



FINAL

INDUSTRIAL WAREHOUSING

IN THE SCAG REGION

**TASK 3. Assessment
of Supply Chain
Strategies and
Implications for
Future Development**

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technical report

Southern California Association of Governments Industrial Warehousing Study

*Task 3. Assessment of Supply Chain Strategies
and Implications for Future Development*

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Table of Contents

1.0	Task 3.1 Trends in Supply Chain Strategies	1-1
1.1	Executive Summary	1-1
2.0	Task 3.2 Trends in Supply Chain Strategies	2-1
2.1	Historical Trends	2-1
2.2	Emerging Trends	2-17

List of Tables

Table 1.1	Matrix of How Trends Are Impacted by BCO Needs	1-3
Table 1.2	Matrix of How Trends Are Impacted by 3PL Needs	1-4
Table 1.3	Omnichannel Retailing Options	1-11
Table 2.1	Main Indicators of the Auto Parts Industry in Mexico 2012	2-5
Table 2.2	Mexican Auto Investments, 2011 to 2012	2-6
Table 2.3	Foreign Direct Investment in Mexico by Automaker, 2007 to 2012	2-6
Table 2.4	Recent Re-shoring Cases	2-10
Table 2.5	Omnichannel Retailing Options	2-17
Table 2.6	Aligning Fulfillment Operations with Changing Channel Mix	2-25

List of Figures

Figure 2.1	Example of a Domestic Crossdock Operation	2-6
Figure 2.2	Four-Corner Distribution Center Model	2-9
Figure 2.3	RFID Applications	2-15
Figure 2.4	CenterPoint Intermodal Logistics Center	2-2
Figure 2.5	Locations of Light Vehicle Manufacturing Plants in Mexico	2-7
Figure 2.6	U.S. Job Growth, 2003 to 2013	2-9
Figure 2.7	Photos of Goods-to-Person Technology	2-14
Figure 2.8	Kiva Bots at Work in Amazon DC	2-15
Figure 2.9	Evolution of the Customer Retail Connectivity	2-19
Figure 2.10	The Omnichannel Experience	2-20
Figure 2.11	Conceptualization of Amazon Drone	2-30

1.0 Task 3.1 Trends in Supply Chain Strategies

1.1 EXECUTIVE SUMMARY

Companies use supply chain strategies to achieve two primary goals: 1) fulfill customer demand, and 2) minimize costs to maximize company profits. To meet these objectives, companies strive to match specific products with appropriate supply chain strategies. Generally, products can be categorized into two types, functional and innovative. Functional products are daily items such as grocery, gas and oil, and office supplies. Because these products have constant demand with smaller marginal profit, supply chain strategies for these products typically focus on maximizing efficiency to minimize cost. On the other hand, high fashion and time-sensitive innovative products, such as the latest model of flat screen televisions, seasonal furniture, and trendy apparel and footwear, are typically of higher value and are delivered through responsive and/or agile supply chain strategies to minimize the time to market. These strategies allow sellers to respond quickly to changing consumer preferences.

In order to meet customer demand for convenience and product variety, numerous supply chain strategies have been developed. This has led to significant changes in the way goods are manufactured, stored, sorted, and transported. This is a dynamic industry, and the system continues to evolve. In this report, relevant trends are explored to provide a better understanding of how they may impact the commercial industrial real estate market and multimodal transportation infrastructure development in the Southern California Association of Governments (SCAG) region.

Six *historical* trends were studied:

1. Mega distribution centers (DC),
2. Transloading and crossdocking,
3. DC location,
4. Value-added services,
5. Vendor-managed inventory, and
6. Information technology (IT) in cargo-handling facilities.

Five *emerging* trends also were reviewed:

1. Multimodal logistics centers,
2. Near-shoring and re-shoring,
3. Warehouse Automation,
4. Retail order fulfillment, and
5. Compressed time of order fulfillment.

These trends have been evaluated from the following perspectives:

- **Beneficial cargo owners¹ (BCO).** Companies that own the goods; and
- **Third-party logistics operators (3PL).** Companies that provide multiple logistics services for customers, such as warehousing, transloading, crossdocking, inventory management, packaging, value-added services, and freight forwarding.

One of the major changes in the logistics field in recent years is the increasing number of BCOs that use 3PLs to manage their transportation, warehousing, and inventory management needs. This has significantly impacted goods movement in Southern California as BCOs seek to fulfill the dynamic requirements of their customers, and as 3PLs find ways to more efficiently operate the facilities under their control. To stay competitive, BCOs and 3PLs must continually respond to changing conditions in international trade, retail fulfillment patterns, and technology advancement.

BCOs today are motivated by a number of key drivers to improve their supply chain performance. Those relevant to this study include the following:

1. Fulfill customer demand for greater product variety, lower costs, meet customer demands for increased convenience, and rapid delivery of products;
2. Anticipate market demand and develop strategies to capture market share;
3. Reduce total landed costs (i.e., sourcing, inventory control, multimodal transportation, distribution, and order fulfillment); and
4. Increase operating efficiency in distribution and fulfillment centers.

For 3PL operators, the picture is only slightly different:

1. Create strategies and programs that provide solutions to supply chain challenges encountered by BCOs;
2. Anticipate market demand and develop strategies to capture market share; and
3. Reduce costs and increase operating efficiency in cargo-handling facilities to offer competitive services to BCOs.

The 11 historical and emerging trends were studied with respect to the BCO and 3PL drivers listed above. The two matrices below highlight the interplay between the drivers and trends.²

Table 1.1 below offers a snapshot of how the drivers impact the trends from the BCO perspective. In certain cases, when “no” is listed, a driver still might have an indirect effect on a trend, but not a primary impact as when the answer is “yes.”

¹ In this study, BCOs are categorized by the size of their import or export volumes in terms of twenty-foot-equivalent units (TEU) per year. Large BCOs move more than 50,000 TEUs per year; mid-sized BCOs move between 2,500 and 49,999 TEUs per year; and small BCOs move less than 2,499 TEUs per year.

² Each trend is described in the sections below the matrix.

Table 1.1 Matrix of How Trends Are Impacted by BCO Needs

Trend	Driver 1. Satisfy Customer Demand	Driver 2. Increase Market Share	Driver 3. Reduce Total Landed Costs	Driver 4. Increase Operating Efficiency
Mega DCs	Yes	Yes	Yes	Yes
Transloading and crossdocking	Yes	Yes	Yes	Yes
DC location	Yes	Yes	Yes	Yes
Value-added services	Yes	No	Yes	Yes
Vendor-managed inventory	Yes	No	Yes	Yes
IT in cargo-handling facilities	Yes	No	Yes	Yes
Multimodal logistics centers	Yes	No	Yes	Yes
Near-shoring and re-shoring	Yes	Yes	No	Yes
Warehouse automation	Yes	No	Yes	Yes
Retail order fulfillment	Yes	Yes	No	Yes
Compressed time of order fulfillment	Yes	Yes	No	Yes

Table 1.2 below depicts how needs affect the trends from the 3PL perspective. As in the BCO matrix, in certain cases when “no” is listed, a driver still might have an indirect effect on a trend, but not a primary impact as when the answer is “yes.” When viewing the 3PL matrix, note that 3PLs operate warehouses, not DC; hence, several of the trends related to DCs are not considered to be impactful to 3PLs. BCOs, on the other hand, operate DCs.

Table 1.2 Matrix of How Trends Are Impacted by 3PL Needs

Trend	Driver 1. Create Solutions for Customers	Driver 2. Increase Market Share	Driver 3. Reduce Costs, Increase Operating Efficiency
Mega DCs	No	No	No
Transloading and crossdocking	Yes	Yes	Yes
DC location	No	No	No
Value-added services	Yes	Yes	No
Vendor-managed inventory	Yes	Yes	No
IT in cargo-handling facilities	Yes	Yes	Yes
Multimodal logistics centers	Yes	Yes	Yes
Near-shoring and re-shoring	No	No	No
Warehouse automation	Yes	Yes	Yes
Retail order fulfillment	Yes	No	No
Compressed time of order fulfillment	Yes	Yes	No

The following is a short description of each trend and its implications for the SCAG region.

Mega DCs

Just as container vessels have grown in size, large BCOs, especially big-box retailers, in the past two decades have gravitated to DC in excess of 500,000 square feet to gain economies of scale and improve operational efficiency. These companies strive to reduce operating costs by consolidating smaller DCs into one or a few mega DCs. These modern buildings are characterized by high ceilings in excess of 30 feet, numerous unloading and loading bays, large yards for container and trailer storage, 24/7 operations (where municipal regulations permit), cargo-handling equipment and software that automate operations, and workers skilled enough to operate these modern tools. Because of the large footprints they require, mega DCs often are located on the outskirts of urban areas where sizable land parcels are more plentiful. Easy access to ports, interstate highways, and intermodal rail systems are critical. They typically serve a wider geographic market than smaller DCs.

Due to its large population and the San Pedro Bay Ports serving approximately 40 percent of total U.S.-Asia trade, the SCAG region has attracted a disproportionately high number of mega DCs relative to many other large urban areas. Since a limited number of suitable land parcels is available in or adjacent to urban centers, BCOs have been forced to locate mega DCs farther away from the San Pedro Bay Ports, which increases transit times, travel unreliability as a result of road congestion, and transportation costs. Availability of skilled workers in these locales also can be an issue.

Transloading and Crossdocking

Transloading and crossdocking strategies are used to efficiently move imports, exports, and domestic goods. With respect to imports, transloading refers to transferring of import cargo from ocean containers into domestic 53-foot containers and trailers for onward movement to U.S. inland destinations via rail or truck. Crossdocking is a type of transloading in which the cargo is transloaded within approximately 24 hours of arriving at the transload facility.

Crossdocking operations are usually performed by 3PLs in near-port facilities under 50,000 square feet with easy access to highways and intermodal rail yards, though some BCOs use this strategy in their own DCs. These facilities are most often located in areas in which the ports, like Los Angeles and Long Beach, attract container carriers offering first port of call services to offset the extra time it takes to dray the container to the transload or crossdock facility and perform the operation.

Transload and crossdock buildings are long and narrow to decrease the distance forklifts and workers must move between the many inbound unloading doors on one side and the many outbound loading bays on the other side. Container/trailer storage yards are large relative to the actual footprint of the building. These facilities have high throughput and generate a high number of truck trips.

By utilizing larger domestic containers and trailers, transloading and crossdocking lowers the per unit cost of transportation and enables the BCO to postpone allocation of imported products to DCs or stores until customer demand can be more accurately forecast – closer to market rather than upon cargo loading at the foreign port. Approximately 40 percent of the imports entering the San Pedro Bay Ports are transloaded or crossdocked, either to rail or to truck, implying this is a supply chain strategy that large- and medium-sized BCOs have embraced. Some industry experts predict that the percentage share of imported cargo through the San Pedro Bay Ports that are transloaded and crossdocked will not increase much in the future.

