

# Internet Fulfillment: The Next Supply Chain Frontier

The advent of Internet commerce has made it possible to buy and sell goods in near-real time with increasing levels of visibility and personalization of the order process. Business customers and consumers now expect this same speed, visibility, and personalization in the fulfillment process. To drive process efficiencies and meet customers' rising service expectations, companies must turn their logistics operations into high-speed, e-business fulfillment networks by leveraging key converging technologies. Companies that successfully master this transition will be able to create new business models and revenue streams around their e-fulfillment activities. Companies that stumble will lose preferred provider status because they will be unable to keep up with changing fulfillment models and customer requirements.

## Logistics Follows Trade

Throughout history, logistics has followed trade – once you sell it, you have to get it there. Centuries ago, traders began selling Asian spices and silk in European markets, and logistics experts followed by building robust trade lanes connecting the continents. Similarly, we have now seen the rise of “Internet trade,” with an explosion of online procurement applications, electronic marketplaces, and Web storefronts. Internet trade has led to a radical reduction in front-end order-taking times and the creation of new trade-oriented business models, such as those of Priceline.com, Dell Computer, and Amazon. However, e-commerce trade applications have also revealed fundamental weaknesses in traditional logistics models.

Throughout the 20th century, most companies were able to hide behind fulfillment inefficiencies because of elongated order cycle times and multiple inventory buffers. As we enter the 21st century, marketing, selling, and order placement can now take place in seconds over the Internet. This radical compression of trade processes has not been matched by an equivalent compression in processes across the fulfillment network (see Figure 1.0). Relevant fulfillment information is often hours, days, or weeks old by the time it is passed from one enterprise system

to the next – and often electronic information is not available at all. At best, this leads to inefficient re-keying of information, further elongating information cycle times, and introducing data errors. At worst, relevant information is never shared, resulting in massive operations inefficiencies and poor customer service levels. The physical movement of goods is fundamentally constrained by this data latency, lack of connectivity, and lack of information visibility. In turn, this has led companies to create time and inventory buffers to protect themselves from uncertainty and variability in the fulfillment process. To solve this velocity discontinuity, what is needed are new fulfillment processes based on the notion of “Internet logistics.”

## Why Are Traditional Fulfillment Models Failing?

As customers become used to operating at “Web speed” in front-end processes, they are becoming increasingly impatient with poorly synchronized, long lead-time fulfillment processes that provide little flexibility and even less visibility. They are seeking fulfillment partners that can operate in “Internet time,” characterized by agile, high-velocity processes.

Indeed, evidence is mounting that it is the ability to profitably meet continually changing

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Retail

commitments made to customers over the Web that will separate the winners from the “wannabes” in the Internet economy. Anyone can post a product catalog on the Web; very few organizations can create personalized delivery experiences that optimize the flow of goods and information throughout the customer fulfillment network (see Figure 2.0).

The analog world now has to conform to the higher bar of the digital world. This means that enterprises must decrease their reaction times. Event-driven responsiveness and dynamic optimization are the price of admission to the digital economy. Rather than reacting to changes in customer demand and in internal and external fulfillment capabilities in weeks or months, companies must design fulfillment networks that can reconfigure processes, relationships, and roles in days, hours, and even minutes.

To create high-speed fulfillment networks, companies must first understand some of the structural barriers to fulfillment agility. One of the most significant constraints is the lack of real-time connectivity among trading partners. The need to increase agility to meet more dynamic customer demand requires shortening the time-to-plan horizon and lowering safety stock. This means that most companies must move rapidly to real-time information sharing. Without real-time information about what is happening across the complete fulfillment network (not only within the company), order fulfillment in the Internet trade environment becomes

