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**EFFICIENCY AND EFFECTIVENESS OF TRANSPORTATION AND WAREHOUSING**

**IN THE SUPPLY CHAIN PROCESS**

**BY**

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### **ABSTRACT**

*Warehousing facilities play a vital role in the overall supply chain process. This article will address “back to the basics” that are fundamental for warehouses to achieve both efficiency and effectiveness in supply chains, and provide some perspective on current challenges and the future. It is evident that continuing globalization and changes/challenges occurring in such areas as reverse logistics, environmental sustainability, information technology, and overall supply chain integration are further evolving the strategies, roles, and responsibilities for warehouses. In fact the term “distribution center” may be much more appropriate in representing the broad range of activities that now occur in modern warehouses that go beyond filling customer orders to provide an ever expanding array of value added services. Transportation is among the more vital economic activities for a business. By moving goods from locations where they are sourced to locations where they are demanded, transportation provides the essential service of linking a company to its suppliers and customers. It is an essential activity in the logistics function, supporting the economic utilities of place and time. Place utility infers that customers have product available where they demand it. Time utility suggests that customers have access to product when they demand it. By working in close collaboration with inventory planners, transportation professionals seek to ensure that the business has product available where and when customers seek it.*

**Keywords:** *Warehousing, globalization, Transportation, logistics and Supply chain process.*

## **Introduction**

There are a number of situations where Distribution center simply would add cost (and little or no value) to the supply chain (Zaryab & Shafaq, 2014). Distribution center add little or no value for products bought in bulk (e.g. raw materials, manufactured items) with little or no time sensitivity associated with their use. Products insensitive to transportation costs (i.e. transportation cost is a small percentage of product value) also typically move directly to customers.

For other products, however, Distribution center provide a dual value-added role making supply chains more efficient and more effective (Ngonela *et al.*, 2014). Distribution center add efficiency by consolidating products for shipment to customers, reducing transportation costs, and performing a broad range of value added services (e.g. branding, labeling, assembly, packaging, kitting, and reverse logistics). Distribution center also make the supply chain more effective. The strategic placement of Distribution center allows the positioning of products and services close to major markets and customers (the economic principle of place utility).

Optimization strategies are utilized to position product availability and delivery as a competitive advantage while also optimizing the cost trade-offs associated with transportation, facilities, equipment, workforce, and other critical cost variables (Hanaa, 2013). Distribution center also facilitate time utility by storing product until it is demanded. Product type often determines the need for and specific role of Distribution center in the supply chain. Characteristics to be considered include:

- a. seasonality in either production or consumption
- b. demand variability
- c. manufacturing economics
- d. marketing and promotional initiatives
- e. transportation economics
- f. service requirements
- g. customizability and variants of product

Products that have extremely high service requirements from a time perspective present unique challenges since they often effect the efficiency, performance, and cost of customers' operations. As an example companies that distribute parts for technology products (e.g. computers) and capital goods (e.g. airplanes, construction machinery) must be capable of distributing those parts within hours (Lucie & Hudziak, 2012). Similarly many automotive manufacturers have "inbound" Distribution center located in close proximity to manufacturing plants so that subassemblies and other components can be assembled and "profiled to line" for the production process.

Postponement is also becoming a critical issue and value added service for Distribution center. When demand is unpredictable it often makes sense to "assemble and ship to order". Inventories remain "generic" providing more flexibility and reducing costs (e.g. inventory, transportation, surplus, obsolescence). Postponement is particularly effective in supporting customer product configuration and branding requirements.

Company capabilities to determine DC requirements are essential for achieving successful networks and operations. DC requirements include location, design and operations, determining the information and technology requirements, and measuring performance.

### **Transportation**

Transportation is a major contributor to the economy and a competitive force in business. It is the activity that physically connects the business to its supply chain partners, such as suppliers and customers, and is a major influence on the customer's satisfaction with the company (Vishal *et al.*, 2013). Transportation is among the more vital economic activities for a business. By moving goods from locations where they are sourced to locations where they are demanded, transportation provides the essential service of linking a company to its suppliers and customers. It is an essential activity in the logistics function, supporting the economic utilities of place and time. Place utility infers that customers have product available where they demand it. Time utility suggests that customers have access to product when they demand it. By working in close collaboration with inventory planners, transportation professionals seek to ensure that the business has product available where and when customers seek it.

