The Impact and Opportunities of Information Technology
In Textile Business

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Abstract: The trajectory of development of Information technology has intersected every application in textile industry. From enhancing performance of textile manufacturing and tighter process control, IT has inserted intelligence at every node of textile supply chain. The shifting face of world-market, induced by increasing corporate merger, acquisition on one hand, and the changing socio-economical landscape have further integrated IT into every part of textile supply chain.

Key Words:
Supply Chain, Logistics, E commerce, Bullwhip effect, Internet, Information technology.

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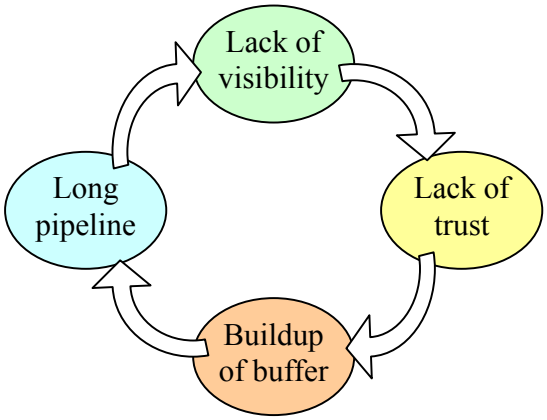
Development of market-induced competition compels textile organizations to leverage technological power to greater extent. Tremendous growth of productivity of various manufacturing machineries on one hand, and intensification of domestic and international competition on the other has stimulated increasing applications of diverse information technology. From enhancing performance of machineries to improving quality of coordination, information technology has played a cardinal role in adding value to textile business.
Textile firms recognize that appropriate information architectures are vital to the strength and competitiveness of their businesses. A survey conducted by Kurt Salmon Associates indicates that Information Technology spending as a percent of sales in the textile & apparel industry is gradually increasing (1). Another survey by IBM and the Textile Institute (UK) indicates that information technology is the key to improving competitiveness through improved decision-making, quality, speed, flexibility and customer service in textile industry (2).



Key Drivers for IT-development in Textile Industry:

Various deficiencies in textile supply chain call for the effective implementation of IT.
Risk spiral: Most of the time, there is a lack of accurate information related to demand and supply in textile supply chain (**fig-1**). This results into building up mistrust all across the supply chain, as every function tries to

protect its own interests by overestimating the effect of demand or supply variability. This leads into excessive inventory (Bullwhip effect) build up at various supply nods. Consequently, this excessive inventory instigates long cycle-time, poor sale, low fill rates and further reduces order visibility. Inadequate information infrastructure leading to no information and delay in getting information triggers this "spiral of uncertainty", which adversely impacts business performance.

Fig-1: Risk Spiral.

Long procurement time: The traditional procurement process of a textile retailer takes between 7 to 9 months, in some cases even eleven months. The biggest problem faced by any textile retailer is to identify consumption trends seven to eleven months prior to actual consumption. Lack of transparency and slow propagation of demand-data entail early stock-outs.

Supply chain inefficiencies: Apparel and textiles account for world trade of over US$300 Billion annually, out of which, cross border trade in apparel alone stands at about US$200 billion. From concept design to retail presentation of the finished garment, the time taken can go up to 12-14 months. Garment production actually accounts for just 5%-20% of that time, the balance "extra" caused by the multiplicity of processes, allowances in elapsed time at various stages and also lack of transparency in the supply chain (3).

Growth in Information Technology (IT): IT growth is brought about by the convergence of three key elements: innovative soft wares, affordable hard wares and high-speed global communication networks. Various application soft wares like mySAP.com, Baan supply chain solution (SCS), i2, SAP advanced planning optimizer (APO) and others offer useful solution to enhance performance of textile supply chain. Development in hardware is possible through creation of relational database, client/server architecture, TCP/IP networks protocols, multimedia, wireless technology, Internet. The scope and extent of Internet usages can be found out by the fact that, 60% of large sized and 30% of medium sized companies worldwide use Internet in marketing and other business related transactions during 2002 (4, 5).

Global migration: Textile and clothing supply chain is currently expanding globally, with many companies either sourcing components from overseas, or moving manufacturing base to countries with lower labour costs. This global-migration necessitates managing every kind of information efficiently and at much faster speed.