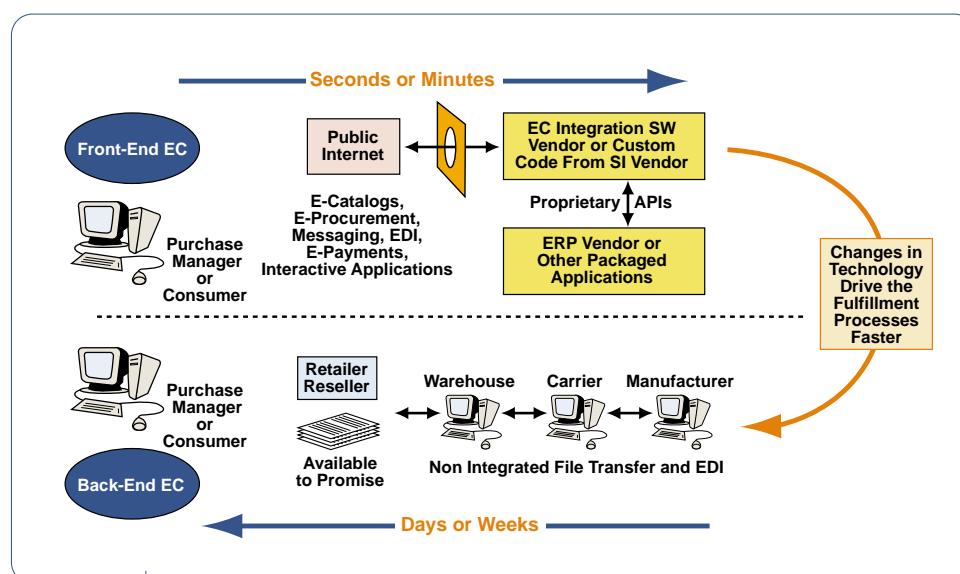


Figure 1.0 E-commerce creates fulfillment velocity disconnects

costly and difficult.

Today, the primary means of systems integration internally and across the fulfillment community has been on a point-to-point basis (particularly bilateral file copying and batch EDI), with many interfaces hard-coded (see Figure 3.0). Operating in the traditional application spaghetti environment not only results in long fulfillment cycle times and bloated inventory levels, it also means that changing trading partners or applications or adopting new business models is often prohibitively expensive and time-consuming.

In a world that increasingly values agility, traditional integration architectures and fulfillment systems are a handicap. Increasingly, enterprises are discovering that:

- The majority of information needed to manage high-speed fulfillment processes resides outside the enterprise.
- External data are often in formats and semantics that cannot be understood by internal applications.
- External data are often incomplete and dated by the time they are received.

Trading partners’ business processes are difficult to understand and thus difficult to dynamically re-engineer relationships with because there is no shared meaning,

data context, or common set of design principles.

These connectivity challenges are exacerbated by the fact that traditional fulfillment systems are transaction-oriented systems based on a monolithic data model focused on the enterprise. These traditional fulfillment systems:

- Lack the flexibility and compartmentalization necessary to integrate and interoperate in a high-speed fulfillment network.
- Lack the ability to make sense of process flows and events from a multiple-enterprise context.
- Lack the ability to provide visibility of the movement of goods and information across the fulfillment community, with user-defined, exception-based alerting.
- Are unable to provide personalized views of relevant information.
- Are unable to optimize processes in the context of the fulfillment community vs. a single enterprise.
- Are not built for dynamic business-to-business (B2B) collaboration, with concurrent decision dialogues.

### Creating High-Speed E-Fulfillment Networks

The shift to the e-business economy is requiring enterprises to adopt new B2B

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integration and knowledge-sharing strategies. These strategies require changes in processes and in supporting information technology. Every new client solution configuration, every new acquisition, and every new partner puts added stress on the integration capabilities of those business systems that have formerly been focused on optimizing the internal management of assets. Companies must embrace a new spectrum of B2B technologies and logistics models that are architected to be deployed across a constituency of trading partners, allowing them to cooperate and collaborate. A company's pool of assets, along with the assets and systems of its fulfillment partners, must be able to be configured into numerous, unique client-oriented logistics solutions. These tailored fulfillment solutions must be able to be rapidly reconfigured in response to new and changing product and service demands of different clients.