Transportation is sometimes to blame for a company's inability to properly serve customers. Late deliveries can be the source of service problems and complaints. Products might also incur damage while in transit, or warehouse workers might load the wrong items at a shipping location. Such over, short, or damaged (called OS&D) shipments can frustrate customers, too, leading to dissatisfaction and the decision to buy from a competitor for future purchases (CSCMP, 2013).

However, when a company performs on time with complete and undamaged deliveries consistently, this can instill customer confidence and gain business for the company. When a company instills confidence in service performance, it can make customers more reluctant to succumb to competitors' bids to steal business away through clever promotions and reduced prices.

Aside from its service ramifications, transportation can also represent a substantial cost for the business. The cost of transportation can sometimes determine whether a customer transaction results in a profit or a loss for the business, depending on the expense incurred in providing transportation for a customer's order (Waiganjo, 2013). Faster modes of transportation generally cost more than slower modes. So although shipping an order overseas by airplane is much faster than transporting by ship, it can cost as much as 20 times more. Such a cost difference might not justify the use of the faster way of transporting the goods. Supply chain managers must therefore carefully consider the cost of transporting goods when determining whether to move product and how to move product in the most economical manner.

In addition to transportation costs distribution center location is determined based on the the location of major markets and customers, the location of supply points, the volume of product moving to or from supply points and customers, transportation rates, the level of service required, and the product characteristics (Lucie & Hudziak, 2012). Local conditions including access to and cost of labor, land and buildings, IT/communications infrastructure, transportation infrastructure, and government policies (e.g. environment, incentives, taxes) also play a significant role in determining location.

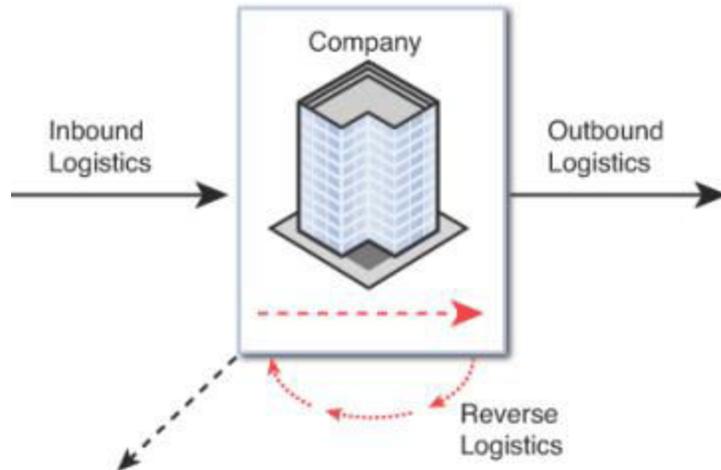


Figure: Forward and reverse flows in logistics.

Transportation is only one activity responsible for providing time and place utilities through inbound and outbound logistics. Logistics also involves forecasting demand, planning inventory, and storing goods as well as delivering them. Optimized logistics performance means that these activities are working closely together so that the customer of the logistics service is satisfied with the service, yet the cost the company incurs is minimized (SoonHu, 2010). This optimal performance requires an understanding of how the various logistical decisions and actions affect service for customers and total cost.

Consider, for instance, that a company seeks to minimize its investment in inventory. The company elects to hold all its inventory in one central warehouse location, for it has been shown that consolidated inventory reduces inventory investment. Warehousing cost should also be minimized because the company is maintaining only a single facility instead of several locations. Customers located close to the central warehouse will be pleased with this decision because the company must travel only a short distance to deliver items to these nearby customers (Forrest, *et al.*, 2008). However, customers located farther from the central warehouse are likely to be disappointed. They will ask for faster transportation to reduce the order lead times. This might involve using faster means of transporting the goods, which, as noted, tends to cost more than using slower modes. In sum, holding inventory in one central location might reduce inventory

and warehousing costs, but it will increase transportation costs. The business might also be at risk of losing sales to competitors who can offer shorter and more reliable order lead times.