All above factors initiate increasing interface of Information Technology with every link of textile supply chain to make business more efficient, responsive and transparent.

Interaction of IT with textile supply chain:

The key impact areas of IT and the resulting opportunities in textile supply chain are discussed along with relevant case studies in the following sections. As shown, the impact of IT on textile supply chain can be mapped into four major phases- Information integration, Planning synchronization, Workflow coordination and new Business models.

Information integration:

Information integration refers to the sharing of information among members of the supply chain. This includes any type of information that could influence the actions and performance of other members of the supply chain. Demand data, inventory status, capacity plans, production schedules, promotion plans, electronic funds transfers (EFT) for payments, status reports and shipment schedules are some of the data that usually get transmitted through this mode.

Bar coding and Electronic data interchange (EDI) are the major information technology contributing in this phase. Bar coding permits detailed recording of business data in electronic form. In turn, this data is transmitted electronically from computer to computer between organizations, in a standardized format through EDI system. Data communicated this way subsequently are counted, tracked, analyzed,

and applied by computers to convert into meaningful information for decisions. EDI specifically replaces more traditional transmission of documents, such as mail, telephone and even fax. Rapid communication possible through EDI reduces order cycle variability, one of the major causes of increases in inventory in the supply chain.
Nygård International, a global apparel manufacturer based in US, with sales in excess of $300 million, manages its supplies from fabric suppliers to retailer using EDI based links activated throughout its network. This EDI-based network helps the company to maintain closure relations and quick response in a global, variable demand and supply environment with its suppliers and customers, who are geographically dispersed from US, Korea, Japan, Europe and Indonesia. The company records inventory-data in electronic form through bar coding and transmit these 'digitized information' across its global network through EDI (8).
Another example of information integration is linking design related information with supplier through Internet linkages. Standardization of software tools and the rapidly decreasing costs of servers enable the smaller manufacturer and retailer to share new designs developed through CAD/CAM packages with the fabric manufacturers located in another continent. Full suites of product design and manufacturing information can be transmitted down the Internet to a remote factory for manufacturing to take place (9**).**

Planning synchronization:

Planning synchronization refers to the joint design and execution of plans for product introduction, forecasting and replenishment. In essence, planning synchronization defines *what* is to be done with the information that is shared by the previous phase. By mutually agreeing, members in a supply chain have their order fulfillment plans coordinated through this phase of IT, so that efficient replenishments are possible to meet the demand of ultimate customer.
Within organization, various software tools like MRP, MRP-II, APSS, MES facilitate harmonization of planning between different functional silos (10). Development of synergistic and well-coordinated ERP systems results in redefining the roles and changes in quality of information sharing. Material Requirement Planning (MRP) is the first generation MRP system started using computer databases to store lead times and order quantity. It applies logic to implement Bill Of Material (BOM) explosions to help in mapping of orders across time-phased priorities in a discrete manufacturing environment.
As a logical extension of MRP system, Manufacturing Resource Planning (MRP II) system is evolved to cover the entire manufacturing function. This typically includes machine loading and scheduling in addition to material requirement planning. It provides the mechanism to evaluate the feasibility of a production schedule under a given set of constraints.
Due to organized databases, computational logic with high processing power of computers, MRP and MRP-II are fairly successful and provide visibility into areas previously hidden. But the development of multipoint-manufacturing, final assembly activities and packaging, vast material distribution requirements in a variable global environment necessitate separate systems such as Distribution Requirement Planning (DRP). Also textile manufacturers need a system that can simultaneously solve both capacity and material constraints and quickly propagate the effects of problems in both backward and forward direction throughout the supply chain. The Advance Planning and Scheduling (APSS) system captures both material focus of MRP and short horizon rapid response scheduling power of MRP-II.
However, though APSS and other ERP systems enable textile companies to plan and to manage their resources, they do not provide the real-time input and actionable information necessary to respond to a constantly changing supply chain. Initially ERP has fundamental limitations like data-centric execution focus, poor flexibility and one-dimensional planning, besides significant up-front investment **(11**).