Transload facilities also are located in inland areas close to population centers. These facilities are commonly used to sort inbound goods from multiple suppliers – some are imported goods and others are domestic – to outbound trailers and containers destined to specific retail store locations. Transloading often is used to consolidate export products from multiple locations within the U.S. In many cases, export crossdocking involves transfer of the contents out of domestic 53-foot trailers into ocean containers (e.g., some scrap paper exports are handled in this manner).

SCAG region has a large number of transload and crossdock facilities both near San Pedro Bay Ports and in the Inland Empire, which provides the region a competitive edge in meeting the demand for both import and export cargo. Because of the increased popularity of transloading to rail, proximity to rail hubs will become an increasingly important criterion in facility location decisions. However, due to high volume of trucks going in and out of these facilities, residents in the surrounding areas tend to be concerned about traffic congestion and emissions from trucks.

DC Location

BCOs make decisions about where to locate their DCs and how many to operate based on their unique business profiles. Some BCOs have adopted a four-corner DC strategy in

which DCs are positioned in the Pacific Northwest, Southwest, Northeast, and Southeast. Others operate one or two fairly large DCs to serve large geographies. Others use numerous, smaller regional DCs. BCOs also outsource DC operations to 3PLs. The BCO may contract out the DC function to one 3PL that may have a nationwide operation to meet the BCO's national needs, or multiple 3PLs based on the BCO's target market locations.

Major urban centers near ports (i.e., Los Angeles, Seattle, New York, and Savannah) or inland cities with easy access to large markets (i.e., Chicago, St. Louis, Memphis, and Louisville) used to be the prime magnets for DCs. In the past few years, more rural locations and those in second tier cities (i.e., in Arizona, Indiana, Kentucky, Nevada, Ohio, Pennsylvania, Tennessee, and Utah) have become attractive, particularly for larger facilities. Transportation costs and distance from markets currently are the most important drivers of DC placement. Government financial incentives, total land cost, and labor costs have become secondary considerations.

Because of its historical importance as a distribution hub with abundant ocean carrier service, access to interstate highways and intermodal rail, and proximity to a large consumer population, the SCAG region will remain a prime area for BCOs to position their DCs, regardless of the strategy they employ – either one mega DC, one smaller DC, multiple DCs, or the four-corner DC model. Suitable land parcels near the San Pedro Bay Ports, within urban areas, and on the region's outskirts will be in demand.

Value-Added Services

Value-Added Services (VAS) refer to the processes performed beyond the typical receipt, storage, and outbound shipping of products to make them “floor ready” for sale, such as bar coding application and scanning; repacking of items in cartons per special configurations (i.e., by color and size); and kitting/assembling items to create a package (i.e., cell phone, earbuds, and charger). It also can denote specialized warehousing activities performed in advance of manufacture. BCOs typically outsource VAS to 3PLs, and 3PLs perform these activities in their regular cargo-handling facilities. Since certain VAS can be complicated, higher worker skill levels, as well as more workers, may be necessary, which has implications for work force availability and training in the SCAG region.

Vendor-Managed Inventory

Vendor-Managed Inventory (VMI) is an integrated supply chain strategy in which the inventory at the distributor or retailer is monitored and managed by the manufacturer or a 3PL. VMI allows market demand to be aligned with inventory replenishment, resulting in fewer stock-outs and higher inventory turns.

With VMI, a 3PL warehouse operator may dedicate all or a portion of its facility to hold inventory on behalf of a its BCO customer's supplier at the supplier's expense until such time as the BCO, often an original equipment manufacturer (OEM) or wholesaler, places an allocation order to pull specific products (raw materials, components, or finished goods) from the VMI facility to an interim or final destination, such as an assembly plant, store, or DC. VMI inventory typically is stored near the BCO's facility. This enables the BCO to reduce operating costs, while ensuring the production inputs or finished goods are available at the required time. Automotive parts, computers, and electronics are often held as VMI. In retail, many big-box retailers are known to use VMI by assigning certain levels of

inventory to be managed by the retailers' product suppliers. For example, Wal-Mart may specify a certain number of Procter & Gamble (P&G) products to be managed by P&G until such time as Wal-Mart requires those products to be replenished in stores. P&G, in turn, may contract out this function to its designated 3PL. Demand for VMI services should increase in the SCAG region, but not cause a big surge in the number of facilities holding VMI.

IT in Cargo-Handling Facilities

To improve order fulfillment accuracy, increase operational efficiencies, and reduce operating costs, many BCOs are incorporating information technology (IT) in their DCs. BCOs keen to capture market share and gain competitive advantage are most likely to recognize the importance of IT investments. The most popular systems are Warehouse Control Systems (WCS), Warehouse Management Systems (WMS), Radio Frequency Identification (RFID), Voice Activation Systems, and Transportation Management Systems (TMS). 3PLs often install these systems as well.

A WCS directs the *real-time* activities within cargo-handling facilities to maximize the efficiency of the material-handling subsystems, such as conveyer belts and sorters, by determining the most efficient product flow. A WMS involves the receipt, storage, and movement of goods to intermediate storage locations or to a final customer, but through *nonreal-time* data. A WCS is generally integrated with a WMS to provide the facility management a comprehensive view of the movement of materials within a warehouse.

RFID tags containing electronically stored information are affixed to objects (i.e., items, cartons, or pallets) to ensure the objects' visibility as they move through the cargo-handling facility. The relative high cost of RFID tags is impeding more widespread use. Voice activation systems typically are found in high-volume cargo-handling facilities to eliminate paper, data terminal screens, and data keying; and speed up the material pick process. The worker wears a headset and a speech recognition device that communicates to a host computer or WMS. The computer or WMS wirelessly transmits a pick assignment to the worker's device, which then translates the data into audible instructions about where to go to pick the items. The worker speaks into the device to advise when the task has been accomplished, and the next assignment is transmitted to the device. A TMS optimizes routing of outbound shipments.

Installation of IT systems in more cargo-handling facilities in the SCAG region may lead to increases in warehouse productivity (i.e., more items moving in and out of a warehouse given increase in demand). While it is difficult to predict how this trend will impact the growth or decline in the labor force, it is estimated that a higher rate of IT installation will create the need for more skilled workers.

Multimodal Logistics Centers (MLC)

About 15 years ago, a few prominent commercial real estate developers began constructing large, multiple building, multimodal logistics parks in strategic locations around the U.S. These facilities offer distinct advantages for their tenants, including:

- On-site or easy access to intermodal rail and interstate highways to facilitate rapid last-mile delivery;

- Large and skilled labor pools;
- On-site U.S. Customs and Border Protection;
- Foreign trade zones (FTZ);
- Lower transportation costs; and
- Other synergistic benefits.

Tenants of these MLCs include BCOs, manufacturers, 3PL warehouse operators, ocean carriers, railroads, and vendors providing ancillary services.

Perhaps the most successful MLC is the CenterPoint Properties Intermodal Logistics Center in Joliet/Ellwood, Illinois, 40 miles southwest of Chicago – a 1,200-acre industrial park adjacent to the 770-acre BNSF Logistics Park Chicago with direct access also to the Union Pacific (UP). With more than 7.5 million square feet developed in less than five years, the industrial park is designed to encompass more than 12 million square feet of DCs and container-handling yards.

In California, several MLCs are under various stages of development:

- Located at the junction of I-5 and SR 99, one-half hour from Bakersfield, the 1,450-acre Tejon Ranch Commerce Center is being developed by Tejon Ranch Company and Rockefeller Group Development Corporation.
- In California's Central Valley, International Trade and Transportation Center (ITTC) is a 700-acre industrial park in Bakersfield with about 2 million square feet of warehousing and DC space being developed by The Allen Group. ITTC is on the main line of the BNSF and includes an intermodal facility with direct rail service to and from the Ports of Los Angeles and Long Beach.
- MidState 99 DC (also developed by The Allen Group) is a 488-acre park located in Visalia, which is halfway between Bakersfield and Fresno.
- On the site of the former George Air Force Base, in a public-private partnership with the City of Victorville, Stirling Capital Investments is developing Global Access. This project is an 8,500-acre multimodal freight transportation hub supported by air, ground, and rail connections in Victorville, approximately 60 minutes northeast of Los Angeles, 100 miles from the San Pedro Bay Ports, and close to I-15 and U.S. 395. It is air freight centric.
- Hillwood Alliance California in San Bernardino has anchored its air freight focused development to San Bernardino International Airport (SBD) and the former Norton Air Force Base with easy access I-10, I-210, and I-215. It is two miles from the BNSF Intermodal Container Facility in San Bernardino.

While there are a couple MLC developments underway in the periphery of the SCAG region and additional plans are proposed, it is yet uncertain whether demand from BCOs and 3PLs to utilize these facilities will fully materialize as expected, as BCOs and 3PLs simultaneously seek to optimize their operational efficiencies in other ways, such as aligning their supply chains more effectively and employing advanced technology. Further, to be successful, these centers cannot be located too far from San Pedro Bay Ports, yet sizable land parcels

within ideal proximity and easy access to interstate highways and intermodal rail yards are more and more difficult to find.

As the occupancy rate and build-out of these MLCs increase, more truck trips will be generated between them and the San Pedro Bay Ports, rail ramps, Los Angeles International Airport (LAX), and various regional airports. Truck traffic will increase on the region's highways. When a BCO or 3PL becomes a tenant of a MLC, it implies they have either vacated a stand-alone facility elsewhere in the region or selected the center as a new operation site. The overall number of truck trips in the Southern California transportation system may not necessarily increase dramatically, but rather, different patterns and shifts will be noticed. As such, trends in MLC development patterns merit close attention.

Near-shoring and Re-shoring

As manufacturers seek methods to reduce the total landed cost of goods, to monitor product quality, and to react more quickly to market changes, some have shifted a portion of their manufacturing to the U.S. (re-shoring) or to Latin America³ (near-shoring). A number of studies has demonstrated that it is becoming common for manufacturers to at least consider relocating portions of their production closer to their intended markets. A wide variety of factors has fueled these two related trends, with rising labor rates in China being on the top of the list.

Mexico seems best positioned to capture a sizable share of the near-shoring market with its large young, well-educated population, stable labor rates, and enhanced multimodal transportation infrastructure. Mexico has a business-friendly attitude, having signed more free and preferential trade agreements than any other country. It also has strong intellectual property laws. The most prominent industry clusters include vehicles; automotive parts; aerospace components; white goods (washers, dryers, refrigerators, etc.); electronics (cell phones and other small electronic devices); medical devices; and pharmaceuticals.

