

# The Impact of Web-Based Technologies on Supply Chain Management

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**Supply chain management is significantly affected by the explosive growth of e-commerce. While the impact of the Internet on coordination has been positive, some reservations remain regarding its impact on design.**

## Supply Chain Management

A supply chain supports three types of flows that require careful planning and close coordination. It is supported by three pillars:

- Processes, which encompass such value-adding activities as logistics, new product development, and knowledge management
- Organizational structures, which encompass a range of relationships and performance measurement and reward schemes
- Enabling technologies, which encompass both process and information technologies

Supply chains perform two principal functions: the physical function of transformation, storage, and transportation; and the market mediation function of matching demand and supply.<sup>1</sup> Innovative approaches have recently been emerging to the market mediation function.

Supply chain coordination is concerned with the coordination of the three types of flow over the network. Effective coordination strategies combine a range of approaches for supply chain transparency through information sharing (e.g., sharing point-of-sales data with the manufacturer) and information deployment (e.g., vendor-managed inventories, efficient consumer response, and collaborative planning, forecasting and replenishment) as well as for operational flexibility (e.g., assemble-to-order and make-to-order systems) to react to timely information.

Supply chain design should be viewed as

the capability to design and assemble assets, organizations, skill sets, and competencies for a series of competitive advantages, rather than a set of activities held together by low transaction costs.<sup>2</sup> This dynamic view is necessary in a fast-evolving world where new products and emerging distribution channels necessitate a continuous review of supply chain design decisions. Just as product design has an enormous impact on manufacturing performance, superior supply chain design offers significant payoffs in supply chain performance.

Three-dimensional concurrent engineering (3D-CE) is a framework for dynamic supply chain design<sup>3</sup> which encourages the concurrent design of products, processes and supply chains, and explicitly considers the interfaces among these three dimensions (Figure 1).

The product/supply chain interface has recently been highlighted through the market mediation role of the supply chains. A “functional product,” e.g., a tube of toothpaste, with a stable demand pattern but thin margins would necessitate a cost-efficient supply chain, while an “innovative product,” e.g., a ski parka, with a highly unstable demand pattern but attractive margins would require a responsive supply chain.

The process/supply chain interface is concerned with make-versus-buy decisions. One should determine whether outsourcing decisions are driven by a shortage of manufacturing capacity or a lack of manufacturing capability. The former is common practice in high-speed industries (e.g., electronics, toys, fashion products), where process technology changes rapidly, rendering existing production facilities obsolete.

## Supply Chain Coordination

The bullwhip phenomenon – the amplification in demand volatility as one moves upstream from the market – is the key challenge in supply chain coordination.<sup>4</sup> It is driven by delayed and distorted information as well as by transaction costs promoting local optimization.

Figure 2 depicts three dimensions of electronic connectivity.<sup>5</sup> Traditional technologies, like EDI and groupware, always entail a trade-off: improvements in one dimension come at the expense of further complications in at least one of the other two dimensions. The Internet and the Web-based technologies provide a real opportunity to eliminate this trade-off. TCP/IP provides a universal communication standard for connecting diverse computer systems over the Internet that significantly reduces up-front investment. Low entry and exit costs make the Internet and Web-based applications affordable at any stage of a buyer-supplier relationship. Web-based technologies also provide a full portfolio of functionality ranging from simple information transmission to telepresence. Browser-based interfaces and

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application development software make it easy even for the uninitiated to start using the system quickly, further reducing the lowest common denominator of IT sophistication among the supply chain entities.

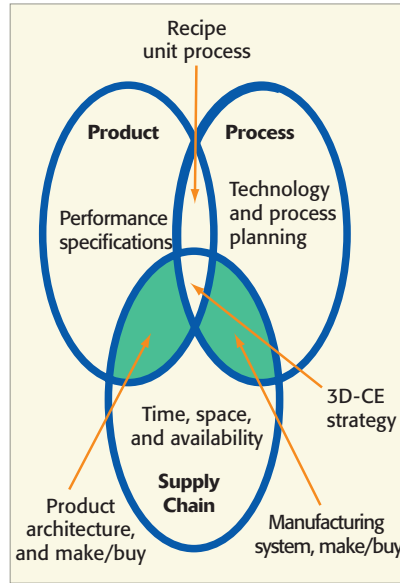
In short, the wider acceptance of open standards, cheap and powerful computing, increased bandwidth, enhanced security, accumulated expertise, and higher familiarity with the technology are bound to increase the utility of Web-based technologies in supply chain coordination. With increased connectivity, the Web provides a practically free platform for enhancing transparency, eliminating information delays and distortions, and reducing transaction costs, ultimately mitigating the bullwhip phenomenon.

