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Managing Information Flows to Support E-Business Enabled Supply Networks

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The Internet has had a great impact on business and society all over the lobe, enabling more and more organisations to become networkedand share resources. Supply chain management is one of the areas that has reportedly benefited greatly, with optimisation being achieve through low cost, high efficiency of the Internet linking global supply chains almost seamlessly. This paper presents the need to consolidate and develop heoretical and practical frameworks to evaluate the impact of e-usiness on supply networks, concentrating on information flow evaluation to achieve increased efficiency. This field is still in itsacademic and ractical infancy, and we recommend future empirical research to develop a core theoretical foundation and advance the practical application of e-business in supply chain management. The main aims and objectives of this aper are to argue the case of standardisation of information flow in supply chains to facilitateintegration, legality, security and efficiency of operations.

Field of Research: Supply Chain Management

1. Introduction

The advent of the Internet and its commercial explosion over the past decade has had widespread implications for business and society. The Internet has already had a huge impact on business all over the globe as it has enabled more and more organisations to become networked and share resources. Supply chain management is one of the areas that has reportedly benefited greatly, with lean manufacturing and Just-In-Time being optimised by the low cost, high efficiency of the Internet to link global supply chains almost seamlessly. Handfield et al. (2002), see the transformation of supply chains into “integrated value systems” where competitive advantage in the new e-economy can only be achieved through the effective implementation and use of new technologies and strategic integration of these systems.

This paper outlines the need for consolidation and development of theoretical and practical frameworks to evaluate the impact of e-business on supply networks concentrating on information flow evaluation to achieve increased efficiency.

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This field is still in its academic and practical infancy, and while there has been some research done in the areas, this is mainly focused on individual case studies which tends to be myopic and leads to production of specific solutions that cannot be easily replicated. We argue that there is a need for more empirical research to be gathered to develop a core theoretical foundation and advance the practical application of ebusiness in supply chain management.

2. Literature Review

The rapid evolution and adoption of the Internet over the past decade has had serious implications on businesses. It has for example hastened the shortening of product lifecycles; facilitated mass customisation and globalisation of markets; increased further the pressure to reduce costs and increase revenues. At the turn of the century, Monczka et al. (2000) identified six critical areas which they believed would impact on the future of supply networks as a result of environmental factors in the 21st century. Included in the six was technology and ebusiness which would enable activities of different firms in the supply network to be co-ordinated; integration and consolidation of information and systems to deal with globalisation; and “network” management as the most effective way of managing the changes and increasing complexity of supply chain activities (Gadde and Hakkansson 2001). Kehoe and Boughton (1998) have identified the need for more research into the role of the Internet across the manufacturing supply chain and its impact on the planning and control operation (Kehoe and Boughton 2000). To date, there is still no consensus of opinion on what e-business is (Tassabehji, 2003).

In a study of supply chain management in the e-business era; CEO’s of organisations identified the urgency of becoming an e-business, but the research could not identify any consensus in what an e-business actually is. [Croom 2001; 2005] Three principal categories of e-business application have been identified as electronic marketplaces; inter and intra organisational systems facilitating the flow of goods and services, information communication and collaboration; and customer services (Phan, 2003). Integrated IT infrastructures enable firms to develop a higher-order capability of supply chain process integration. This capability “enables firms to unbundle information flows from physical flows, and to share information with their supply chain partners to create information-based approaches for superior demand planning, for the staging and movement of physical products, and for streamlining voluminous and complex financial work processes” (Rai et al. 2006: p 227). We are already beginning to see “e-business” being introduced into supply chain management – primarily as a collaborative use of Internet technology to enable integration of value and supply chains with key partners, by supporting business processes to improve speed, agility, real-time control, and customer satisfaction (Jelassi and Leenen 2003). This is done largely through the use of computer and communication networks to transfer information electronically. Porter (2001) argues

that the main advantages to an organisation is how e-business is deployed to benefit from the advantages of Internet technology, rather than whether it is deployed. Currently there is no universally accepted and widely implemented standardisation of technological architecture and applications across supply networks: for example the use of XML, middleware, Internet technology, the role of e-marketplaces and electronic auctions (Tassabehji et al. 2006; Wallace et al., 2006). If the technology is to be fully exploited, there is a need for standardisation and developing Internet enabled “common systems infrastructure” (Kehoe and Boughton 2001) to remove the problem of systems integration.There is consensus amongst academics and practitioners that the success of an ebusiness enabled supply chain depends on two major factors:

• collaboration between partners (Norris et al. 2000) and integration of supply chains through linking information systems (Cigolini et al. 2004; Zank andVokurka (2003) which is also seen as a major source of competitive advantage;

• information visibility (Kehoe and Boughton 1998; Garcia-Dastugue and Lambert 2003) including the ability to share accurate data and information from a wide range of operating areas across the supply network (Lancioni, et al. 2000).