These high-speed, e-business fulfillment networks require a new IT architecture that:

- Captures, integrates, analyzes, and presents information residing in applications and information stores beyond the enterprise's boundaries, including wireless and mobile devices
- Masters issues of syntax and semantics in a distributed computing environment that often involves complex, hard-to-define business processes and information flow
- Is designed for zero-latency information transfer, so as soon as information is captured by the system, it is made immediately available to any other system (or user) that needs to know about the information
- Is event-based and workflow-enabled, interoperating based on external events (e.g., point-of-sale information that automatically triggers a shipment release, or proof of delivery that triggers an invoice payment)
- Contains real-time alert capabilities between companies and their trading partners
- Can be configured uniquely for each trading partner's point of view

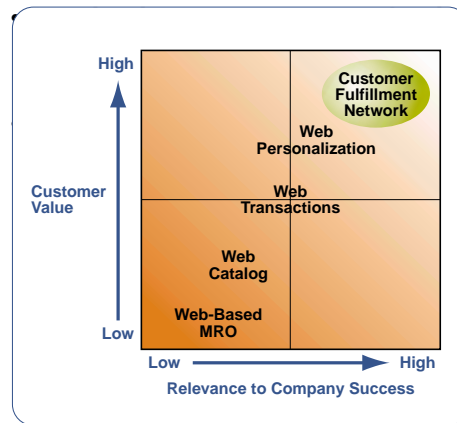


Figure 2.0

E-fulfillment is critical to customer satisfaction and market differentiation.

found in the distributed logistics environment, which are much more dynamic and complex than those found in most manufacturing processes

- Enables a company and fulfillment community to deploy different and changing e-business models by channel, product, and customer vs. forcing the organization into a rigid enterprise data model or process

High-speed e-fulfillment systems must be designed to integrate with external systems from the inside out rather than from the outside in. They must be built to accommodate, rather than exclude, external data, processes, or applications. And they must be designed to provide transparency of data and events to authorized participants throughout the fulfillment network, solving the issues of connectivity and visibility (see Figure 4.0).

E-fulfillment networks enable a company to:

- Quickly grasp control of the supply chain beyond "the four walls" of the business
- Improve inbound and outbound inventory visibility and thereby reduce inventory obsolescence and cycle times
- Increase outsourcing capability and leverage core competencies
- Gain a better view on performance within the business and throughout the fulfillment network
- Manage more fluid business relation-

ships and higher velocity data and product flow

- Streamline distribution and remove fulfillment bottlenecks and redundant processes
- Achieve high-velocity, tightly synchronized business processes that can flexibly adapt to changing business conditions and objectives
- Develop personalized service capabilities and offerings for customers

### Converging Technologies Enable Fulfillment at Web Speed

Creative destruction, the term coined by Harvard economist Joseph Schumpeter, is the continuous process by which emerging technologies push out the old. Creative destruction is rapidly occurring in the fulfillment world. The convergence of Internet technology, mobile and wireless devices, and dynamic optimization techniques is enabling dramatic restructuring of logistics processes. This convergence presents logistics professionals and business managers with an opportunity to create new businesses and revenue streams around redefined fulfillment processes.

Among the technologies that will redefine how fulfillment systems are managed are: 1) connectivity architecture, 2) supply chain visibility technology, and 3) dynamic optimization technology. These technologies enable organizations to build high-performance customer fulfillment networks, solving both inbound and outbound material flow visibility and real-time decision support issues.

#### Connectivity

To manage real-time supply chains, companies require an e-fulfillment network architecture that includes real-time source data collection and advanced B2B integration. Collecting data at point of capture and funneling it via a zero-latency messaging architecture to interested systems and users throughout the supply chain ensures a high level of data quality and timeliness. This makes planning and transactional applications more effective through more timely and higher-quality information flow.

Increasingly, source data collection will originate from wireless devices that capture execution data in real time through the use of RFID tags, bar code scanners, GPS, Web forms, and wireless telemetry.

