Supply-chain management across the Internet

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Abstract *The concepts of supply-chain design and management have come to the fore, owing to the ever-increasing complexity of the systems driving buyer-supplier relations in both industrial and consumer-based markets. The unprecedented levels of supply-chain management complexity are partly attributed to the Internet, through its more recent business acceptance and commercial use. Deals with new competitive challenges being realised from the unprecedented speed of growth of the Internet and building commercially-viable supply chains to meet the challenges faced by emerging virtual organisations.*

In industries where new business models rapidly supplant old ones, innovation must encompass more than incremental product line extensions and efficiency gains. The current international business environments require innovation across the entire business processes. Supply chains are a key factor in many business processes. They are typically modelled at three levels:

(1) strategic;

(2) tactical; and

(3) operational (Thomas and Griffin, 1996).

Industrial practice suggests that very few raw materials remain in the constant ownership of one "player" from their source, to the time they are sold to the end customer. Almost invariably, materials flow through a series of "players" whose role may be to transform (manufacturing plants), store (warehouses) or move (distributors) material (Berry and Towill, 1992). This refocusing of company roles in terms of end customer satisfaction is in line with a systems thinking approach to management (Parnaby, 1988). Recently the concepts of supply-chain design and management have come to the fore, due to the ever-increasing complexity of the systems driving buyer supplier relations. The Internet increases the richness of communications through greater interactivity between the firm and the customer (Watson *et al.*, 1998). This article is about new competitive challenges being realised from the unprecedented speed of growth of the Internet and the need to build commercially viable supply chains in order to meet the challenges faced by the emerging virtual enterprises.

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Developing supply-chain management on the Web

Good supply-chain management is essential for a successful company. Supply-chain management can reach beyond the boundaries of a single company to

share that information between suppliers, manufacturers, distributors, and retailers. This is where the Internet plays a central role. The ability to focus on one layer of the supply chain has enabled organisations, such as AOL and lastminute.com to be far more innovative. Shifts towards the development of a virtual supply-chain architecture focuses much more emphasis on the importance of knowledge and intellect in creating value. An adoption of an integrated approach throughout the supply chain requires a trade-off between autonomy and control to which the balance is unique, between each supply partner relationship.

Armstrong and Hagel (1996) maintain there is beginning to be an evolution in supply chain towards online business communities. General Electric (GE) in the USA is a pioneering company which is starting to realise benefits, by shifting from the physical to an electronic business community model. GE's trading process network (TPN) is an online business community that allows the company to transact about $1 billion worth of business with more than 1,400 suppliers scattered around the globe. TPN simplifies the previous time-consuming labour intensive contract bidding and award processes, which have previously characterised GE's relationship with its suppliers. The eventual goal is to push the service out to other firms and have GE's suppliers transacting similar business with their suppliers. There is emerging a multi-tiered business community with different vertical and horizontal interactions.

Electronic business communities can target new markets, by offering low entry costs, relatively minimal complexity with more flexibility and a convenient way in transacting business. The trend to outsourcing and strategic alliances in most industries provides an added impetus to support the sharing of supplier, customer, and corporate information, that was once proprietary with competitors and other cross-industry players. Businesses today are finding themselves in an environment in which unprecedented information sharing among all participants is driving fundamental changes in the interactions, business practices, and operations of everyone involved. One need only consider the recent collaboration between the "big three" auto makers in the USA, in launching the automotive network exchange (ANX) to further understand the impending effects of electronic business communities.

ANX will establish a standard method for parts suppliers to communicate with and obtain order information from the auto manufacturers. The potential result will be a lower cost structure for the entire auto industry in which all participants will benefit. At the same time, such benefits will greatly modify the competitive strategies and interactions among all participants.

Web-based relationships in the supply chain

The growth of Web-based electronic commerce has created a number of approaches to creating a model of how it impacts on business. Figure 1 illustrates the array of potential relationships in the supply chain.

Multiple interactions can be seen from three company perspectives:

(1) business-to-business (b^2b);

(2) business-to-consumer (b^2c); and

(3) marketspace (M).