Milliken, the leading textile company in US and pioneer of quick response concept, work with several clothing suppliers and major department stores, to electronically collect POS data from the department stores to synchronize their ordering and manufacturing plans. Internet technology helps Milliken to redefine their business models so as to improve the extended enterprise performance. As a result, the lead-time from order receipt at Milliken's textile plants to final clothing receipt at the department stores is reduced from 18 weeks to 3 weeks. (12.)

Workflow coordination:

This phase of IT interaction contributes maximization of the value of textile supply chain through integrating supply chain operations within the company and across the organizations after collaborating with vendors and customers based on shared forecasts. This signifies next advancement of IT-applications in the continuum of inter-organization coordination.

Information technology enables Wrangler and Wal-Mart to practice workflow coordination to enhance their business in high volatile apparel market. Wal-Mart sells 100,000 pairs of Wrangler jeans every day. Wrangler responds to this demand through Vendor Managed Replenishment or VMR, to continuously feed Wal-Mart's store, by capturing all 100,000 of these sales transactions from various Wal-Mart outlets through web-enabled communication. Then Wrangler sorts these actual demand-data by style, size, fabric and color to replenish Wal-Mart's inventory, the level of which is predetermined by both parties after reviewing history of sales by product and buying styles of the community. This helps the supplier (Wrangler) to better serve the retailer (Wal-Mart) after knowing the exact selling trend and keeping the optimum inventory at retailer's shelves. Improved fill-rate and higher customer satisfaction are the major upshots from this IT-involvement (13).

New business models:

More than just improvements in supply chain efficiency, this phase allows partners within textile supply chain to redefine logistics flows so that the roles and responsibilities of members may change to evolve newer business strategies. A supply-network jointly creates new products, pursues mass customization, and penetrates new markets and customer segments.

Internet interacts with textile business with greater degree as textile supply chain becomes more tightly connected with greater coordination in terms of time and resources (14). New rules of the supply chain game emerge as a result of business innovation fueled by the Internet.

Information modeling: This stage characterizes information modeling, data- analysis and decision-making with regards to the different textile manufacturing processes, as developed by researchers at the College of Textiles (15). Computer Integrated Manufacturing, design of supply chain systems, knitting data model, enterprise modeling are some of areas explored in this stage (16,17). To ensure good fit into business process, applications of these information models necessitate proactive effort, far beyond that required to order and filter data.

***Data mining and Data warehousing*:** Data Mining is the automatic extraction of patterns of information from historical data, enabling companies to focus on the most important aspects of their business. On the other hand, data Warehousing is a repository of data. These methodologies have concentrated on filtering and coordinating the data to make decisions (15).

Information engineering (IE): The information systems developed over the past thirty years have been heavily technology based, while decision-making remained a human thinking process (18). Unfortunately, as business becomes more complex and the system can generate increasing quantities of information, the discriminating power of the user to select and comprehend the "right" information is stretched to the limit. This encourages development of information engineering approach in textile (15). The objective of information engineering is to fundamentally increase the decision-effectiveness in textile manufacturing by designing a new and efficient decision-making system using he Data-to-Decision Cycle model.

***E-Commerce*:** E-commerce primarily consists of B2B and B2C commerce. Business to Consumer or B2C commerce is the direct selling of merchandise to consumers through Internet. While Business-to-business or B2B marketplace can be defined as neutral Internet-based intermediaries that focus on specific industry verticals or specific business processes, host electronic marketplaces, and use various market-making mechanisms to mediate any-to-any transactions among businesses. B2B appears much more promising than B2C and sets to far exceed B2C financially (19). It is expected that more than 25 percentages of all business-to-business purchases will be carried out over the Internet by 2004 (20).

***E-auction*:** It has been created by the rapid advancement of Internet technology. Electronic commerce also allows textile mills to communicate directly with internationally based buyers of wholesale fabrics. For example, Phoenix Textiles, a U.S.-based buyer and distributor of textiles, uses the Internet to purchase its fabrics from mills around the world (21). Then, through its Web site, Phoenix Textiles sells to individuals and small and medium-sized enterprises as well as large corporations. The company relies on the Internet to replenish its inventory as needed.