Supply chains are currently in a state of flux, where they must be able to manage the complexity of stakeholders and flows of information and materials throughout, while still maintain their “leagile” optimised designs (Naylor et al. 1999). Croom (2001;2005) has suggested the existence of a staged evolutionary process in the adoption of supply chain strategies in relation to e-business systems, beginning with customer facing processes, followed by internal (operations) processes, supplier-facing processes and finally total chain integration. This vision is supported by other academics and practitioners (Hadfield et al. 2002; Poirer n.d.) who see the supply chain of the near future as a synchronised flow of materials and information through a fully networked virtual business. This incorporates all the companies in the supply chain where not only are internal processes linked with customers and suppliers, but the whole value chain would be networked end-to-end, managed through creating value, and all stakeholders are in a win-win position. Modularisation is another trend that supply chains are experiencing where there is “value shifting” as systems are being integrated into smaller subsystems that can function alone or as a part of the network (Doran 2003). Kehoe et al. (2001) suggest the need for a supply chain resource planning approach where Internet technologies will enable supply chain partners to dynamically view and manage both demand and capacity data to create supply webs. There is however little empirical research into the type and degree of integration that is taking place and how this can be measured in order to evaluate the impact on information flows and relationships between and within supply network partners.

One of the critical foundations of supply networks is information flows. This is even more critical in integrated networks where physical material supply chains are being replaced by a network of information servers distributed across organisations. Gadde et al. (2001) see the exchange of information playing a significant role in creating network efficiencies, where efficient information flows are pre-requisites for coordination of activities in a network and for the exchange of information needed for resource development. Not only efficient flows of information, but also “information enriched” supply chains where the information systems are carefully engineered to match the specific supply chain requirements. For example, in an information enriched supply chain, all stakeholders receive marketplace data directly increasing transparency, reducing distortion and avoiding double guessing. “Whereas information enriched concept is highly desirable in lean supply, it is obligatory in the achievement of agile supply. It is only when effective marketplace feedback is available that the next deliveries can be pulled from the supplier” (Mason-Jones et al. 2000: p.55).

The more accurate and timelier the information flow, the more responsive companies are to changes in demand (Wallace et al. 2006). Also direct knowledge of end demand through the supply chain is a way to reduce both inventory levels and the bullwhip effect (Ciglioni et al. 2004; Wallace et al. 2006) However an exploration of the information flows that link all the supply chain members – Tier 1,2, 3 suppliers as well as the manufacturer, customer and consumer/end-consumer – have not been fully researched and needs further investigation (Garcia-Dastugue and Lambert, 2003).

3. Discussion

So the main gaps in the research are a typology of e-business as it relates to supply networks, a deeper understanding of what integration is, its linkage with e-business and its impact on supply networks, and a wider examination of information flows through the supply network in order to classify information according to a set of criteria which will make it better support the needs and requirements of all the members in the supply network. An ideal test bed for this kind of research is the process industry. The process industry sector is extremely important and one that is estimated to grow at an average of around 4% per annum until 2010 (staff 2003) based on the projections of demand from process industry products and services worldwide. Pharmaceuticals is estimated to be the fasted growing process industry with the trend in highly industrialised countries towards more productive, more efficient, more flexible plants which increase availability and environmental sustainability but are less resource intensive. As such supply chain management and the Internet based tools that facilitate this management is a critical part of these strategies.

3.1 Towards a standardised approach to integrated supply chains: Recommendations

The issues identified above, can be divided into three major parts. These are not mutually exclusive and there is a strong degree of conceptual overlap where information for all three stages can be sought at one interaction with stakeholders.

Stage 1: *Develop a typology of e-business technology and applications infrastructure in support of information flow in supply chains*

Identify “e-business” technology and how it is used in the organisation’s business supply and value processes including the use of electronic marketplaces and electronic auctions. The information will then be analysed to develop a typology of “e-business” according to the technology and applications used within the supply chain. This can eventually be used as a benchmarking tool and bring standardisation to the area. Table 1 presents a taxonomy of pertinent hardware and software, and their application in an e-supply network that we posit should be standardised.