Advanced B2B integration solves the problems of heterogeneous syntax and semantics, and eliminates the need for point-to-point connections by using many-to-many message brokering techniques. This lets companies rapidly integrate disparate systems across trading partner boundaries, enabling more fluid business relationships. This makes it easy to plug and unplug trading partners and systems as business scenarios change.

Advanced B2B integration also supports channel-wide business processes while still supporting each trading partner's unique point of view. It supports information flow through the enterprise, between enterprises, and to individual users, allowing the synchronization of planning, scheduling, and execution processes using data from different systems and sources.

Most importantly, enterprises should realize that advanced B2B integration is not just about gluing systems together; it is about adding intelligence to the messaging environment. It is about creating new services, new revenue streams, and new efficiency opportunities based on the context of the information flowing through the systems. As the need to share resources and collaborate with partners becomes the foundation of process alignment and channel integration strategies, information interoperability will become the cornerstone of logistics strategies.

### Visibility

Supply chain visibility technology involves the real-time monitoring and exception-based alerting of the movement of goods and information across a supply chain, including both inbound and outbound activity (see Figure 5.0). It lets fulfillment organizations gain tighter control and real-time understanding of supply chain activities beyond the four walls of the business. In many regards, it acts as a command and control system for the customer

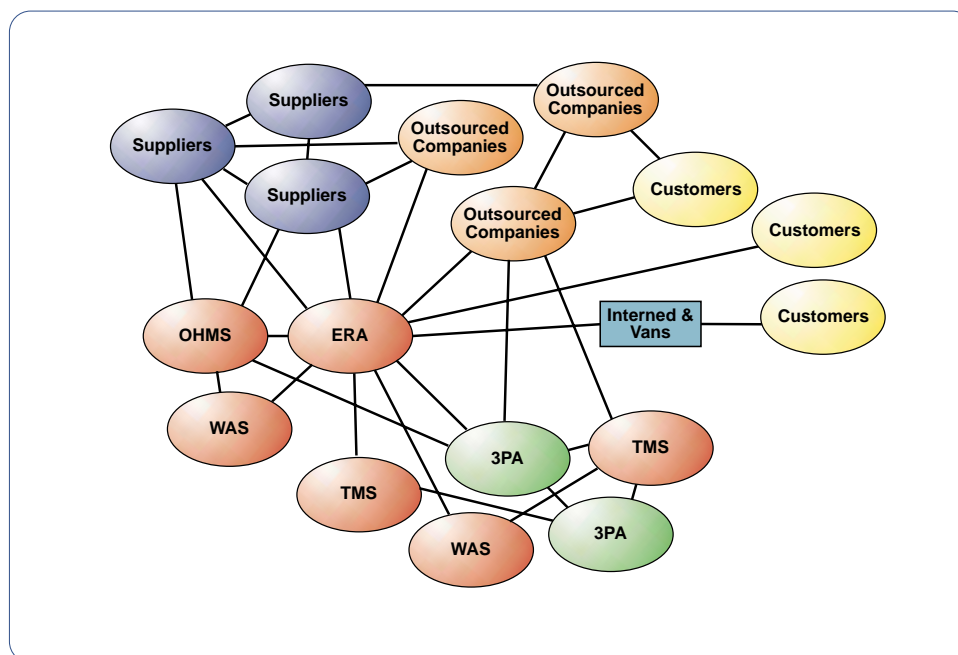


Figure 3.0 Traditional fulfillment architecture: Application Spaghetti

fulfillment network, enabling the monitoring and control of third-party activities like supplier lead times and carrier performance.

Providing real-time visibility of the movement of goods and information across the fulfillment network greatly enhances the network participants' confidence in the system. This directly translates into less "just in case" inventory and time buffers. Unlike reporting systems that tell you what's wrong long after you can do anything about it, supply chain visibility systems enable companies to proactively respond to fulfillment problems before they impact the end customer. This real-time service failure avoidance leads to customer service improvements through increased delivery reliability and timeliness. Moreover, enterprises can also use this visibility to spot opportunities for cost or time savings, such as merge in transit and cross docking, or to deploy delayed allocation and other advanced logistics strategies.