**Supply Chain Design**

While Web-based technologies make it feasible and easy to operate at any point within the cube (Figure 2), for a specific manufacturer, the selection of that point, i.e., the design of supply chain relationships, is not necessarily facilitated by these technologies. The impact of Web-based technologies is less convincing within 3D-CE for supply chain design. We focus on product-supply chain and process-supply chain interfaces in 3D-CE, where the principal decision is what to produce in-house and what to outsource.

The Web poses a dilemma. Most manufacturers spent the past two decades establishing close relationships with a smaller number of suppliers under various initiatives, such as strategic sourcing and supply base rationalization. On the other hand, e-procurement signals a dramatic shift towards an arm's length relationship based solely on cost reduction. To analyze the dilemma, we classify the items purchased by a manufacturer in two broad categories: manufacturing inputs and operating inputs, usually referred to as MRO (maintenance, repair, and operations).

MRO hubs, which may bring a large number of vendors, constitute an example where the Internet is ideally suited for eliminating the inefficiencies of the current channel by reducing transaction costs, integrating lower-tier suppliers, eliminating the duplication of data entry, and expanding the prod-



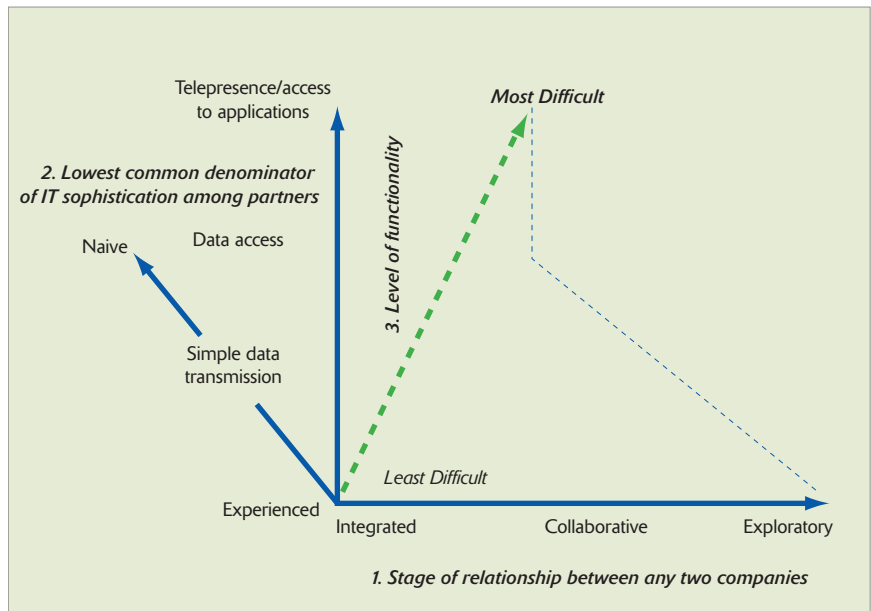
**Figure 1** | Fine's Three-Dimensional Concurrent Engineering Framework

systematic sourcing.

Web-based technologies have provided an infrastructure that enables better matching of supply and demand by offering manufacturers a larger choice of suppliers, and offers suppliers increased access to manufacturers. Both types of players can substantially increase their reach.

**Higher Reach and Higher Richness?**

Richness refers to the quality of information – accuracy, content, currency, customization, interactivity, relevance, security, etc. Reach simply refers to the number of people sharing that information.<sup>4</sup> A 30-second TV commercial may have great reach during prime time, but low richness due to the difficulty of broadcasting customized information during such a short period. A catalog or prospectus, on the other hand, is capable of



**Figure 2** | Upton and McAfee's Framework for Electronic Connectivity

uct portfolio. For manufacturing inputs, catalog hubs, (meta-catalogs), offer the possibility of bringing together a virtually unlimited number of offers from different suppliers all over the world. Such an infrastructure would greatly reduce the search cost for the buyer. For the supplier – in particular, for the small supplier – the platform offers unparalleled access to potential markets. This is the first step in

transmitting rich, customized information; it will, however, reach a much smaller pool of people. The Internet appears to mitigate this trade-off in certain domains. For example, Dell OnLine provides greater reach than a call center, while affording considerable richness for key corporate customers through "Premier Pages," which are customized Web-based interfaces between Dell and its key corporate customers.