Hardware & Software Application in the Supply Chain/Network

Barcodes
Integration platform networks (such as XML)
RFID tags have antenna and chip containing an electronic product code that includes more information than a regular bar code (e.g. when and where the item was made, components source, time of expiry etc).
Wireless devices (e.g.PDA)
Neural Technology
Grid Technology
Security infrastructure (e.g. PKI)
Global Information Systems
E-mail
Workflow systems and tools (use set of software programmes that automate almost any information processing e.g. document management)
Groupware and other collaborative tools
(VOIP web conferencing)
Internet enabled EDI
ERP
Vendor Managed Inventory (VMI)
Collaborative Planning forecasting and replenishment (CPFR)
Advanced planning and scheduling (APS)
Adaptive Inventory Management

E-procurement:
requisitioning; sourcing;

contracting; ordering;
payment SC monitoring and control
(use of RFID)
Inventory management
(wireless devices to enter inventory item counts; XML infrastructure)
Collaborative planning
(sharing info via the net;
dynamic data exchange; B2B workflows across multiple enterprises over the net
E-logistics (spot buying of
trucking capacity (internet bas ed freight auctions)
Collaborative product development

Table 1. Standardising Hardware and Software in an E-supply Network

Stage 2: *Determine the degree of integration between supply network partners*

Determine the strategic level of integration of systems and information flows and how effective they are in terms of achieving supply chain objectives. Evaluation of integration would also be made at an operational level examining systems and network diagrams as well as access; control; and permissions listings.

Stage 3: *Examine information nodes across the supply network and identify criteria for classifying information flows*

It is widely acknowledged that managing the flow of information within and between organisations will lead to efficiencies in organisational processes (Krovi et al. 2003).The methodological approach to this part of the research is based on systems thinking, with a process flow analysis of information passing though the e-business enabled supply chain using flow charts. Within these charts will be the identification of information nodes where the value of the node (i.e. “the entity or group of entities capable of altering the properties of information flow” [Krovi et al. 2003: p.78]) is determined by the information content, the importance to decision making and the ebusiness infrastructure or technology infrastructure on which it relies. Some suggested information flow parameters include:

- velocity – the speed of information arriving at a node
- viscosity – the degree of conflict at the node where there might be contradictory information components (this can potentially cause the bullwhip effect in supply chains)
- volatility – uncertainty about the content, format or timing of information
- density – the number of intermediate nodes involved in the information processing channel

Each of the participants in the supply network has a large number of needs to a) request b) aggregate c) filter information from different and multiple sources. All these factors will be a starting point in the classification of information flows.Supply chains are no longer internal, but are multi-tiered, multi-echeloned with different configurations at each level with multiple players and multiple supply chains

– internal or external. Three specific tiers of supply chains can be identified (Van der Velde and Meijer 2003) namely internal supply chains; external supply chains and total supply chains. Information can similarly be structured into three major categories:

• Firstly macro-environmental information – factors that impact on the macroenvironment of the whole supply network – for example, political, legal, social, economic, technological factors

• Secondly meso-environmental information – industry specific factors – for example, new technological/or innovative developments in the industry, new competitors, industry or sector specific information

• Thirdly micro-environmental factors – factors that impact on the firm itself for example, internal systems, credit control policies, training and skills development

Part of the information classification process would also need to include identifying the type of information each supply network partner feels is necessary to supply chain management and then to classify that information according to its importance in achieving organisational objectives, decision making, progressing processes within the e-business enabled supply chain.

It is clear from current research in the literature that there are serious issues of trust and power in the use of e-business, particularly in the use of e-auctions and references therein and so issues of trust must also be included in the classification of information which will likely impact information flows. Partners in the supply network must also classify information according to the level of trust with partners they are prepared to share information.

The information gathered at this stage would be analysed to develop an information flow chart that clearly marks the source of the information, the type of information (internally generated/external report), its criticality, its speed of accumulation,relevance and importance to supply networks members, potential for conflicting sources of information, format and timing, sensitivity and willingness to share the information.

From this, a framework or series of frameworks can be developed to support the management of information flows across supply networks. This approach would be consistent with the “supply chain resource planning” suggested by Kehoe et al.(2001).

4. Conclusions

The main aims and objectives of this paper are to argue the case of standardisation of information flow in supply chains to facilitate integration, legality, security and efficiency of operations. We argue that this standardisation can be achieved by:

a) Consolidating the definition of e-business and develop a typology of technology and applications infrastructure to enable supply network partners to benchmark themselves against each other according to an explicit set of ebusiness criteria. This will enable closer standardisation and integration of systems throughout the supply network, which will facilitate further operational efficiencies.

b) Determining the degree of integration between and across supply network partners in order to evaluate the impact on information flows and efficiencies in the supply chain as a whole according to the degree and type of integration. By being able to classify integration of supply network partners, it will be easier to highlight bottlenecks and potential problems throughout the network.

c) Identifying information nodes across the supply network in order to examine and classify information flows that pass through them according to a number of criteria that will improve efficiency, leanness and agility of the network as a whole and reduce problems such as the bullwhip effect.

The information resulting from this approach can then be used in future research to model e-business enabled supply chains and optimise the impact of Internet technology and types of information flows to create robust, reliable, agile and lean value networks.

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