Because of the vast quantities of data surrounding the fulfillment process (some companies process millions of line items a day), it is crucial that the individual user be able to personalize the visibility experience and see only relevant information. A ware-

house manager may want visibility of everything that will show up on the dock tomorrow morning so receiving and put-away can be optimized. A production scheduler may want to receive alerts only for supplies that are going to be late according to the production plan so that rescheduling or alternate sourcing can be done to insure that customer commitments will still be met. A customer service representative may want to receive alerts of all shipments that are going to be late to an important customer. A transportation manager may want to receive a carrier performance scorecard every Friday, with the ability to drill down to issues like lead-time variability by lane. A field installation worker may want to know when all goods are going to arrive at the customer location so that installation can be timed to coincide. This personalization of exception-based fulfillment information is what adds context and value to what otherwise would be just streams of transactional and planning data. From an interenterprise systems and scalability perspective, it is also important that the user can do the configuration and management of this personalization experience and does not have to rely on a database administrator to get a new view of fulfillment data.



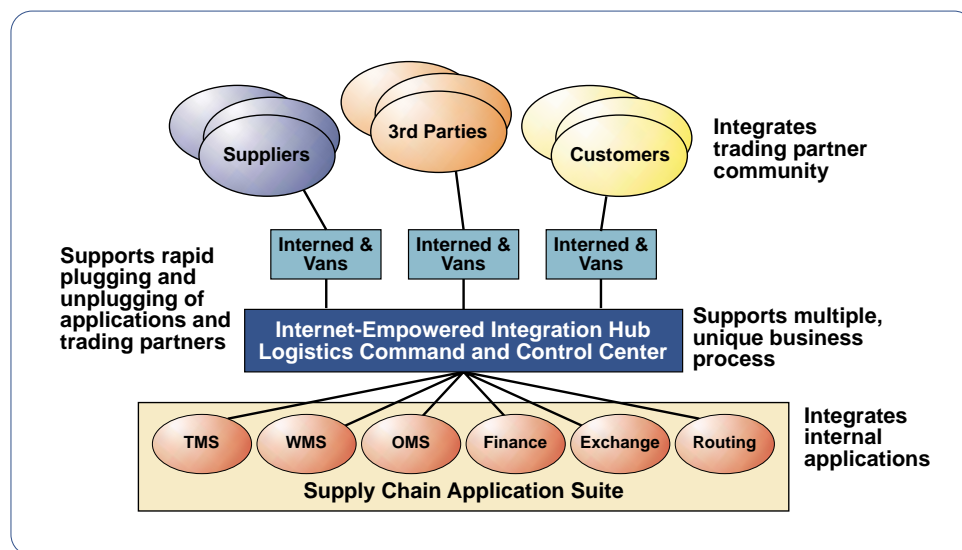


Figure 4.0 High-speed e-fulfillment network architecture

The data and performance information gathered by the supply chain visibility system also enables the fulfillment network to implement statistical process control and total quality management processes. For instance, statistically measuring on-time performance and lead time variability by product, carrier, and lane enables an organization to systematically search out and eliminate the bottlenecks, redundancies, and inefficiencies in the fulfillment network.

#### Dynamic Optimization

As fulfillment cycles compress in response to the radically shortened order cycle times of Web commerce, planning cycles will compress as well. In a world where marketing the product, taking the order, making or sourcing the product, and shipping the product may happen in the same day, there is an increasing need for optimization technologies designed for short-time-to-plan horizons. Fulfillment organizations must begin to adopt systems that can re-plan, re-sequence, and reprioritize in real time. If a truck is delayed, a high-speed fulfillment network cannot afford to wait until the next hour or day to re-route it; new plans must be produced in seconds or minutes. While linear programming and other techniques are appropriate for long time-to-plan horizons, techniques of dynamic optimization must be applied for short time-to-plan problems.