However, manufacturing inputs, unlike MRO procurements, are industry specific, where longer-term contracts are negotiated with specific suppliers. Web-based technologies do indeed provide extended reach into a wide pool of potential suppliers, but the richness of the information on the suppliers' process and logistics capabilities provided by current Web technology may not always be adequate.

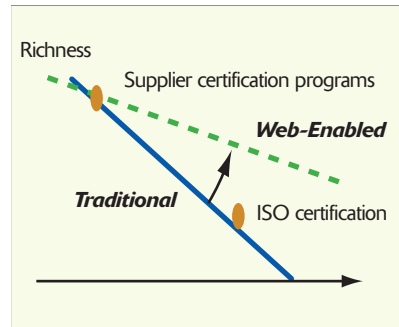
Our hesitation concerns the upstream stages of the procurement process. While market makers such as FreeMarkets, Ariba, and CommerceOne provide valuable support for request-for-information or request-for-quote preparation, supplier performance evaluation, and contract management, the crucial activity of supplier identification and certification is still affected by the richness/reach trade-off.<sup>5</sup>

Many manufacturers, particularly those in the automotive and aerospace industries, launched their own certification processes to ensure critical process capability at potential suppliers. While these supplier certification programs possess the desired depth or richness, they have limited reach due to their intensive resource requirements.

While Web-based technologies greatly increase the reach, it is not evident whether they are currently providing the necessary richness for effective supplier selection. It therefore comes as no surprise that 87 percent of Internet purchases are for indirect products, 61 percent for services, 52 percent for maintenance and repair items, and only 35 percent for direct products.<sup>6</sup> We observe two approaches to mitigate this trade-off. The market-making process championed by FreeMarkets relies heavily on preliminary fieldwork of identifying, assessing, and certifying suppliers prior to inviting them to join the bidding process. Hence, market makers are assuming the

role of the certifying bodies in the supplier selection process (or navigators in the supply space) with the same credibility challenge faced by previous certifying bodies (e.g., ISO 9000 certification).

A second approach is the creation of vertical markets (or exchanges) managed by industry-specific professionals. In fact, most such markets follow an "admission process" for potential members during



**Figure 3** Reach versus richness trade-off in supplier certification.

which the applicant's process capabilities are assessed prior to admission. Alternatively, incumbents opening a Web-based channel do not face such a credibility challenge. For example, while ChemConnect brings together a large number of manufacturers in the chemical sector, Chemsinglesource.com launched by Solvay offers not only the commodity products but also the specialty chemicals and the engineering services offered by the company. Hence, unlike the initial claims, brand name has become even more important in B2B e-commerce, as a supplier's reputation represents a surrogate measure of its capabilities.

The challenge for incumbents is the scalability of such a channel (or reach) and the logistics infrastructure needed to support the virtual channel. Collaboration

among industry incumbents, software vendors, and computing and communication hardware providers indicate that a solution to mitigate this trade-off should emerge soon [e.g., Covisint (automotive), GNX and Transora (retail), and myAircraft.com (aerospace)].

## Conclusion

Web-based technologies are having a significant impact on supply chain strategies. On the coordination side, the Web provides a practically free platform for enhancing transparency, eliminating information delays and distortions, and significantly reducing transaction costs. As a result, the Web makes it easier to mitigate the bullwhip phenomenon.

On the design side, current technology does not yet permit the mitigation of the trade-off between richness and reach in the crucial area of supplier identification, certification, and selection. Given the rate of technology development, however, effective solutions may well be imminent. ■

## Footnotes

- <sup>1</sup> Fisher, M., "What is the Right Supply Chain for your Product?" *Harvard Business Review*, March-April, 1997, 105-116.
- <sup>2</sup> Fine, C.H., *Clockspeed: Winning Industry Control in the Age of Temporary Advantage*. Perseus Books, 1998.
- <sup>3</sup> Fine, C.H., "Clockspeed-Based Strategies for Supply Chain Design." *Production and Operations Management*, 9.3, 2000, 213-221.
- <sup>4</sup> Lee, H, P. Padmanabhan, and S. Whang. "The Bullwhip Effect in Supply Chains." *Sloan Management Review*, Spring, 1997, 93-102.
- <sup>5</sup> Upton, D.M. and A. McAfee. "The Real Virtual Factory." *Harvard Business Review*, July-August, 1996, 123-133.
- <sup>6</sup> Goldman Sachs Investment Research. "B2B: 2B or Not 2B: The Second Survey." 2000 *New York*