Business partners and customers connect together through the Internet to participate in commercial trading and participate in communications and interaction. Each of these areas has a set of strategic activities and issues. Opportunities for creating value occur at each of the boundaries. Some are better defined and more porous than others. "Business-to-consumer" encompasses all interactions between the customer and firm:

- product ordering;
- sharing product information;
- creating display space;
- defining customer information;
- co-developing products; and
- providing customer service.

Federal Express (http://www.fedes.com) and UPS (http://www.ups.com) offer product tracking information to customers.

The "business-to-business" space includes the myriad upstream and downstream transactions that can enhance channel co-ordination and customer relationships. JC Penny (www.jcpenny.com) shares packing, shipping, inventory and product movement with suppliers. Philips Petroleum (www.phillipsbb.com) shares product movement trends and forecasts with pipeline partners. In this case, the "marketspace" involves the company, its partners, and its customers and provides the opportunities for

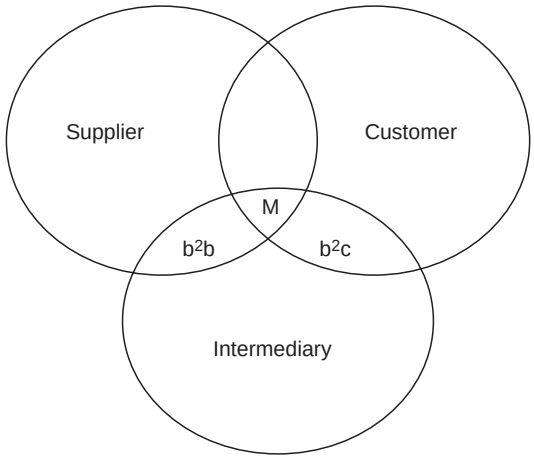

Figure 1.
Web-based commerce model with key relationships (b^2b, business-to-business; b^2c, business-to-consumer; M, marketspace)

developing communication interactions, including customer surveys and information exchange on such things as product warranty and service capabilities.

The Web enables all suppliers in a supply chain to identify and co-ordinate data transfers with each other. Research laboratories, pharmaceutical distributors and end-users, for example, can all swap information on new product developments, specific diseases, and treatments within these settings.

It is proposed that, with marketspace reconfiguring the traditional value proposition, supply-chain management needs to manage the organisational complexity of adopting a dynamic mix and emphasis between content, context and infrastructure. This ability to focus at one layer of value creation (Rayport and Sviokla, 1994) has enabled organisations, such as AOL and lastminute.com, to be far more innovative. Shifts towards virtual organisational architecture focuses on the importance of knowledge and intellect in creating value. Venkatraman and Henderson (1998) identified three interdependent vectors – virtual encounter, virtual sourcing, and virtual expertise – as integral to realising the virtual organisational structure. By the creation of organisational integration mechanisms on the Internet such as discussion groups, Web forums and video conferencing, virtual multi-functional teams become enablers of the three independent vectors. The process of innovation, with the adoption of an integrated approach throughout the supply chain, requires a trade-off between autonomy and control, of which the balance decided upon is unique to partner relationships. The organisational challenge of reaching an acceptable balance between autonomy and control is probably best achieved by the idea of subtle control (Shrivastava and Souder, 1987).

The "players" must have access to a wide range of external technological services, such as the Internet and other complementary online networks, in order to operate effectively. They must have access to electronic capabilities using fibre optics, high-speed digital switches, satellite downlinks and compatible EDI ensuring reliable, efficient information flows among suppliers, manufacturers, and distributors while protecting proprietary data. Shared resources, such as harmonised electronic transfer across transportation modes and onsite education and training facilities, will also help companies improve their supply-chain management in the emerging marketspace. Even small and medium-sized enterprises increasingly now rely on international networks of suppliers, distributors, and customers, frequently via the Internet, to improve their global competitiveness through reducing fixed and operating costs and overall competitive position.

Individualisation of both product and process driven innovation requires high levels of organisational integration in being able to respond to market demands. Integration along the supply chain in the virtual market can be viewed as being a mix of both formal and loose integration mechanisms, similar to the Internet infrastructure. A common theme, which is identified as important to organisations in the development of creativity and innovation, is the relevance of both technological and organisational integration. The "virtual

organising grid" (see Figure 2) encompasses organisational integration in a broad sense, that covers a wide range of issues in enabling organisations to be both responsive and adaptable through improved communications.