While outsourcing and off-shoring of manufacturing still dominate the current industry practice, large multinationals like General Electric and Caterpillar are re-shoring some jobs to the U.S. The types of products that lend themselves to re-shoring fall in a fairly narrow range and include electrical equipment, appliances, transportation equipment, computers and electronics, plastics and rubber products, fabricated metal products, and machinery.

Potential impacts to the SCAG region include:

- Reduced imports from China through San Pedro Bay Ports, particularly of components and semi-finished goods in the long term;
- Increase in truck traffic connecting San Pedro Bay Ports, Baja California border area, and warehouse/distribution clusters in the Inland Empire;
- More congestion and delays at Baja/California border crossings;
- Greater competition to secure empty trucks for moving products northbound as a result of a wider trade imbalance between Mexico and the U.S.;

³ Mexico, the Caribbean, and Central and South America.

- More demand for suitable sites for cargo-handling facilities near the California-Mexico border and the Inland Empire; and
- An increase in the clustering of complementary functions as suppliers group near manufacturers.

Warehouse Automation

BCOs, particularly large retailers, are increasingly investing in automated systems to more efficiently manage their DCs and better meet customer demands, particularly for rapid order delivery. Such innovations include:

- Material-handling systems;
- Conveyor sortation and controls;
- Advanced technologies, including robotics and advanced storage and retrieval systems; and
- Picking/packing technology.

BCOs selling on the Internet, in particular, are finding it difficult to process the typical small-quantity, multiple-stock keeping units (SKU) orders with conventional manual-pick systems. Where a picker had to spend 60 percent of the time traveling and 40 percent of the time picking, as is typical in a person-to-goods model, more efficient solutions are being implemented to minimize the time spent to fulfill orders. Many are adopting a goods-to-person model, in which software and hardware, such as robotic shuttles and conveyor systems, are implemented. Inbound products are put into totes, which are stored in high-density automated storage and retrieval systems. As each order needs to be filled, the appropriate SKUs are automatically retrieved from storage and brought to the picker at the pick/pack station. This reduces the likelihood that workers pick the wrong items. For example, Amazon is deploying more than 15,000 Kiva-wheeled robot drive units in 10 of its biggest DCs.

Implementation of automated cargo-handling equipment, especially in mega DCs and fulfillment centers, should reduce demand for unskilled workers over time and increase demand for skilled workers capable of operating such machines and computers, and software engineers able to deal with the complex data elements in the warehouse setting. The physical characteristics of these facilities also might evolve in terms of increased ceiling height and floor space dedicated to various activities. Existing older facilities may not be economically retrofitted, necessitating the construction of modern buildings with the desired interior configurations.

Retail Order Fulfilment

The trend with the most potential to impact the SCAG region's transportation patterns and demand for industrial space is the evolution of how orders are fulfilled. In 2012, 22 percent of U.S. manufacturers were selling on-line, but by the end of 2014, 50 percent would be⁴.

⁴ Tompkins International.

By 2022, 65 percent of orders are estimated to be either placed on-line or influenced by web searches, as opposed to 50 percent in 2012.⁵ With the rapid rise in electronic order placement in the past five years, BCOs have been challenged to decide the most efficient and cost-effective ways to replenish store inventories while fulfilling on-line orders by consumers who are increasingly expecting convenient, rapid order fulfillment usually for free. A number of approaches has emerged, and the environment continues to change. Omnichannel retailing denotes the concept of ordering and fulfilling across multiple channels to meet consumer demand for choice, flexibility, and speed (see Table 1.3).

Table 1.3 Omnichannel Retailing Options

	Shop	Order	Fulfill	Return
	(Browse)	(Buy)	(Pick up or deliver)	(Return unwanted merchandise)
1	In store	1 In store	1 Pick up in store	1 In store
2	On-line or catalog	2 On-line or catalog	2 Ship from store	2 On-line ^a
3	On phone or other mobile device	3 On phone or other mobile device	3 Ship from DC	3 On phone or other mobile device ^a
			4 Ship from fulfillment center	
			5 Ship from vendor or OEM	

Source: Cambridge Systematics, Inc.

^a Item returned via Integrator (USPS, FedEx, DHL, or other express package carrier).

Currently, most BCOs have not yet settled on a preferred methodology that suits their business profiles. Only the largest BCOs like Wal-Mart and Home Depot have implemented stand-alone order fulfillment facilities to compete with category leader Amazon. The rest of the retail industry uses traditional DCs to replenish store inventories and fill individual Internet and catalog orders. Recognizing that this may not be the optimal way to fulfill retail orders, the industry continues to explore and improve its order fulfillment practices. This will likely result in a major paradigm shift in retail order fulfillment, and perhaps significantly impact the demand on the region’s transportation system, including the location, characteristics, and configurations of industrial facilities. More details of the challenges and how BCOs are responding to the customer demand and addressing the challenges are discussed in the later section.

Compressed Time of Order Fulfillment

Amazon’s operating model has stimulated consumers’ appetite for rapid order fulfillment at either low or no cost (cost invisible to consumers), as evidenced by “Amazon Prime” and “Get it Today” program, which offer same-day delivery. Google offers same-day delivery

⁵ Ibid.

service by automobiles in parts of the San Francisco Bay Area, Los Angeles, and New York. Amazon is testing bike couriers in New York City in an effort to deliver on-line orders in one hour or less.

Further, though not yet Federally approved, testing of delivery via aerial drone is gaining much attention. When drones become feasible and economically viable for retail order fulfillment, strategic positioning of small-sized fulfillment centers across urban centers could accommodate drone delivery of small packages.

For the foreseeable future, vehicle-based delivery is expected to be the main mode for the last-mile delivery, but the leaders are expanding into low-technology methods, such as bicycles and taxis in certain situations. The environment could change dramatically and quickly as technology brings innovative capabilities like drones into widespread use. This will impact air space, traffic flow on roads and highways, and industrial warehousing – where buildings are located, their size and functions – in ways that cannot be predicted today.

Summary

This report documents prevailing trends observed in supply chain practices, specifically in industrial facilities; and identifies potential impacts in the SCAG region. The 11 trends discussed above are driving BCOs and 3PLs to alter and adapt their supply chain operations and business strategies to meet the higher expectations of consumers while remaining competitive. The consumer demand for product variety, affordability, availability, and accessibility (as in shorter delivery time) has created the complex and diverse supply chain strategies that impact how goods are moved, processed, and stored in the SCAG region. Considering all the products and services that are available, and the variation in supply chain strategies to best deliver these goods and services, there is no single approach to addressing goods movement impacts on the transportation system and development patterns of industrial facilities in the region.

Southern California is a major goods movement hub because of its large consumer base, and because it is home to the largest container port complex and the largest manufacturing complex in the U.S. It is the gateway for 40 percent of the nation's imports. It has an extensive transportation network that connects the region to the rest of the nation, and offers nearly 1.2 billion square feet of warehouse and distribution facilities.

Traditionally, SCAG's goods movement planning has focused on roadway and railway impacts, such as congestion and delay, and how they impact our region's competitiveness with other regions. Expanding SCAG's planning focus to include analysis of logistics; cargo-handling procedures; and industrial facilities (locations, functions, markets they serve, and future demand) is a new, but critical, undertaking, as there is a strong need to understand constraints and opportunities that impact the future demand for industrial facilities. To improve traffic forecasts and infrastructure needs assessment, it is critical that the regional planners and policy-makers:

- Gain a better understanding of trade patterns and supply chain strategies and how logistics, including transportation and warehouse management, serve to meet industry needs;
- Broaden the dialogue and extend outreach to goods movement practitioners; and

- Keep up with the latest trends in supply chain management, logistics, and cargo-handling procedures.

In this way, SCAG can facilitate coordinated planning among its partner agencies as they develop policies, programs, and projects designed to support the region's economic growth and environmental quality.

2.0 Task 3.2 Trends in Supply Chain Strategies

In recent years, there have been significant changes in supply chain practices. These changes have been driven by a desire to: 1) fulfill customer needs and 2) to reduce costs to maximize profits. In this report, the relevant trends are explored to provide a better understanding of how they may impact the commercial industrial real estate market and multimodal transportation infrastructure development in the SCAG region.

Six *historical* trends were studied:

1. Mega DCs,
2. Transloading and crossdocking,
3. DC Location,
4. Value-added services,
5. Vendor-managed inventory, and
6. IT in cargo-handling facilities.

Five *emerging* trends also were reviewed:

1. Multimodal logistics centers,
2. Near-shoring and re-shoring,
3. Warehouse automation,
4. Retail order fulfillment, and
5. Compressed time of order fulfillment.

2.1 HISTORICAL TRENDS

Mega DCs

Description

In the past two decades, it has become common for large BCOs, especially big-box retailers and top tier importers (e.g., Wal-Mart, Target, Home Depot, Lowe's, Ikea, Nike, etc.), to operate state-of-the-art mega DCs in the 500,000 to 1 million-square-foot range; many are much larger. The primary common drivers are to increase economies of scale by operating large and modern facilities, improve operating efficiencies, extend reach to markets across a wider geography, and reduce overall logistics costs. Yet, each BCO is motivated by a slightly different operating profile. Sometimes, this entails consolidating several smaller buildings into a mega DC (e.g., Skechers). For others, it involves operating mega DCs in areas with high store density (e.g., Lowe's and Home Depot). Some only

operate one mega DC to satisfy demand in a country (e.g., the Skechers mega DC in Moreno Valley, California, serves North America. Nike operates one mega DC for footwear and one for apparel, both in Memphis, Tennessee, to serve the U.S.). Many large BCOs position mega DCs in a four-corner DC model – Southern California, Pacific Northwest, Northeast, and Southeast – which is discussed below under the Distribution Center Location trend. Amazon, in contrast, which operates numerous mega DCs, needs huge facilities and operating space to house vast numbers of SKU.

Wal-Mart operates a 4 million-square-foot facility in Texas, as well as a number of smaller mega DCs across the country. Target's DC in Lacey, Washington, is 2 million-square-feet; most of its other mega DCs are in the million-square-foot range. In 2011, Skechers built a highly automated mega DC in Moreno Valley. Sitting on more than 200 acres, "at 3,000 feet long and 700 feet wide, Skechers' 1.8 million-square-foot DC in the eastern end of Southern California's Inland Empire is big enough to contain 40 football fields."⁶ Prior to opening this mega DC, the company had operated in six smaller warehouses in Ontario, which posed challenges in inventory control and added truck trips. This model was not sustainable because the company is on a fairly high growth trajectory, having opened its 1,000th store in November 2014. By consolidating into one facility, Skechers sought to greatly improve productivity. In the small buildings, it could handle 7,000 pairs of shoes an hour. At the mega DC, with its efficient design and advanced robotics, Skechers is able to move 18,000 to 20,000 pairs an hour.