Conversely, a supply chain strategy that seeks to minimize transportation cost will likely not represent an optimal solution for the company. This might call for shipping orders to customers in large volumes and using slow means of transportation. Requiring large order quantities and using slow forms of transport are two more ways to disappoint customers and risk losing business to competitors (Davis & Mentzer, 2006). So although transportation is usually a sizeable expense for a company, and often the largest expense in the function of logistics, supply chain managers must consider the interrelationships among the various logistical actions and costs. Tradeoffs are often associated with these decisions, and the company's customers are also affected. The recognition of interrelationships among transportation, inventory, warehousing, information exchange, and customer service is the embodiment of a **systems approach**. The manager seeks to optimize the performance of the logistics system instead of optimizing a singular element of the system. This book, therefore, treats transportation as one important element of the logistics system.

### **Design & Operations**

The product, how it is received, the nature of customer orders, service levels, and transportation mode are the primary determinants of distribution center design and operations. Product characteristics include weight and dimensions, packaging, shelf life, temperature and lot control requirements, and hazardous material requirements. How the product is received is critical to both inbound operations efficiency (dock to stock cycle time) and space utilization/storage efficiency.

To optimize efficiency in inbound operations it is ideal to receive material in an immediately storable conveyance (e.g. pallet, case, box). The types and volumes of orders that are processed and the number of stock-keeping units (SKU's) in the distribution center are important considerations in determining layout, equipment selection, and business process requirements. Storage equipment selection should be matched to product characteristics, volume, and any additional unique requirements (e.g. security, temperature control, lot control).

A word of caution if you are considering automation - automation to reduce transit time in the distribution center almost always represents an opportunity for improved efficiency. Automation of other processes (e.g. receiving, locating/storage, order filling) may become a critical constraint particularly if there is a significant variation in demand (e.g. seasonality), change in product characteristics, or change in product mix.

### **Information and Technology Requirements**

Information is the critical driver for successful distribution center operations. Short term forecasts provide information to determine labor and space requirements over a short term planning horizon. Longer term forecasts are used for capacity planning (e.g. distribution center size, workforce and equipment requirements.). Information technology is critical in achieving distribution center performance. Warehouse Management Systems (WMS) direct where products should be stored and provide the necessary functionality for the completion and optimization of receiving, storing, and shipping operations (Lysons & Farrington, 2006). Additional functionality may permit the use of hand held devices and bar coding to optimize efficiency and reduce errors. Most WMS systems also include inventory management functionality that permits the distribution center to have real time information on the inventory status of all items in the distribution center.

### **Measuring Performance**

The primary objectives of Distribution center include providing the right product, at the right place, right time, and damage free – at a competitive cost. Fundamental to achieving and sustaining these objectives is measuring performance. The most common distribution center performance measures include handling productivity, space utilization, accuracy, damage, service, cost, and inventory (Tummala, & Schoenherr, 2011). Handling productivity is often measured in “units or lines” picked per hour or total handling cost per “unit”. Space utilization is evaluated based on the percentage of total space available for storage, percentage of useable storage space actually used for storage, and storage cost per unit of product.

Accuracy includes measures of location and record accuracy, the percentage of items picked correctly, and the percentage of orders picked correctly. Damage measurements include the

percentage of items picked that are undamaged when received by the customer and the percentage of orders picked without damaged merchandise. Service measures include fill rate which is based on the number of orders that were filled completely.

Cycle time is also a critical measure to determine service and efficiency. Dock to stock cycle time is a critical measure of how long it takes to make material available following receipt. Order cycle time measures the elapsed time from order receipt until order shipment. Order cycle time may also include transportation to measure the total elapsed time until the customer receives the product. Cost and inventory performance measurements include total distribution center cost per unit handled, distribution center cost as a percentage of sales, and inventory turnover.

### **Ways 3PLs Support Warehousing & Distribution**

#### **1. Crossdocking Imported Goods**

Whether their operations are domestic in nature or based overseas, companies that import goods typically need crossdocking support to help manage and direct those goods. Defined as the unloading of materials from an incoming vehicle and then loading the materials directly into outbound vehicles with no “storage time” in between, crossdocking allows companies to receive goods, segregate them by purchase order, destination, SKU or store location, and then distribute the items to the final destination without having to ever store the goods.