#### Creating New Businesses and Revenue Streams through E-Fulfillment

While a high-speed e-fulfillment network reduces inventory levels and operational inefficiencies, it is its ability to support completely new business models and create new revenue streams that is truly noteworthy. Following are examples of how companies can create innovative e-fulfillment strategies.

#### Home Delivery: Conquering the Last Mile

The exponential increase in Internet commerce is fueling interest in servicing consumers directly. As consumers increasingly use the Internet for online shopping, the delivery of goods and related services into consumer homes is increasing dramatically. Home delivery of groceries, “mobile concierge” services, and big-box items, such as furniture, electronics, and major appliances pose different logistical challenges from Web orders delivered to the home via small parcel. The former are items that may require special handling, installation, or other services associated with the delivery, or may require the customer’s presence at the time of delivery.

Webvan, Peapod, Shoplink, and other leading Web home delivery companies have discovered that personalizing the delivery experience, increasing customer convenience, and ensuring delivery prof-

itability are key to conquering “the last mile of the supply chain”: delivery of goods and services into the consumer’s home. Accomplishing this requires software that enables:

#### Fast, On-Time Delivery with Delivery Status Reporting (Visibility)

Customers expect goods and services to be delivered quickly and when promised; a disappointed customer will be less likely to place an order again. This requires the ability to accurately predict and execute on-time deliveries to the consumer’s home or alternate pick-up location (e.g., their office). Customers want to know the status of their delivery. If the order cannot be delivered when originally promised, then they want a new estimated time of arrival. Meeting these requirements requires dynamic route optimization software with accurate driving distances, times and directions (not crow fly estimates), as well as a forward predictability functionality so that the consequences of a late delivery or a traffic jam can be determined for later orders and new ETAs or reoptimized schedules can be generated.

#### Customer Self-Scheduling (Dynamic Optimization)

Major motivators driving online shopping are convenience and control, so it is not surprising that consumers wish convenience and control over the delivery issue as well. In addition to providing rapid turnaround of orders and on-time deliveries within narrow delivery windows, consumer direct and home delivery companies will need to offer the shopper the opportunity to “self-schedule” delivery or service via the Web or a store kiosk – without the intervention of the seller. This requires a transition from traditional batch resource-centric scheduling (which only cared about optimizing driver and vehicle utilization from the enterprise’s view) to a new generation of dynamic routing software that provides customer-centric scheduling. Customer-centric scheduling gives the consumer the ability to choose a delivery or service appointment time win-

dow from a set of options, but the optimizer will only present the options that will produce efficient and productive route schedules. Real-time optimization capabilities let the system continually optimize delivery window choices as new orders are placed. Personalizing the delivery experience is proving to be a powerful way to build brand. Webvan, for instance, has built its brand around creating a customer delivery experience that allows users to select from multiple 30-minute delivery windows.

#### Mobile and Wireless Devices (Connectivity)

Mobile and wireless devices act as source data collection devices by reporting delivery status, collecting consumer information in the home, scanning totes and other delivery packages, and so on. This information can be used for a variety of productivity-enhancing purposes, including re-optimizing schedules, re-routing vehicles in real-time, and improving driving and service time estimates. These devices are also important as a receiving device for information – such as receiving new delivery instructions with new driving directions, or receiving repair or installation instructions.

Customer-centric delivery is only possible when supported by the proper technology. Many couriers today fail to make a profit on residential deliveries because they have not implemented supporting technology. Profitable home delivery requires real-time optimization of routes and supply chain visibility of inventory and orders. When combined with solutions for mobile and wireless communications and the ability to let customers self-schedule deliveries, home delivery suddenly becomes a viable proposition for Web and traditional retailers, manufacturers, distributors, and logistics providers.