The advantages of housing huge quantities of a myriad of SKUs in these large facilities are numerous. BCOs achieve efficiencies associated with gaining critical mass and are capable of serving customers across a wide geography, whether regionally or nationally. They secure a competitive edge and reduce inventory costs by employing push-pull supply chain strategies, in which the SKU quantity ordered from the supplier, the volume of the products pushed to stores, and the timing of that inventory placement matches forecasted consumer demand as closely as possible. Inventory visibility and control is enhanced because of the sheer concentration of products in one place, as opposed to the complexity of tracking inventory across multiple smaller DCs.

Management costs are spread over a larger number of workers. "Larger warehouses also are able to handle the high volumes of traffic required to make 24-hour operations economically feasible. In turn, operating around-the-clock allows management to better schedule truck loading and offloading and reduce driver wait times. Extending the hours of operation also allows deliveries to be scheduled around times of typical highway congestion or to match port or rail operations hours."⁷ Moreover, these BCOs benefit under programs such as PierPass, which assesses fees for picking up containers at the Ports of Los Angeles and Long Beach during daytime operations. However, not every mega DC is located in a municipality that permits 24/7 operations, as many jurisdictions frown upon or even prohibit night-time and weekend work because of the noise, lights, and traffic.

Inbound and outbound transportation costs are impacted either negatively or positively, depending upon the location of the mega DC, whether the BCO operates many or one, and the size of the market served by the mega DC. If transportation costs increase, it is a tradeoff the BCO is willing to make to achieve the other benefits.

⁶ Biederman, D., "Racing Toward Efficiency," *The Journal of Commerce*, November 11, 2011.

⁷ *Ibid.*

Though mega DCs are not constructed in a cookie-cutter manner, there are attributes that are common among them. These include ceilings 35 feet or higher, large staging yards for containers and trailers, higher ratios of dock doors to total square footage, energy-efficient lighting and building materials, and high automation in terms of material-handling equipment and software.

Because of the large land requirement, mega DCs tend to be concentrated in cities and regions with ample vacant land, such as Los Angeles' Inland Empire; Chicago, Illinois; and Savannah, Georgia. Other areas that are emerging as suitable include Nevada, Ohio, Pennsylvania, and Texas. Often, they are located near large population centers or in places where a sizable consumer population can be reached within a one- to two-day truck trip. Since they require a high number of skilled, as well as unskilled, but trainable workers, being located in population centers enables the BCO to draw from a large labor pool, particularly during peak seasons. These DCs also gravitate towards areas where there is easy access to interstate highways and intermodal rail.

Despite the many advantages, mega DCs pose certain challenges for their operators, which include the following:

- Because of their large land requirement, few parcels are still available in close proximity to large port gateways around the country, so mega DCs end up being positioned farther away than might always be optimally desired, such as in Southern California's Inland Empire, rather than proximate to the Ports of Los Angeles and Long Beach.
- By relying on one or a few mega warehouses as opposed to numerous smaller ones scattered strategically across the country, the costs to fulfill orders by truck to customers farther afield can be high, particularly as the price of fuel increases.
- Last-mile transit time from the DC to final destination lengthens.

BCOs have figured out how to minimize disadvantages in order to reap the benefits. One way is to work with motor carriers to match inbound and outbound loads through a backhaul program to reduce transportation costs. Some BCOs incorporate a near-port transload or crossdock program (see following trend section) to better position cargo once it arrives at the inland mega DC.

Implications for the SCAG Region

With its many favorable attributes, the SCAG region will continue to be a magnet for mega DCs, with the Inland Empire and other less densely developed areas on the outskirts of Los Angeles being the most logical areas for future construction. However, due to limited land availability in the urban area, additional construction of mega DCs is expected to take place farther inland. Big-box retailers and large importers of fast moving consumer goods, such as apparel, footwear, electronics, and household products, will continue to be the most prominent categories of BCOs to employ the mega DC strategy.

Similar to smaller scale DCs and warehouses, mega DCs rely upon a smooth functioning multimodal transportation network for inbound and outbound shipments, highlighting the imperative need for transportation infrastructure investment to ensure mobility and accessibility for trucks serving these facilities and the rail system that connects these facilities to the rest of the country. Considering the potential locations for the future mega

DCs and associated transportation network capacity needs, stronger collaborative planning among local jurisdictions, county transportation commissions, the California Department of Transportation (Caltrans), and SCAG will be needed.

Traffic generated by mega DCs is naturally more concentrated compared to multiple smaller sites. This will place greater pressure on nearby freeway ramps and on arterials leading to these facilities. However, regional impacts from vehicle miles of travel (and resulting emissions from trucks) could be more or less depending on the locations of the mega DC's customers.

Transloading and Crossdocking

Description

A primary goal of BCO supply chain strategies is to fulfill customer demand at a minimal cost to the company. Transportation cost is one of the major components that influences total landed cost of goods. The transportation cost per unit is lowest on ocean vessels, followed by rail, then truck, and lastly air freight. In order to lower inland transportation costs, many BCOs in the wholesale and retail trades, particularly big-box retailers, have incorporated transloading and crossdocking into their supply chains. These operations also enable the BCO to allocate products to stores later in the cycle to more closely align merchandise with forecasted demand.

The terms transloading and crossdocking are sometimes used interchangeably in the industry. For the purposes of this study, transloading is defined as a strategy in which a third-party warehouse (3PL) operator transfers the contents of approximately three import marine containers into two domestic 53-foot rail or truck containers at a warehouse near a gateway port for onward movement to a U.S. inland destination. This process converts the shipment from an international intermodal move under control of the ocean carrier on a through bill of lading to final U.S. destination into a domestic rail or domestic truck move controlled by the BCO and arranged by the BCO's nominated intermodal marketing company (IMC), such as JB Hunt, Pacer, Hub Intermodal, and Schneider, or motor carrier. Transloading takes place within a short timeframe (days or weeks), so cargo storage is minimal.

Crossdocking differs from transloading, in that, the cargo is transferred within approximately 24 hours from an inbound ocean container to an outbound rail or truck container without being stored on pallets or racks in the warehouse. It can also denote merging either domestic and/or import cargo already in U.S. warehouses. It usually takes a day for a crossdock operation to occur, which includes the dray from the port to the crossdock facility, and then to the rail ramp, in the case of a rail move.

Transload and crossdock facilities are typically less than 50,000 square feet, rectangular in shape, with many doors on the two long opposite walls (one for inbound and one for outbound) to facilitate rapid transfer of cargo and minimize interim forklift trips. Yards are large to accommodate numerous trucks and containers. For their size, transload and crossdock facilities generate a high volume of truck trips.

In order for transloading and crossdocking to make economic sense for a BCO from a transit time perspective, this activity is typically performed near a gateway port, where first port of

call services are abundant to mitigate the time needed to perform the transload or crossdock operation. This strategy also reduces the cost associated with repositioning empty ocean containers back to the port of call. Transloading and crossdocking facilities are most prevalent near the Ports of Los Angeles, Long Beach, Seattle, Tacoma, New York and New Jersey, and Savannah. Most ocean carriers make their first port calls at these Ports. Rail intermodal service and domestic rail and truck equipment also are readily available.

Another key benefit of this strategy is that the final allocation decision for the imported products can be made just as the vessel approaches the U.S., rather than at the time of container loading at the foreign origin. The BCO is able to direct the products to the DC or rapid replenishment center best suited to meet customer demand by transloading or crossdocking the cargo near the port of entry. This helps maximize inventory turns and minimize inventory obsolescence and price markdowns. Other value-added services can be performed at the transload or crossdock facility, such as merging the international imports with domestically sourced products or cargo that was previously imported and stored in the facility into outbound containers.

Transloading/crossdocking improves warehouse efficiencies, primarily by reducing the man-hours required to receive, put away, pull orders, and ship product. Other benefits include:

- Consolidated shipments to destinations;
- Savings from reduced inventory-carrying costs;
- Reduced transportation costs; and
- Products getting to market faster.

Approximately 40 percent of import containers moving through San Pedro Bay Ports during the period of July 2010 through June 2011 were transloaded.⁸ The number of transloaded marine containers (to rail and truck combined) was estimated at 2,900,000 TEUs, which includes:

- About 1,964,000 TEUs (27 percent of total imports at San Pedro Bay Ports) that were transloaded into 53-foot domestic containers shipped out of the region by rail; and
- About 912,000 TEUs (13 percent of total imports at San Pedro Bay Ports) that were transloaded into wheeled trailers for shipment by trucks to final destinations.⁹

However, the volume of transloaded or crossdocked cargo of import cargo in the region may not increase measurably in the future, as BCOs indicate that majority of imports that can be transloaded is already being transloaded.¹⁰

Transloading and crossdocking volumes continue to be constrained by the situation in Southern California. Congestion within the Ports of Los Angeles and Long Beach currently is at a high level, primarily because marine terminals have not solved the chassis management issue now that most ocean carriers have divested themselves of chassis. Wait time at marine terminals compromises the ability of drayage drivers to make multiple

⁸ “Transloading of Marine Containers in Southern California,” Cambridge Systematics, Inc., December 13, 2012.

⁹ *Ibid.*

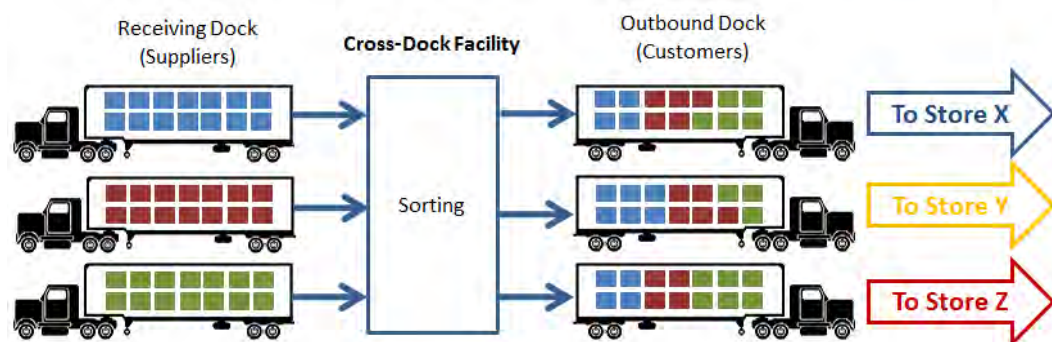
¹⁰ Mongelluzzo, B., “Transloading Hits Record at LA-LB in 2013, But Future Growth Uncertain,” *The Journal of Commerce*, January 31, 2014.

trips per day, and therefore, their profitability. The drayage industry is under huge pressure. It is challenging for BCOs to secure additional drivers to move containers from the San Pedro Bay Ports to Inland Empire DCs, as most motor carriers have all the business they can handle, and they are reluctant to accept such assignments because a driver can make only one trip a day on this route as a result of marine terminal congestion. This makes it difficult to secure enough drivers to dray containers to transload and crossdock facilities near the ports since the entire pool is inadequate.