Kyle Oslos, senior director of logistics at APL Logistics, says companies with global supply chains are particularly well positioned to benefit from this offering. “If your supply chain is primarily overseas in countries like China and India, the breaking out of the shipments into separate POs and destinations doesn’t happen at the origin,” he says. “A 3PL can provide the crossdocking functionality that allows companies to bring those goods in without having to manage, sort and even touch them.”

#### **2. Access to IT Infrastructure**

Companies that want be able to leverage all of the features of a warehouse management system (WMS), but don’t want to have to invest in a full-blown technology platform, can tap into their 3PLs - many of which offer such integrations. Seko Logistics, for example, owns a proprietary

WMS that integrates with companies' existing enterprise resource planning (ERP) or transportation management systems (TMS).

"We're agnostic in technology," says Brian Bourke, vice president of marketing at Seko, "so we will just figure out a way to connect to a customer's existing systems." This is a particularly important point, he says, because once stretched outside of a company's four walls, technology systems aren't always easy to integrate with other solutions. "We get involved with connecting the pieces together," he adds, "to give customers visibility all the way from their vendors to the end customers."

Calling IT infrastructure a "significant expense" for companies, Alan Amling, vice president of global logistics and distribution marketing for UPS, says he's seeing more companies leveraging their 3PLs' existing platforms. "When you can utilize a WMS that a 3PL already has in place," he says, "that's one less thing that you need to worry about and invest in."

### **3. Omni-Channel Fulfillment Support**

With all eyes focused on omni-channel (i.e., creating a seamless shopping experience for customers across all distribution channels) right now, it just makes sense that logistics specialists like 3PLs would step up to the plate and support omni-channel efforts. "When a retailer moves from 5% e-commerce to 80% to 90% e-commerce, the fulfillment side shifts quite a bit," says Bourke. Consider the company that has to comply with the big box retailer's standards and that must make sure all items are packed, labeled and shipped correctly. The same company may also be sending items directly to consumers - an exercise that requires return labels, printed catalogs, and/or even handwritten notes to be included with the orders. "These steps have to be taken during the fulfillment stage," says Bourke, "and they are just some of the warehouse/distribution services that a 3PL can provide."

### **4. Strategic Workforce Management**

The fact that 3PLs aren't historically known for helping warehouses and distribution centers manage their workforce hasn't stopped some of these providers from providing overall strategic workforce management. "3PLs are helping warehouses and distribution centers get a handle on issues like labor and workforce optimization," says Todd Johnson, global vice president of the

3PL global business unit for JDA. Driven primarily by the post-recession labor shortage that's currently challenging some companies, this value-added service helps companies focus on the utilization and development of their staffs. "Labor is one of the largest cost drivers in the warehouse," says Johnson, "and we're definitely seeing 3PLs helping to take the cost of out of the warehouse through the use of advanced labor planning solutions."

### **5. Last-Mile Configurations and Deliveries**

In response to demands for fewer distribution points across the supply chain, 3PLs are offering value-added DC activities that help companies cut down on the number of nodes within their own supply chains. "We're using DC points to apply those value-added services to products - mostly in the interest of velocity and customer responsiveness," says Carl Fowler, vice president of sales and engineering for Menlo Logistics. Such services help warehouses and distribution centers address their "last mile" distribution challenges. Defining the last mile as the final point of configuration to final delivery to the customer, Fowler says 3PLs are installing finishing touches on products, handling final configurations, and even embroidering team hats for events like the Super Bowl. "It's about delaying configuration until the last 'touch,'" he says, "and then addressing the last mile delivery component, which can include installation, coding, quality checks, and/or final white glove-style delivery service."

### **6. Industry-Specific Supply Chain Oversight**

In light of the increased scrutiny being paid to the pharmaceutical space by the U.S. government (for example, the Compounding Quality Act and the Drug Supply Chain Security Act will require the FDA to develop a national track-and-trace system that pharma manufacturers must use when introducing products into the supply chain), Johnson expects more 3PLs to get into the track-and-trace and supply chain visibility services businesses. "Some of these developments are really driving a need for 3PLs that can offer these types of services and technology," says Johnson. "That would allow the pharmaceutical companies to quickly adapt to emerging legislations while gaining better visibility control in the space."