The dynamics of individualisation of product and service offering in relation to both technological and organisational integration is clearly reaching new levels of complexity on the information superhighway. Hence we have focused our attention on ascertaining the implications of adopting an integrated approach to e-business, in the context of individualisation of products and services (Figure 2). E-business is defined to include organisations operating solely in marketspace and also those with a mix between the traditional marketplace and marketspace. Each of the four quadrants in the virtual organising grid (Figure 2) provides a useful framework for identifying business activities and avenues for future development.

The "portal/utility" quadrant represents what are becoming essential gateways and fundamental utilities for the wider world of cyberspace. Portals such as Netcentre, Lastminute, Yahoo and AOL all provide essential routes to the Internet for what are viewed as growing communities (Platt, 1998). The portals attempt to demystify and smooth the communications channels through the Internet by providing guides and essential sites of importance and relevance. As portals develop, their success will clearly be reliant on being able to provide a customised service to end-users. They are developing what may be termed virtual communities or specialist information sources. We believe portals currently provide relatively low individualisation of output and buyer-supplier integration. Portals are highly successful through the ability to offer fast, customised, up to date information across the Internet to the consumer. Future developments on the Internet will require in particular higher level of creativity for the consumer with flexible but loose integration. Customers of

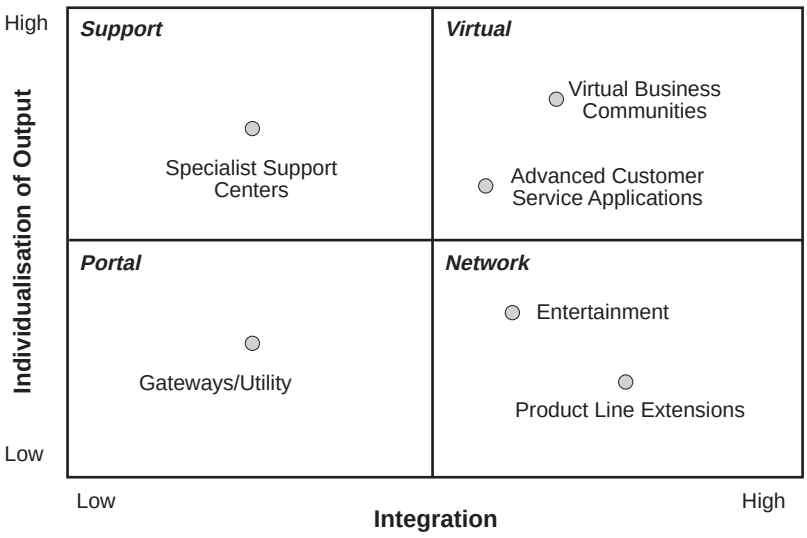

Figure 2.
The virtual organising grid

DHL can now access the DHL global Web page (http://dhl.com) and locate their freight, book a package to be picked up, calculate freight costs, and check delivery times, just to name a few. The global Web site allows customers to open an account, track international and domestic shipments, calculate freight costs, the projected time of delivery and print out forms such as customs declarations. International customers have hotlinks to the DHL Web site so that they can track their purchases. The Web has been fundamental to DHL for developing new supply chain forms through far faster communication on the Internet.

The "support" quadrant represents specialist support centres that offer value added information to the consumer but with relatively limited buyer supplier integration that is reflected in a lack of customisation of the service or product offering. Specialist support centres include technical support information from organisations, such as IBM in the computer industry, on products and services. Many consultancy services and academic institutions also tend to fall into the "support" quadrant, offering highly creative and leading edge knowledge but generally limited focus on the end customer resulting in limited buyer-supplier organisational integration. Specialist support services are typical of Internet-based information sources which are characterised as being dynamic in nature, but often of limited commercial concern, and as a consequence are a fluid and evolving communications channel. Physicians provide the emergence of specialist support services with the more recent establishment of a Web presence. In a survey, which included 86 members of a north-east chapter of the American Medical Association, roughly 35 per cent of the respondents either have a Web site already or were planning to establish one within the next 12 months. The sites established by the physicians were all corporation information sites and were mainly used as a competitive tool. Eder and Darter (1998) asserted that it is interesting to note that intangible services such as doctor's appointments, which may not be the most appropriate service to be transferred to an electronic channel, nevertheless are increasing on the Internet. Moreover, physicians are mainly micro businesses.