For transloading and crossdocking volumes to increase in the SCAG region, additional capacity in these facilities is required, either in new facilities or through higher throughput in existing facilities. Yet, space for new operations is hard to come by. The vacancy rate for industrial properties in Los Angeles is down to 4 percent; the second lowest in the U.S. after New York’s 1.1 percent, and well below the national average of 7.4 percent.¹¹

Crossdocking also is a widely used practice to position goods from multiple domestic suppliers into trucks destined to specific customer store destinations. Figure 2.1 below illustrates how products from inbound trucks from multiple suppliers are sorted, reconfigured, and reloaded into outbound trucks per the BCO’s desired allocation. In this case, the operation is done at the BCO’s DC, but more often, 3PLs perform this function. Domestic crossdocking from 53-foot trucks into 53-foot trucks is designed primarily to more effectively replenish store inventories, rather than reduce inland transportation costs.

Figure 2.1 Example of a Domestic Crossdock Operation



Source: SCAG.

Implications for the SCAG Region

Transloading and crossdocking have become fundamental elements of the supply chain strategies of most large and mid-sized BCOs. The SCAG region will continue to be a prime area for this activity because of the variety and quantity of ocean carrier first vessel call services that are available at San Pedro Bay Ports, the number of 3PL warehouse operators offering this service, supply of rail and truck containers because Southern California is a large population center, and easy access to the intermodal rail yards and interstate highway systems. Further, transloading helps to strengthen San Pedro Bay’s position as a desired port of call for imported cargo. The alternative is to move imported cargo “intact” via rail in

¹¹ “Southern California Pressure Cooker,” Peter Tirschwell, *The Journal of Commerce*, September 29, 2014.

the original 40-foot container, also known as Inland Point Intermodal (IPI). IPI cargo is more susceptible to diversion to other gateways, because demand for IPI cargo is more elastic with respect to price than transloaded cargo.

Keeping the constraints highlighted above in mind, one can surmise that transloading and crossdocking of imported cargo in the SCAG region may not grow substantially in the next few years unless the environment in the marine terminals, driver shortages, and industrial real estate sectors dramatically improves.

It is critical to establish strong support for freight mobility on key access roads between the ports, intermodal rail yards, highways, and the high concentration areas with transload and crossdock facilities. Because these facilities are drawn to near-port land by the nature of their functions, it is important for suitable parcels to be available with easy access to highways. Zoning and other regulations need to support 24-hour operations and the provision of ample truck parking and container storage, as well as geometric configurations that are conducive for truck operations. Though many cargo-handling facilities exist in near-port municipalities, the interior design, shape, and small number of doors of many are not appropriate for transload or crossdock operations; and these somewhat antiquated buildings cannot be easily or economically reconfigured.

Another impact of increased transloading in Southern California is fewer containers moving on the Alameda Corridor and lower revenue for the Alameda Corridor Transportation Authority (ACTA). Transloaded containers are not subject to ACTA's user fees.

DC Location

Description

Traditionally, importers operated one, or maybe two DCs, to handle national and international distribution. These tended to vary in size, but usually were less than 500,000 square feet, unless the BCO was sizable. In contrast, big-box retailers like Wal-Mart, Target, Home Depot and Lowe's, must operate numerous DCs because of their sheer volume; and these buildings typically are large.

In the past decade or so, many BCOs have reevaluated their supply chains and changed their approach on inventory management to meet customer demand. Many factors influence the number of DCs a BCO chooses to operate and their placement across the U.S. Previously, state and local government tax abatement and other incentives and abundant, competitively priced land and labor were key factors. Today, proximity to consumer market and access to all modes of transportation are stronger drivers than tax and financial incentives in choosing distribution facilities to achieve quick response to changing customer demand.^{12,13} As retailing has evolved and become more fragmented and competitive, with e-commerce representing a greater portion of overall sales, rapid order fulfillment and customer satisfaction are becoming more important than ever. Most BCOs consider a DC's optimal market service range to be a one- or two-day truck trip.

¹² Mongelluzzo, B., "Customer Location Central to DC Choices, Shippers Say," *The Journal of Commerce*, July 1, 2011.

¹³ Scally, T., "Logistics Drives Site Selection," *World Trade 100*, October 2014.

This shift to smaller and more numerous regional DCs is occurring simultaneously with the mega DC trend. This is an indication that the number of DCs and their placement is a function of BCO size, types of goods the BCO handles, and the best suited supply chain strategies that fulfill customer demand at the lowest cost to the BCO. Determining the best location for a new DC requires companies to consider not only local, but global, factors that will affect the cost of getting their goods to their customers. Transportation currently represents the largest single cost factor in the supply chain, as much as 10 times the cost of real estate and rent. With escalating fuel and trucking costs, BCOs and 3PLs are finding important savings in inland DC locations close to rail intermodal hubs; some of which are located in smaller, less congested, and less costly cities.¹⁴ Since 2000, construction has begun on approximately 146.6 million square feet of industrial space within five miles of a U.S. intermodal terminal to serve smaller DC markets.¹⁵

In meeting the selection criteria for transit time to market and cheaper rents, nontraditional states, such as Arizona, Indiana, Kentucky, Nevada, Ohio, Pennsylvania, Tennessee, and Utah, are starting to attract new DC developments.¹⁶ These locations offer a two-day truck trip to large population centers, with lower rents than in gateways, such as Los Angeles and the New York-New Jersey region. Capacity in Atlanta, Georgia, is 12.4 million square feet, 104 percent higher than in second quarter 2014. In excess of 141 million square feet are still under construction, 53.5 percent higher year over year. About 45 percent of demand is for facilities more than 500,000 square feet.¹⁷

To illustrate this geographic expansion to smaller, nonmaritime industrial real estate markets, in 2014, Wal-Mart opened a 1.2 million square-foot on-line retailing fulfillment center outside of Indianapolis near the CSX intermodal hub in Avon. With access to five interstates, including the major east-west throughway I-70, the DC can reach 90 percent of the U.S. population within two to three days by truck. The DC will be the newest tenant at AllPoints Midwest, a 958-acre distribution park near Indianapolis International Airport, which houses FedEx's second-busiest freight hub in the U.S. In 2008, Amazon opened a 650,000-square-foot DC northwest of Indianapolis and has at least four fulfillment centers in the State, according to its web site.¹⁸

As BCOs seek to respond quicker to market demands, there has been a trend for medium and large BCOs to employ a four-corner DC strategy, as opposed to having one or two. Using this strategy, the BCO typically locates facilities in the Northeast, Southeast or Gulf, Pacific Northwest, and Southern California. This enables maximum nationwide coverage and fulfillment of most orders within a one- to two-day timeframe by truck (Figure 2.2). This increases flexibility and lowers inland transportation costs because of the shorter distances to the ultimate customer. These DCs vary in size and have distinct purposes or operations. For example, the BCO might have one large import DC in Los Angeles, and

¹⁴ Boyd, J. H., 2012, "Think Globally, Site Locally," The Boyd Company, Council of Supply Chain Management Professionals Supply Chain Quarterly, Quarter 5.

¹⁵ "The Site is Right," Mark Szakonyi, The Journal of Commerce, September 1, 2014.

¹⁶ Szakonyi, M., "Driving DCs Inland," The Journal of Commerce, March 19, 2012.

¹⁷ "Shippers Expand Distribution Center Footprint," The Journal of Commerce, November 10, 2014.

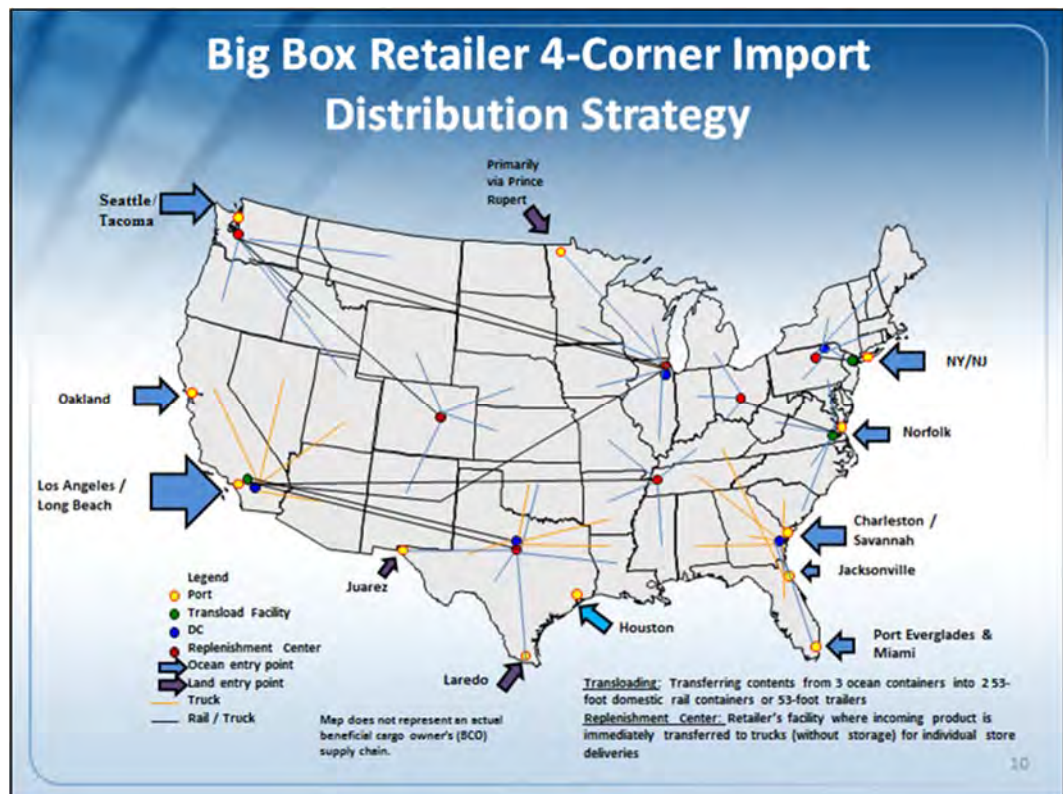
¹⁸ Szakonyi, M., "Wal-Mart Latest to Tap Indiana as e-commerce Hub," The Journal of Commerce, July 2, 2014.

smaller rapid replenishment centers (RRC) that store the most popular items for quick fulfillment of orders in the other three locations.

