing an end-to-end process, even though the activities and the ownership of capabilities are decentralised. Research in Australia, Europe and the US confirm this trend [17-19].

The Supply Chain Operations Reference (SCOR) Model provided by the Supply Chain Council specifies inter-organizational business processes and their information flows [21, 37]. The SCOR Model contains measures for operational control and best practices of supply chain design, and is a reference model for structure, processes, and information flow within an inter-organizational supply chain [38]. As a result, the SCOR model needs to be extended with a framework for the adjustment of internal and external business processes, in order to align an existing process infrastructure with the inter-organizational processes that are the result of a SCOR approach [39].

Supply chain wide routines enable the development of information systems as the backbone of integrated supply chains [38]. Information technology is widely perceived as the enabler for supply chain integration [40]. Firms participating as partners in a supply chain have to provide their capabilities in a way that maximizes the supply chain efficiency and effectiveness by concentrating on their core competencies.

We posit that improvement in an enterprise's information processing capabilities with reference to a supply chain relationship will allow its supply chain linkages to better support reconfiguration of offerings and partnerships.

The above discussions are summarized in Figure 4, which depicts the main factors that influence e-connectivity and the outcome of e-connectivity in producing increased flexibility and supply chain coordination.

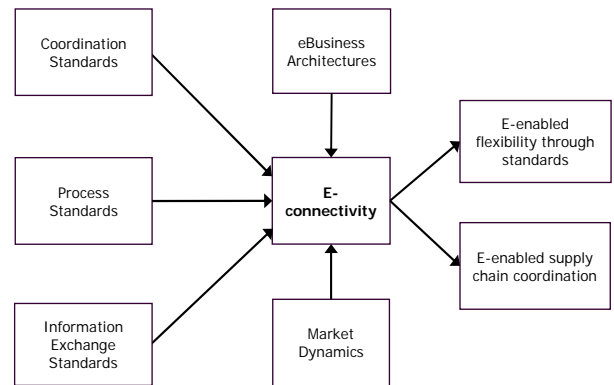


Figure 4: e-Connectivity in dynamically networked supply chains

III. Areas for further research

The paper has outlined the key concept for eConnectivity in supply chains. While this concept was validated through a literature review and expert interviews, an area for further research focuses on empirically validating the relationships between technology, process and management standards, and how they lead to improvements in connectivity and performance. This will subsequently provide additional insight for improved supply chain design.

IV. Conclusion

This paper has identified a number of drivers and enablers in an eBusiness context that supply chain partners can use to create quick and flexible linkages in their supply chains for leveraging their respective capabilities. The e-connectivity construct was introduced and examined, as it was established that information integration and resulting supply chain visibility is a key factor for quick decision-making in the supply chain.

Through a literature review and exploratory research with industry experts, the study concludes that technology is only but one key driver. Existing and further emerging technology standards enable companies to connect their operations systems easier and quicker. Standards supporting the establishment of information platforms, technology infrastructures, and process methodologies have become drivers that enable connectivity for eBusiness.

In order to achieve superior performance, our preliminary results suggest that processes and the mechanisms for coordinating capabilities need to be aligned within the capability technologies have to offer.

The findings further suggest that e-enabled supply chain infrastructures provide companies with faster and richer information, and hence allow supply chain partners to make appropriate decisions in highly dynamic market situations, allowing the entire supply chain to become both more adaptive and more proactive in capturing value opportunities.

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