The "network" quadrant identifies limited innovation but highly integrated organisations through the supply chain. Organisations in the "network" quadrant include many manufacturing businesses adopting the Internet as an essential communications channel – supporting supply-chain management activities – including the control of the flow of goods. Volkswagen, in particular, with the launch of the "revamped" Beetle is viewed as an exemplar of the Network quadrant, utilising the Internet as an integral tool in developing superior buyer-supplier relations. Through providing an interactive and dynamic environment for existing and potential customers, many organisations and individuals regularly express their views and provide feedback on product innovation initiatives. Network organisations appreciate the flexibility and cost-effectiveness of the Internet as a fundamental communications channel. An examination of Virgin Records' Web site (http://

virgin.com) illustrates the use of a network that is using information to create value. The traditional product of a major record label such as Virgin is a package of pre-recorded music captured on a compact disc or audiocassette. The product is the end point of a set of value-adding processes that occur in the physical world. These processes include discovering new musicians, screening them for potential marketability, recording their work in the studio, editing and selecting their music, creating master tapes, producing CDs or cassettes, and finally packaging, promoting and distributing the products. The company has a site on the World Wide Web devoted to the label's bands and uses it to distribute digital audio and video samples and to provide information about the bands' tours. The Web page has become Virgin's showroom in marketspace and a potential new retail channel. In addition to using its own Web page, Virgin could search for new talent at Stargig.com's Web site rather than audition bands in a studio, or edit and modify music on a computer. Each activity is a stage in a virtual value network that occurs through and with information and mirrors a stage in the physical world.

The emergence of virtual business organisations is for many being driven, by the speed of Internet developments, in terms of bandwidth and commercial acceptance (Venkatraman and Henderson, 1998). The "virtual" quadrant represents many leading organisations that have clearly grasped the Internet as being central to commercial activities. For organisations to operate in what we have termed the "virtual" quadrant, high levels of creativity and individualisation of output are required along with an integrated perspective. Increased flexibility is being offered in the financial services sector (the Royal Bank of Scotland (RBS)). RBS offers an Internet-based banking service that clearly increases both the levels of flexibility and also integration with its consumers. Highly innovative organisations integrated through the supply chain in marketspace offer the potential for far greater levels of responsiveness than are traditionally accepted in marketspace (Rayport and Sviokla, 1994). The Web's primary importance, from a manufacturing point of view, is that it provides a common visual interface for connecting to a computer network. A growing number of companies are embracing these standard browsers and protocols to be the way for sites in different organisations to communicate. This broad acceptance makes it an immensely powerful tool for inter-company transactions. Advanced customer service transactions on the Internet already can help buyers of electronic components find what they are looking for on the Web (see http://centralres.com) or match buyers and sellers from more than 26,000 companies in the textile industry (http://www.apparalex.com).

Integrated approach to the physical and virtual supply chain

In the development of a sustainable Internet presence, through commercial trade, the adoption of non-linear innovation across the whole of an organisation's business processes is seen to be a fundamental criterion. Marketspace transactions along the supply chain require a thorough

understanding of virtual markets in terms of customer interaction, organisational integration across the supply chain, and leveraging diverse sources of expertise (Venkatraman and Henderson, 1998).

Integration is the essence of the deployment of a flexible and concurrent approach towards innovation (Zhang and Zhang, 1995). Lawrence and Lorsch (1967) defined integration in terms of achieving "unity of effort" in various organisational subsystems. Excellence of teams, as a valued integration mechanism, is viewed as being developed through empowerment, staffing, leadership, organisation, measurement, self-management, motivation, and leveraging success (Zhang and Zhang, 1995). Integration therefore refers to the strategic and operational linking of business processes across functionally specialised groups while preserving their individual orientations. Through the continued development of the Internet this process is continually becoming more fluid and responsive through changes in the traditional marketplace and unprecedented growth of marketspace. The Internet, through the continual development of open system standards, has provided a flexible approach to technological development and as a consequence created a shift towards more dynamic communication and improved integration.