#### Virtual Logistics Providers: Managing Complex Logistics Flows at Web Speed

A new breed of non-asset-based logistics providers are using B2B integration tech-

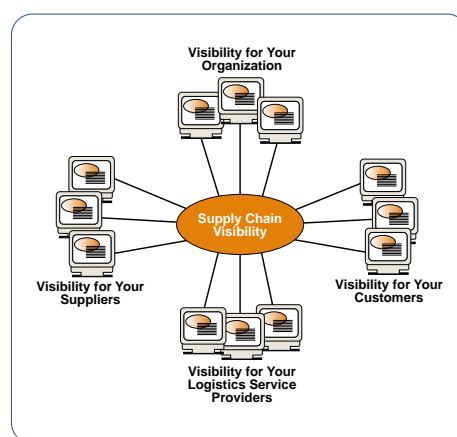


Figure 5.0

Supply chain visibility: Core to e-fulfillment networks

nology, supply chain visibility, and dynamic optimization to restructure traditional fulfillment channels. For example, Virtual Supply Logistics, a new logistics service provider, is creating a whole business around using these technologies to reinvent the fulfillment process of white and brown goods in the Asia-Pacific region. Specifically, it is leveraging these technologies to streamline the order fulfillment process in national retail chains in Australia and New Zealand, including industry leaders Harvey Norman and Vox Retailing VSL will use B2B integration technology to integrate the retailers to white and brown good suppliers and to a virtual network of third-party delivery and installation agents throughout the Asia-Pacific region. This will enable home delivery directly from the supplier facilities, bypassing multiple nodes in the traditional fulfillment network, allowing dramatic cost reductions from the current process.

By using supply chain visibility technology to gain real-time visibility of the movement of goods and information across the entire fulfillment network, VSL can synchronize its partners' disparate systems and activities over a neutral information network. This will enable shipment directly from suppliers' warehouses to consumers' homes, with third-party service and installation workers coordinated to arrive at consumers' homes when the goods arrive, reducing the cost of delivery, decreasing damage rates, and increasing service levels.

#### 3PLs of the Future: IT Becomes the Competitive Weapon

Shippers are no longer looking to their logistics service providers simply to move goods and cut transportation costs. They also expect their providers to help them improve their supply chain processes and increase their revenue. Leading providers in the next five years will help their customers succeed with mass customization and Web commerce initiatives, and the management of multiple customer universes. This requires not just moving boxes but analyzing and redesigning supply chain structures and flows to increase their customers' supply chain agility and velocity.

Most third-party logistics providers (3PLs) are constrained from effectively managing their client base because they lack a real-time command and control system that supports multiple parties and business models. A number of Web fulfillment accounts keep passing from 3PL to 3PL because the logistics service providers do not have a high-speed information architecture to enable physical fulfillment activities to operate at Web speed.

The vast majority of 3PLs buy one IT system at a time to serve individual customers. The end result is a jumble of systems that prevent visibility across the customer base, and thus prevent leverage and economies of scale. To co-mingle loads, share capacity and labor, maximize continuous moves, and deliver time-definite service, providers must deploy B2B integration, supply chain visibility and dynamic optimization architecture, and tools and methods across all customers and extend those systems to customers to create multiclient networked systems. Logistics providers like Conway, Exel, and TNT are deploying e-fulfillment network architecture and visibility solutions that serve as a real-time command and control system across their multiple clients' fulfillment networks. This enables them to provide new levels of service and efficiency for their customers that were not attainable with previous generations of fulfillment technology. In effect, they are competing as much on their information infrastructure as on their physical infrastructure.