### **7. Final-Stage Kitting and Packaging**

Third-party logistics providers offer up a host of transportation and warehousing services, but Amling says the real magic happens when those providers go beyond standard fulfillment - storing, picking, packing and shipping - with value-added services like final-stage kitting and packaging. Using athletic bandages as an example, Amling says that while Walmart may want the items assembled into a five-pack, Walgreens might request a “buy two, one free” offer. Carl Fowler, vice president of sales and engineering for Menlo Logistics “All of these different retailers want everything customized to their own preferences,” Amling says. “You have to be able to predict demand across the various retailers and handle the different, requested configurations upstream - when you’re doing the manufacturing and packing.”

Where the 3PL comes in is by providing kitting and packaging. This effectively allows the warehouses and distribution centers to postpone any type of predicting or decision-making around specific order volumes. “The company sends them to us in bulk and, as the orders come in,” he says, “we pick and pack them according to the retailer’s requirements.”

### **Summary**

Understanding distribution center performance measurements is critical to achieving successful outcomes. A recent study (January 2010) conducted among distribution center Velocity’s readers and members of the Warehousing Education and Research Council (WERC) by Georgia Southern University (Dr. Karl Manrodt) and consultancy Supply Chain Visions (Kate Vitasek and Joseph Tillman) is their seventh annual survey of key distribution center and warehousing metrics. Although the survey indicates slow but steady improvement in operational performance it highlights significant opportunities for improvement. Transportation and Logistics

Logistics is defined as “that part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services and related information from the point of origin to the point of consumption in order to meet customers’ requirements.”<sup>1</sup> Transportation is represented in this expression through the word flow. Transportation provides the flow of inventory from points of origin in the supply chain to destinations, or points of use and consumption. Most businesses manage both inbound and outbound logistics. Inbound logistics involves the procurement of materials and goods from supplier locations. Outbound logistics involves the distribution of materials and goods to

customer locations. Therefore, transportation is necessary on the inbound and outbound sides of the business. The definition of logistics mentions not only the forward flow and storage of goods, services, and related information, but also the reverse flow.

Inventory sometimes flows in the reverse direction. Reverse logistics refers to “the role of logistics in product returns, source reduction, recycling, materials substitution, reuse of materials, waste disposal, and refurbishing, repair, and remanufacturing.”<sup>2</sup> So transportation not only delivers material and products to customers, but also moves reusable and recyclable content to companies that can use it.

As companies outsource more warehouse and distribution functions to third parties, and as more 3PLs step up to the plate and incorporate more services and solutions into their offerings, expect to see even more symbiotic relationships form between 3PLs and their customers. “We’re definitely seeing an increased interest from companies that want to use 3PLs that can expand outside of the transportation area,” says Johnson, “although right now, the majority of 3PL services are still focused on the core transportation and logistics areas.”

Johnson (2014) sees a shift coming on the horizon, however, with more 3PLs providing services around whole inventory and order visibility. “From a consumer perspective, we expect to be able to have full visibility to our orders,” Johnson says. “From the moment we place the order, through the transit process, and right up until it reaches our doorstep. That’s the expectation.” To meet that expectation, Johnson adds that warehouses and distribution centers need the kind of technology and solutions that many 3PLs already possess and provide.

### **Areas for Further study**

The gap analysis in this survey should challenge each of us to reassess our distribution center performance measurements. What do we measure? How often do we measure? What are the results? How do we compare? The gaps represent significant opportunities for improvement in bottom line results. The bottom line results will not be achievable without refocusing distribution center organizations on the fundamentals of cost, quality, and operational performance. Benchmarking assessments also consistently indicate that business process competence and workforce buy-in are important contributors to success. Business process competence is

underpinned by statistical discipline (e.g. Lean, Six Sigma). Workforce buy-in is not only critical but the workforce can become an outstanding source for continual process improvement. If you don't benchmark please let me encourage you to do so both within and outside your principal industries and markets. As we view the future, the role and responsibilities of distribution centers will continue to be shaped by the globalization of business and the integration of supply chains. As supply chains extend and become more complex and costly to operate, information technology will be critical to achieve efficiency and performance. Supply chain differentiation will continue to be achieved through value added services that reduce cost, improve service, and enhance overall product value and the customer experience.

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