BCOs can derive a number of benefits by having multiple DCs that include the following:

- The foremost benefit is rapid delivery to customers as a result of shorter distances between the BCO's DCs and its customers' DCs or the BCO's stores.
- Expediting hot orders is less expensive from a transport perspective because of the shorter distance to travel from DC to customer.
- The BCO can route containers in the most advantageous and cost-effective way for each order, depending upon product value and time sensitivity. Choices increase. For example, the BCO can select intermodal landbridge via West Coast ports, transloading or crossdocking at West Coast port gateways, or all-water via the Suez or Panama canals to East and Gulf Coast ports.
- Having more than one DC decreases the risk of product stock-outs or the inability to fulfill orders due to natural disasters or other unforeseen, uncontrollable events since the other DCs can step in.

Figure 2.2 Four-Corner Distribution Center Model



Source: Cambridge Systematics, Inc.

Yet, drawbacks and complexities of operating multiple DCs exist. Some are:

- Inventory forecasting can be fraught with inaccuracies, depending upon how sophisticated and integrated the BCO's IT systems are, its order cycle time, transit times of inbound products based on routing, and unpredictable events that disrupt supply chains. As a result, and to minimize the risk of failure to fulfill orders, the BCO often keeps a higher level of buffer stock than is really necessary, which drives up operating costs.
- It can be difficult to determine whether to store the same SKUs in each DC or allocate certain SKUs to each one, and then decide the quantities to maintain by SKU. This creates inventory management issues.
- Additional management across facilities increases overhead costs.
- The BCO might utilize different WMS in its facilities, which complicates data flow and integration between the corporate order management and financial systems and the WMSs.
- Planning the frequency of inbound deliveries to replenish stock is more complicated with multiple DCs.
- Space capacity in each DC might not be fully utilized at all times, which drives up costs.

The BCO must carefully weigh the benefits and risks of adding facilities to its order fulfillment model. It will likely continue to be only mid- and large-sized BCOs that are able to effectively employ a four-corner or multiple DC strategy.

Implications for the SCAG Region

Even though other states have gained momentum in attracting DCs, because of its strategic location and population density, the SCAG region will remain a prime area for BCOs to position DCs, regardless of whether they have a mega DC, one DC, multiple DC, or four-corner DC models.

However, land availability and transportation network accessibility are obvious constraints near the urban population centers, as well as outskirts of the urban areas. Other considerations, such as contrasting interests from local jurisdictions for land use types and facility operations, need to be widely discussed among various stakeholders to balance the region's economic sustainability.

Relative to one mega DC, traffic generation for multiple DCs is more dispersed. The interest in siting facilities closer to population centers to reduce time of delivery could have significant impacts on traffic patterns and real estate demand. It is possible that industrial real estate rents could increase in the urban core because of pent-up demand for facilities in the urban core.

Value-Added Services

Description

Value-Added Services (VAS) refer to the processes performed beyond the typical receipt, storage, and outbound shipping of products to make them "floor ready" for sale. It also can

denote specialized warehousing activities performed in advance of manufacture. VAS can include such activities as:

- Barcode application, barcode scanning, and barcode data transmission;
- RFID tag application, scanning, and data transmission;
- Marking, remarking, labeling or relabeling of items, product tags, inner cartons or outer cartons;
- Item tag and security tag application;
- Repackaging of products into carton assortments by color, size, or other desired configuration;
- Pick-and-pack of items from original cartons into other cartons;
- Breaking down pallets or removing shrink-wrap from pallets;
- Kitting or bundling of several components together into one package for sale (i.e., a cell phone, case, charger, and ear buds);
- Retailer-specific customization of product configurations, especially for special promotions of slow-moving products to mitigate aging inventory;¹⁹
- Managing new product launches;
- Quality control inspections of specific products;
- Garment processing such as steam pressing, mending, folding, insertion of hangers, and placing hanging garments on garment-on-hanger (GOH) racks;
- Outbound transportation network planning and optimization;
- Managing product returns from customers (reverse logistics);
- Sequencing products to correspond to assembly line requirements;
- Line-feeding – delivering assembled components to a production line on a just-in-time (JIT) or just-in-sequence basis; and
- Light manufacturing and assembly.

BCOs perform VAS in their own DCs, but most often 3PL warehouse operators perform these activities to conserve space for storage, cargo receipt, and shipping within their DCs. Although foreign factories or foreign 3PLs perform many types of VAS, the retailer or manufacturer often chooses to have it done after the products enter the U.S. to take advantage of more recent consumer demand forecasts or updated manufacturing schedules. This helps to decrease the potentially costly risk of making the wrong decision.

Implications for the SCAG Region

Even if the demand for VAS increases in the near term, it is unlikely that additional DCs or 3PL warehouses will be constructed to accommodate the activity as existing facilities should be adequate. This trend should have a neutral impact on the transportation infrastructure

¹⁹ Sensing, S., 2010, “Value-Added Services Bring Flexibility to the Supply Chain,” Inbound Logistics.

and industrial real estate market in the SCAG region. Since certain VAS can be complicated, higher worker skill levels, as well as more workers, may be necessary, which has implications for work force availability and training in the SCAG region.

Vendor-Managed Inventory Warehouses

Description

A Vendor-Managed Inventory (VMI) warehouse is defined as a 3PL warehouse or portion of one that holds inventory on behalf of a BCO's supplier at the supplier's expense until the BCO, often an OEM or wholesaler, places an allocation order to pull specific products (raw materials, components, or finished goods) from the VMI facility for transport to an interim or final destination, such as an assembly plant, store, or DC. The 3PL dedicates the entire facility or just a portion of it to storing products for a particular supplier or group of suppliers that sell to that BCO. The VMI warehouse usually is near the BCO's DC or factory. Having a VMI warehouse enables each supplier to move products out of its typically small warehouse space usually colocated at the factory, and for the BCO to delay ownership of and liability and payment for the products till the BCO really needs the products, while at the same time ensuring the products have been produced and are readily available. Ace Hardware and Dell Computer were early adopters of the VMI strategy. This strategy is fairly common in the high-technology and automotive industries.

Key benefits from VMI include:

- Lean inventory by visibility and minimum/maximum electronic data interchange (EDI) submitted reports;
- Noncore activities of the BCO managed by the logistics service provider;
- Shorter supply times of components for production; and
- Improved working capital and reaction to demand fluctuations.²⁰

“VMI takes the art and the problem of handling inventory needs efficiently to a new level. It goes beyond the idea of ‘just-in-time’ to something like ‘exactly what you need when you need it.’ It is made increasingly feasible by continuing advancements in inventory management software technology and the increasing ability of 3PLs to provide a variety of value-added warehousing solutions.”²¹ Warehouses administering VMI also perform other activities such as VAS and even transloading and crossdocking, depending upon the time-sensitivity of the order, nature of the products, and the BCO's desires.

Implications for the SCAG Region

We can surmise that demand for VMI services will increase in the SCAG region, particularly among certain sectors like automotive parts, computers and electronics, but it is **not likely to cause a sizable surge in the number of facilities performing such a service**. Not every 3PL is equipped to handle VMI or wishes to do so. It is quite possible that truck trips will increase because of the interim stops at the VMI facilities. Transport of inbound and outbound orders will be in ocean containers, domestic 53-foot containers, full truckloads,

²⁰ www.panalpina.com.

²¹ Debenedetto, B., “Putting Vim in VIM,” *The Journal of Commerce*, February 12, 2007.

less-than-truckload trucks, and delivery vans, depending upon the quantity and time-sensitivity of each order.

IT in Cargo-Handling Facilities

Description

Modern cargo-handling facilities demand more sophisticated, robust software systems to manage inventory and move it through the facility efficiently and cost effectively and to meet evolving customer demands. About 42 percent of warehouse managers considered or have integrated some type of automation for their operations.²² In this trend, a number of IT systems is discussed:

- WCSs,
- WMSs,
- RFID,
- Voice Activation Systems, and
- TMSs.

Warehouse Control Systems (WCS)

A WCS is a software application that directs the *real-time* activities within warehouses and DCs. The WCS is responsible for keeping everything running smoothly within four walls of a warehouse; maximizing the efficiency of the material-handling subsystems, such as conveyer belts and sorters, by determining the most efficient product flow; and often, the activities of the warehouse associates themselves. It interfaces to the WMS (discussed in the next section). A WMS involves the receipt, storage, and movement of goods to intermediate storage locations or to a final customer, but through *nonreal-time* data. The bridge between the two systems has become blurred and functionality sometimes overlaps.²³

A WCS “enables companies to efficiently process and ship both individual and bulk orders from a single location. One facility can then satisfy both needs, which saves organizations money and space – especially since the software allows for more densely packed inventory. The software evaluates orders and determines the most efficient way to route inventory to the appropriate stations within the facility, based on their sizes and destinations. The software also reduces the dependency on people to complete the most repetitive and heavy lifting processes in the warehouse/DC by automating the movement of goods, which lessens the impact on operations as the labor force shrinks. A WCS gives operators real-time, granular insights into their systems that allow them to fine-tune all of the different processes as they’re running. Each WCS module provides insight into the performance of its particular area of usage, such as a zone, storage area, pinch points and schedules, and

²²Marble, R., “Aligning the Distribution Center with the Demands of the New Digital Consumer,” Supply and Demand Chain Executive, May 30, 2014.

²³Alexander, J., “Omni-Tasking for Omni-Channels,” World Trade 100, February 3, 2014.

then turns operational data into useful information that can be applied to effect positive change. It's an iterative practice: Operators get new information; they improve the process; and on and on, the cycle continues, with each round becoming incrementally more streamlined and efficient than the last."²⁴

Larger companies with intricate operations and the capital to invest in supply chain optimization tools are more likely to implement a WCS. As more companies sell a greater portion of their goods on the Internet, the complexity of their distribution processes will increase. At a certain point, they will have little option but to make that investment in WCS software that can manage the higher level of complexity, lest they risk customer service failures and decreasing profitability as a result of operational inefficiencies. This is especially true for BCOs operating complex fulfillment centers, where both e-commerce orders are dispatched and store replenishment is conducted.

Warehouse Management Systems (WMS)

A WMS is a software application that supports the day-to-day operations in a warehouse by enabling centralized management of tasks, including putting away merchandise; tracking inventory levels and stock locations in floor stacks, bins and racks; and picking outbound orders. Inventory visibility in real time is achieved through the use of technology, such as barcode scanners, mobile computers, and RFID, to efficiently monitor the flow of goods.