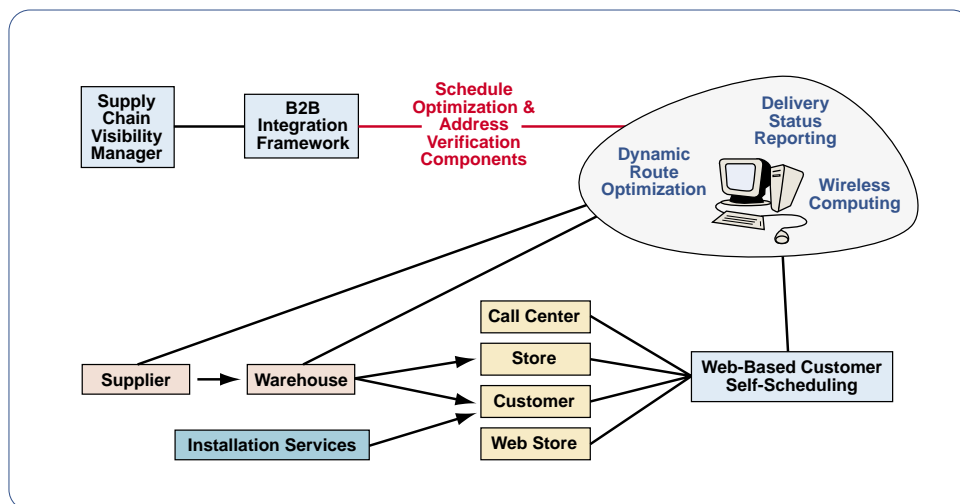


Figure 6.0 High-speed fulfillment networks: From supplier to consumer's home

### Portals and Exchanges: Providing Fulfillment Information Services

Innovators will use e-fulfillment technology to create logistics portals and transportation exchanges, providing value-added information and business process outsourcing services in addition to providing simple access to a variety of transportation-related applications. These systems will enable more fluid business relationships and higher velocity data and product flow, reducing the need for data to pass in and out of every ERP system (typically by batch file or paper), as the goods and services flow throughout the supply chain. E-fulfillment systems let the marketplace manager leverage technology and processes across multiple customers, creating network effects. These network effects can include group buying power for lower transportation rates, the ability to dynamically balance demand across the transportation community, and the ability to communicate seamlessly with other community members.

While some logistics portals and transportation exchanges will be developed by start-up organizations, many others will be built by established organizations seeking to develop new services and revenue streams. Rentway, Canada's largest fleet lea-

sor, for instance, has created a Web-based fulfillment information service for its customers. Customers can access the hosted Web service to obtain optimized local fleet routes on a pay-by-use basis. Key to the success of these portals and exchanges will be their ability to deploy an information architecture that can support the diversity of trading partners and their evolving business models.

### High-Performance Manufacturing: Managing Global Fulfillment Networks

Global manufacturers and other organizations that must manage distributed logistics operations are deploying high-speed e-fulfillment systems to gain significant operational improvement and customer service enhancements. Ericsson, a global telecommunications system manufacturer, was unable to provide customers with timely delivery information because it had no visibility of the movement of goods inbound or outbound. Ericsson deployed an e-fulfillment network architecture and supply chain visibility system to connect and reconcile the disparate data semantics of hundreds of air carriers, freight forwarders, trucking companies, warehousing facilities, and field service

workers. More than 500 Ericsson employees around the world now use the e-fulfillment system to track orders, proactively manage delivery exceptions, and monitor delivery lead-times and performance. Combined with organizational changes and tighter supplier oversight, this real-time connectivity significantly enhanced delivery performance and customer service levels and contributed to a 72% reduction in lead times and order-to-cash cycles.

### Conclusion

The rapid adoption of Internet trade methods is driving equivalent innovation in Internet fulfillment methods. Enterprises now have the ability with e-fulfillment technology to reinvent fulfillment processes and relationships, creating brand new businesses and revenue streams, and reshaping entire industries. Key to success will be embracing technology that enables connectivity, visibility, and dynamic optimization across the fulfillment network. These technologies help slash transaction and interaction costs and let companies redefine the customer value proposition around the delivery experience.

### Descartes' E-Fulfillment Software and Solutions

Descartes specializes in creating software solutions for e-fulfillment operations around the world. Descartes' B2B integration, supply chain visibility, and dynamic fulfillment optimization technology enable companies to create high-performance customer fulfillment networks – aka DeliveryNets™. These solutions empower organizations to deliver reliable, responsive customer service in a profitable manner and to create innovative new products and services. Descartes products are used today by more than 850 companies in 35 vertical industries and 50 countries worldwide. Customers include Webvan, Peapod, Shoplink, Virtual Supply Logistics, Rentway, and Ericsson.