A key integration mechanism is via dynamic information. Information flows affect a firm's ability to integrate value-adding operations and improve innovativeness. Indeed exchange of information frequently precedes physical movement of materials and products, thus enabling firms to reduce inventories and utilise resources most effectively. Weiber and Kollman (1998) consider the new emerging virtual value chain and the changing role of information (see Figure 3). The digital age has seen information functioning as a unique source of competitive advantage. Now virtual supply-chain activities in marketspace can operate completely independent of the physical value chain. The model in Figure 3 illustrates the blurring of boundaries between virtual and physical markets.

Through the unprecedented speed of growth of the Internet a common value matrix is now emerging representing the interrelations between physical (marketplace) and virtual (marketspace). The common value matrix (see Figure 3) indicates the changing nature of product and service offerings that represent a significant shift in value creation throughout the supply chain with an emphasis on information as the primary resource. The virtual value chain identifies the changing nature of value creation, but just as importantly indicates how new products and services are emerging through the information driven economy.

The emerging value matrix through virtual markets places Internet technology as a driver of sustaining commercial success. A responsive integrated organisation is essential in enabling effective Internet technology implementation. The commercial acceptance of the Internet is clearly based on internationally recognised networking standards, but just as importantly we need to evaluate the role of emerging cyberspace business communities.

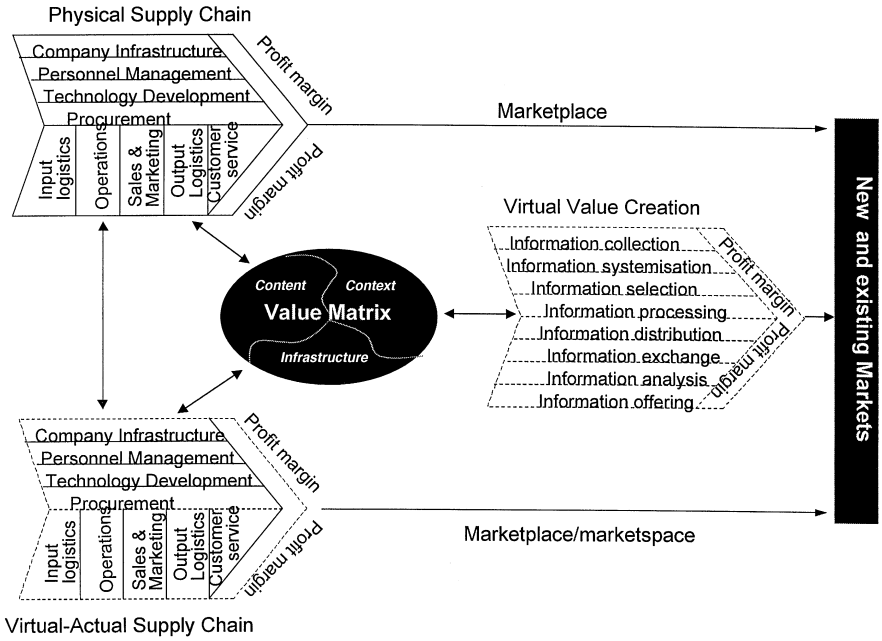

Figure 3.
The road through the physical to the virtual supply chain

Clearly, the more subtle integration mechanisms (organisational structure, task orientation and organisational culture) are fundamental drivers in the pursuit of non-linear forms of both product and process innovation on the Internet.

Conclusion

The Internet, as a means of virtual organising, has become a central part of a commercial drive towards systemic innovation and the re-evaluation by many of value creation. A major shift in the communications between business organisations is taking place, which is actually redefining organisations and commercial transactions. The Internet has become a key element in moulding and propelling business into new directions in the traditional marketplace and emerging marketspace. Successful organisations in particular on the Internet are showing unprecedented levels of integration across the supply chain in the pursuit of both process and product innovation.

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