Radio Frequency Identification

RFID is another type of IT tool now commonly used in cargo-handling facilities to track items and cartons. RFID "refers to small electronic devices that consist of a small chip and an antenna. The chip typically is capable of carrying 2,000 bytes of data or less. The RFID device serves the same purpose as a barcode or a magnetic strip on the back of a credit card or ATM card; it provides a unique identifier for that object. The RFID device must be scanned to retrieve the identifying information."²⁵

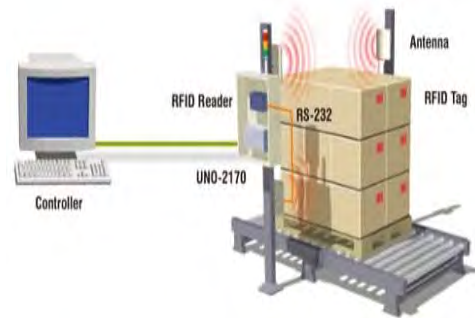
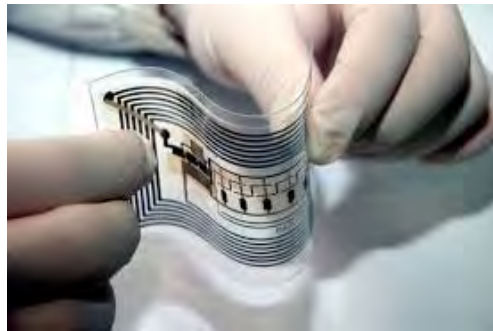
More than 20 years ago, BCOs and 3PLs started implementing this technology in their operations. RFID tags can be affixed to items or cartons, depending upon the product value or characteristics. In the retail setting, it is large companies like Wal-Mart that have been driving the increased use of RFID technology, particularly to track high-value items as they move through the supply chain. Large manufacturers such as Boeing use RFID to better manage the assembly process. Ocean carriers, motor carriers, and railroads are even using RFID tags on containers, trucks, truck chassis, and rail equipment to manage those capital assets. 3PL warehouse operators often attach RFID tags to cartons as they are unloaded from the container or truck in order to track the inventory as it moves from carton put-away to outbound shipping. At the Ports of Los Angeles and Long Beach, RFID tags are used to manage truck arrivals and departures at marine terminals. Tags are attached to the rear-view mirrors of trucks. The tag is read when the truck arrives at the portal, and the truck is matched to a database used to administer the Clean Trucks Program and the PierPass program.

²⁴Ibid.

²⁵<http://www.technovelgy.com/ct/technology-article.asp>

The following four images in Figure 2.3 depict examples of how RFID technology is being adopted in cargo-handling facilities.

Figure 2.3 RFID Applications



Sources: skladman.com; and Advantech.



Sources: Findwarehousejobs.com; and www.clearstreamrfid.com.

Though adoption of RFID has gained momentum, many BCOs and 3PLs cannot justify the added expense of this technology, with other parts of their businesses competing for scarce financial resources. Many prefer solutions that are lower in cost. It is uncertain how much RFID will proliferate in the supply chains of the future.

Despite these rosy projections, however, the economic turmoil of the past two years has undoubtedly had an impact on the RFID market, according to Shel Myeroff, President of Direct Recruiters (www.directrecruiters.com), a Cleveland-based executive search firm that places sales and technical staff with vendors that sell supply chain solutions to end-user companies. “Real demand for these solutions is still pretty low,” Myeroff says. Not that companies aren’t interested in achieving the benefits of RFID, he adds. Rather, end-users are having trouble justifying the investment and “pulling the trigger” on projects at a time of economic uncertainty. As a result, vendors have focused on offering solutions that are low cost, can be implemented quickly, and can provide fast return on investment.

Voice Activation Systems

Voice activation systems are another innovation being adopted in high-volume cargo-handling facilities. The worker wears a headset and a speech recognition device on his or

her belt, or the device can be mounted to a forklift. The device communicates to a host computer or WMS. The computer or WMS wirelessly transmits a pick assignment to the worker's device, which then translates the data into audible instructions about where to go and the items to pick. The worker speaks into the device to advise when the task has been accomplished, and the next assignment is transmitted to the device. Voice activation systems eliminate paper, data terminal screens, and data keying; and speed up the pick process. With both hands free, workers simply listen, pick, and speak.²⁶

Transportation Management Systems (TMS)

Many retailers, especially mid-sized and large ones, use TMS to optimize routing of outbound shipments. These TMS support making cost/service tradeoffs for shipping activities. Moving into e-commerce impacts a company's shipping processes, necessitating an upgrade to a more robust and integrated TMS to handle omnichannel commerce. Internet orders typically are moved by the Integrators (FedEx, UPS, DHL, and other express carriers), rather than by the dedicated delivery services or fleets many retailers use. Moreover, consumers expect near-instant information on shipping costs and order status when they order on the Internet. E-commerce fulfillment requires real-time status feeds and better integration between systems for ordering, inventory, and customer management than traditional channels.²⁷

Implications for the SCAG Region

The wider proliferation of efficiency-enhancing IT systems in DCs and 3PL facilities may lead to increases in warehouse productivity (i.e., more items moving in and out of a warehouse, given an increase in demand). While it is difficult to predict how this trend will impact the growth or decline in the labor force, it is estimated that a higher rate of IT installation will create the need for more skilled workers and possibly a slight reduction in the workforce required, which could directly impact the economies of cities in the SCAG region. These IT systems-related jobs will command higher wages as well, making them desirable.

It will likely mean that the internal layout and configurations of existing cargo-handling facilities will be rearranged, although with a neutral impact to the region in terms of the number of facilities. It also seems possible that with an increase of IT applications and their combinations in one cargo-handling facility (i.e., VMI, WMS, WCS, RFID, etc.), potentially smaller facilities might become more in demand than before as utilization of a facility could improve significantly. This might be an opportunity for infill redevelopment in the Gateway Cities area. In that case, there will be implications to transportation infrastructure, local access, and hours of operations to comply with local ordinances, etc.

Improved productivity within the warehouse implies the ability to move more cargo with the same square footage. This potentially implies a higher truck trip generation rate per square foot. The efficiency and productivity gains within the warehouse may also result in higher warehouse utilization within a given square footage, potentially reducing the amount of square footage needed to store the same volume that currently is stored at much larger

²⁶Alexander, J., "Voice Streamlines DCs," *World Trade 100*, February 1, 2013.

²⁷"The Impact of Omni-Channel Fulfillment on Distribution Systems," www.fortna.com.

facilities. This may influence the amount of larger warehouses and DCs needed in the SCAG region.

2.2 EMERGING TRENDS

Multimodal Logistics Centers (MLC)

Description

Commercial real estate developers are constructing large, multiple building, multimodal logistics parks in strategic locations that offer distinct advantages for their tenants, such as easy access to intermodal rail and interstate highways to facilitate rapid last-mile delivery, large labor pools, on-site U.S. Customs and Border Protection, foreign trade zones (FTZ), lower transportation costs, and other synergistic benefits. These real estate developers often capitalize on the site's natural attributes by focusing on one mode in particular; for example, positioning the center adjacent to rail mainlines or by redeveloping former military air bases into air-centric logistics complexes. They market the complexes to attract a mix of retailers; manufacturers; logistics service providers (3PL warehouse operators, ocean carriers, railroads, motor carriers, etc.); and vendors performing support services (i.e., equipment maintenance and repair).

An example of a highly successful MLC that puts intermodal rail front and center is the 6,500-acre CenterPoint Properties Intermodal Logistics Center in Joliet/Ellwood, Illinois, 40 miles southwest of Chicago. Development of the land in Joliet commenced in 1998 and Ellwood in 2002. The center features an ultramodern, 1,200-acre industrial park adjacent to the 770-acre BNSF Logistics Park Chicago. With more than 7.5 million square feet developed in less than five years, the industrial park will eventually encompass more than 12 million square feet of DCs and container-handling yards.

A key advantage is reduced average drayage and demurrage costs per container because of the Center's proximity to the rail yard and its location in FTZ No. 22. Importer tenants can save an estimated \$200 to \$275 per container compared to locations as little as five miles away.²⁸

Current tenants are listed below.²⁹

- The DeLong Company,
- Stepan Chemical Company,
- The Home Depot,
- BNSF Container Yard,
- Georgia Pacific,
- DSC Logistics,
- Clearwater Paper,
- ITL,
- Partners Warehouse,
- Wal-Mart,
- Logistics Team,
- Saddle Creek Logistics,

²⁸<http://www.allengroup.com/?p=1266>.

²⁹www.centerpoint-intermodal.com.

- Cypress Medical Products,
- Bissell,
- Neovia Logistics Services,
- Bridge Terminal Transport,
- Saturn Agriculture,
- NFI,
- APL,
- Mediterranean Shipping Company,
- U.S. Army T.E.M.F.,
- Resource Management Company,
- Cargill,
- Central States Trucking,
- Container Port Group,
- Adrian Carriers,
- Gertsen,
- Prairie Materials,
- Pacer,
- Gavilon Grain,
- Potlach,
- Sanyo Logistics, and
- LaFarge.

Figure 2.4 depicts an aerial view of the CenterPoint Intermodal Logistics Center. The BNSF and UP rail yards are clearly visible adjacent to the 3PL warehouses and BCO DCs.

Figure 2.4 CenterPoint Intermodal Logistics Center



Source: CenterPoint Properties.

Another MLC of note is the 1,450-acre Tejon Ranch Commerce Center being developed jointly by Tejon Ranch Company and Rockefeller Group Development Corporation as a master planned development with a mix of industrial, commercial and retail leasing and building opportunities. The complex is located at the junction of I-5 and SR 99, one-half hour from Bakersfield, two hours north of the San Pedro Bay Ports, and four hours south of the Port of Oakland. It boasts of “advantages in low total cost of operations, a large productive and loyal labor force, logistical advantages and a business-friendly operating environment,”³⁰ and it is an FTZ. It does not appear that direct rail access is available; unlike many other MLCs. However, the Kern Economic Development Corporation’s web site presents the following information regarding nearby cargo rail service:

- **BNSF – main line:**
 - Nearest Intermodal – Shafter, Los Angeles, Fresno, and Barstow;
- **San Joaquin Valley Railroad – short line and regional railroads:**
 - United States and Canada; and
- **UP – main line:**
 - Nearest Intermodal – Los Angeles, Fresno, and Modesto.