E Retailing: The textile-retail landscape has been metamorphosed with many "brick-and-mortar" retailers adding an Internet shopping-component to their offering. Enter "click-and-mortar" giants Wal-Mart, K-Mart, Target, Barnes and Noble, to name just a few (22). Having the distribution and warehousing infrastructure in place, these retailers have advantage over their "brick-and-mortar" counterparts.

Wal-Mart, the world's largest retailer, successfully incorporates this e-retailing in their supply chain through electronically enabled stock-replenishment. This improves fill-rate and customer satisfaction, which are so crucial in surviving today's volatile market. It has been at the forefront of stock replenishing, offering shoppers more than a 98-per-cent chance of finding a complete selection (23).

Also, manufacturers and retailers opt for a direct route to consumers by closely scrutinizing individual customer's tastes, habits, and buying patterns. The fast and efficient transmission of point-of-sale data through web-enabled technology makes this "automatic customer replenishing" possible as retailers begin to restock consumers' closets, instead of their stores (24).

The impacts and key benefits of information technology have been comprehensively reviewed in the table (table-1).

Taken in order, the first three phases represent escalating degrees of integration and coordination among supply chain members culminating into whole new ways of conducting business in the fourth phase.

Table-1: Summary of impacts of IT on textile supply chain:

Key IT-Phase	Key Impact Area	Opportunity
Information Integration	Information sharing & transparency Direct & real time accessibility	Reduced Bull-whip effect Early problem detection Faster response Trust building
Planning Synchronization	Collaborative planning & forecasting Joint product design	Reduced repeatability in planning & lower cost Optimized capacity utilization Reduced bull-whip effect Improved service

Workflow Coordination	Coordinated operational planning, procurement, order processing, product launching Integrated, automated business	Improvement in efficiency & accuracy, Better fill-rate Fast response Quick time-to-market Expanded network
New Business Model	Virtual resources Logistic restructuring Help in mass customization Click-and-mortar method	Better asset utilization Higher business efficiency Development of new market Creation of new product

Conclusion:

The trajectory of development of Information technology has intersected in every application area in textile industry. From enhancing performance of textile manufacturing and tighter process control, IT has inserted intelligence at every node of textile supply chain. Initially, Information technology has focussed on automation and sharing of information. Afterwards, IT has effected synchronization of planning across textile supply chain to improve visibility and to optimize performance.

The transition of world-market, induced by increasing corporate merger, acquisition on one hand, and the changing socio-economical landscape on the other, have further integrated IT into every part of textile supply chain. The consolidation by retailers, as reflected by the increasing share of top ten retailers in the world from 46% in 1985 to 80% in 2001 (13), allows them to dictate the 'rule of the market'. IT has enabled the textile manufacturers to embark on superior logistic management to efficiently cater to these powerful retailers worldwide. Superior operational tie-up across the supply network is the hallmark of IT-applications at this stage.

As innovation rates accelerate and product life cycles shorten, so companies become increasingly sensitive to three key metrics: speed-to-market; speed-to-volume; and time-to-profit. Knowledge and understanding of the various vendors and their systems assist the textile and apparel industry in clearly identifying the functions performed by these systems and in selecting the appropriate information system based on the needs of their enterprise. These efforts lead to a better understanding and definition of the role of information systems in the textile and apparel supply chain management, with formation of new business models. New road maps to conduct trade not charted previously, and novel opportunities of business not formerly possible have emerged with the advent of the Internet and other associated technologies as major communication tools across the globe.

However, the importance of supporting e-infrastructure with an adequate logistics infrastructure or supply chain is increasingly emphasized (25). It is estimated that $4.4 billion of e-commerce revenue was lost in1999 alone, due to inadequate infrastructure that led to poor service performance (26). While the development in the computing and telecommunications industries made the transmission of information almost instantaneous, manufacturing, warehousing and distribution technologies could not accelerate the movement of material to such phenomenal level. Co-operation, precise performance metrics and adequate incentives are the prerequisites for IT investment to be successful in textile and apparel business. In this web- enabled world, when consumers are only mouse click away from the suppliers, the organization that can weave the information technology into the very fabric of organizational performance will be the winner.

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