Currently, parcels from 20,000 to more than 2 million square feet are available for lease or purchase. DCs and 3PL warehouses can operate 24/7 because no existing or planned residential areas are in close proximity. As of December 2013, the following companies had operations in the complex: Ikea which has a 1.7 million-square-foot customized DC, Sears, Wal-Mart, Target, Car Quest, Caterpillar, Nestle, Frito Lay, Famous Footwear, and Dollar General. As is often the case, to entice companies to locate cargo-handling facilities in their cities and states, the Kern Economic Development Corporation helps companies secure financial incentives.

Two more examples of a multimodal logistics parks are located in California’s Central Valley – International Trade and Transportation Center (ITTC) and MidState 99 Distribution Center developed by The Allen Group. ITTC is a 700-acre industrial park in Bakersfield with about 2 million square feet, easily reaching 35 million consumers within four hours. ITTC is on the main line of the BNSF and includes an intermodal facility with direct rail service to and from the Ports of Los Angeles and Long Beach. MidState 99 Distribution Center is a 488-acre park located in Visalia, which is halfway between Bakersfield and Fresno. Current tenants include VF Corporation, International Paper Company, JoAnn Stores, Coast Distribution Systems, Workflow One, Worms Way, Bound Tree Medical, ORS Nasco, and DATS Trucking. More than 99 percent of the California market can be served next day from MidState 99 by UPS.³¹

On the site of the former George Air Force Base, in a public-private partnership with the City of Victorville, Stirling Capital Investments is developing Global Access. This project is an 8,500-acre multimodal freight transportation hub supported by air, ground, and rail connections in Victorville, approximately 60 minutes northeast of Los Angeles, 100 miles from the San Pedro Bay Ports, and close to I-15 and U.S. Highway 395. It boasts of being

³⁰<http://kedc.com/site-selection/certified-sites/tejon-ranch-commerce-center/>.

³¹ Ibid.

a 90,000-acre Redevelopment District with Local Agency Military Base Recovery Area (LAMBRA) Zone Credits and Incentives being available. The largest fully integrated commercial development in the region, Global Access, comprises three development divisions, which include the following:

- **Southern California Logistics Airport.** A 2,500-acre world-class aviation and air cargo facility serving domestic and international needs with maintenance and repair capabilities.
- **Southern California Logistics Centre.** A 2,500-acre commercial and industrial complex totaling 60 million square feet of diverse development. Manufacturing/distribution facilities (some with direct rail spur access) from 2,500 to 2.5 million square feet are available.
- **Southern California Rail Complex.** A planned 3,500-acre intermodal rail and multimodal complex, including rail-served facilities, with dual serviced rail capacity (access to both the BNSF and UP). City of Victorville officials executed a Memorandum of Understanding (MOU) with BNSF in 2007. This intermodal facility will be a critical component in the overall development of the Rail Complex.

More than 100 companies have chosen to conduct business at Global Access Victorville, including the following:³²

- Aircraft Recycling Corporation;
- Blackhawks;
- Boeing;
- CB Richard Ellis;
- Dr Pepper Snapple Group;
- Embry-Riddle Aeronautical University;
- Enterprise Rent a Car;
- Excel Scientific;
- Exel Logistics;
- Fastenal;
- Federal Express;
- General Electric;
- Goodyear Tire Company;
- Verizon (GTE);
- High Desert Power Project;
- Leading Edge Aviation Services;
- Mercy Air Services;
- Million Air;
- Modern Space Pacific Services;
- Newell Rubbermaid;
- The Nordam Group;
- ORBIS;
- Pacific Aviation Group (PAG);
- Plastipak Packaging, Inc.;
- Pratt & Whitney;
- Prego;
- Product Systems;
- Red Bull;
- Southern California Aviation;
- Sparkletts;

³²www.globalaccessvictorville.com.

- Stoodly Industrial;
- The Boeing Company;
- United Furniture Industries (UFI);
- U.S. Customs;
- Victorville Aerospace;
- Wal-Mart; and
- World of Leisure

Hillwood is another example of a MLC; this one being air freight-centric. “Hillwood has anchored its AllianceCalifornia in San Bernardino, California, to San Bernardino International Airport (SBD), the former Norton Air Force Base with easy access to Interstates 10, 210, and 215. It is also two miles from BNSF Intermodal Container Facility. It offers a new fuel farm, U.S. Customs facilities and personnel, and room to construct or expand facilities. More than \$90 million have been invested in major infrastructure improvements that include the runway, hangar, and utility upgrades. Over the past seven years, more than 7.8 million square feet have either been built or are under construction.”³³ Tenants include ODW Logistics, Kohl’s, Mattel, Stater Bros., Pactiv, Medline, and Pep Boys.

Commercial real estate developers are not the only industry sector eager to construct MLCs. Railroads understand there are profits to be made as well. BNSF is developing Logistics Park Kansas City Intermodal Facility (LPKC), a master-planned distribution and warehouse development to suit a broad range of multimodal needs. Located 25 miles southwest of downtown Kansas City, Kansas, on a FTZ site with 535 developable acres, LPKC will offer direct rail service to and from Pacific and Gulf of Mexico ports and access to Interstate Highways 35, 70, and 29.³⁴

In May 2013, the Los Angeles City Council approved BNSF’s Southern California International Gateway (SCIG) project. “The \$500-million facility, located within four miles of the San Pedro Bay Ports, will shorten the distance trucks loaded with cargo need to travel before transferring the containers to rail, instead of traveling 24 miles up the 710 Freeway. While eliminating millions of truck miles from the 710 Freeway, BNSF will clean up an existing industrial site and replace it with a new intermodal facility featuring wide-span, all-electric cranes, ultra-low emission switching locomotives, and low-emission rail yard equipment.”³⁵ Though this is a rail-centric project, it is envisioned as a multimodal logistics center.

Implications for the SCAG Region

MLCs provide job opportunities for warehouse workers. However, a region can support only so many large MLCs, depending upon such factors as population density, international trade volume, and demand from potential tenants that seek the synergies of such centers as opposed to stand-alone cargo-handling facilities. The southern one-half of California may be reaching a saturation point, making it more difficult for new and existing complexes in the process of expanding to attract sufficient tenants to maintain profitability. To be successful, these centers cannot be located too far from the Ports of Los Angeles and Long

³³<http://www.allengroup.com/?p=1266>.

³⁴ DeMuth, J., “Global Gateways,” *Global Trade Magazine*.

³⁵ “LA City Council approves BNSF SCIG project,” RT&S, May 9, 2013.

Beach, and sizable land parcels within ideal proximity and easy access to interstate highways and intermodal rail are more and more difficult to find. As can be seen in the above examples, these centers tend to be on the outskirts of Los Angeles and even further north or east.

It is possible that a suitable location within the SCAG region can be identified for a new MLC to serve California and markets afield. If so, instead of assuming viability, a study should first be conducted to ascertain potential demand from BCOs, 3PL warehouse operators, and other types of tenants to define the target market; and to understand the potential of the new center to compete with those already fully or partially developed in Southern California.

Near-shoring and Re-shoring

Description

As manufacturers seek methods to reduce production costs and the total landed cost of goods, gain more control over production, and reduce time-to-market, they have increasingly been turning attention to manufacturing closer to the U.S. market, specifically in Mexico, the Caribbean, Central and South America (near-shoring), and in the U.S. (re-shoring). A wide variety of factors have fueled these two related trends. Each is addressed separately below.

Near-shoring (Near Sourcing).

In early 2011, 42 percent of 80 executives at global manufacturing companies indicated in a survey they are either already near-shoring or intend to do so by 2014.³⁶ Mexico was selected as the top choice for near-shoring by 43 percent of respondents. The main reasons were lower freight and inventory (in-transit) costs and improved speed-to-market. Another survey in 2014 concluded that 92 percent of manufacturers intend to increase the level of near-shoring or hold it steady.³⁷

As labor rates in China continue to increase, more companies engaged in wholesale and retail trades are considering or have already shifted some portion of their sourcing closer to the U.S. consumer market, particularly to Mexican factories. Mexico appears to have the most to gain in terms of garnering the lion's share of near-shoring activity in the near term. A number of factors and conditions are driving this trend. Alix Partners in its *2011 Manufacturing-Outsourcing Cost Index* indicated that Mexico had the lowest landed costs for U.S. customers, of which labor is only one component. Besides attractive labor rates and proximity to the U.S., over the past decade, the technical skill levels and education of Mexico's workforce of both managers and laborers have improved dramatically. It is a young workforce with the average age being 29. About 90,000 engineers graduate from Mexican universities annually – three times the number who graduate from U.S. schools.³⁸

³⁶“Alix Partners Executives’ Perspectives on Manufacturing Near-shoring Report,” Alix Partners, 2011.

³⁷Trunick, P. A., and with J. P. Dittman, “Nearshoring on the Rise,” *World Trade 100*, July 2014, pages 22 to 24.

³⁸“Nearshoring Fuels Mexican Manufacturing Growth,” *Industry Week*, March 14, 2012.

Managers are well compensated, are typically bilingual, and familiar with U.S. culture. On the whole, workers take pride in their work and are motivated to satisfy the requirements of their customers.³⁹ The country encourages international trade; it has signed more free and preferential trade agreements – 12 with 44 nations⁴⁰ – than any other country in the world. By comparison, the U.S. has signed only 20. Mexico’s Federal and state governments provide incentives to attract foreign direct investment and domestic consumption is on the rise.⁴¹

Since around 2007, Mexico has invested approximately \$40 billion on transportation infrastructure, with about 20 percent being private-sector funding.⁴² These investments have significantly raised the quality and capacity of the multimodal transportation system. Encouraging public-private partnerships has stretched the government’s dollars available to spend. In 2007, a five-year National Infrastructure Program (NIP) was launched that enabled the government to begin complementing its existing North American Free Trade Agreement (NAFTA) Highway with four new interstate corridors and much needed updates and upgrades to many of its railways, ports, airports, and roadways. The U.S.-to-Mexico intermodal industry has expanded to include five major corridors/services and 14 metropolitan areas. Railroads improved infrastructure and upgraded routes and connectivity.⁴³

Protection of intellectual property (IP) in Mexico is not an issue like it is in China and many other nations where manufacturing is prevalent. Under NAFTA, there are minimum standards of IP protection that Mexico must provide in its domestic laws. This benefits companies, particularly in the high-technology sector.⁴⁴ In the past two decades, Mexico has reduced its dependence on commodity exports like oil, and created an environment that enabled diversification of its manufacturing base. “Focused spending on high-tech manufacturing also has helped move the ‘Made in Mexico’ tag from cheap T-shirts to the high-end suit you’ve been eyeing, the Cadillac in your driveway or your teenager’s Fender Stratocaster Electric Guitar.”⁴⁵

As BCOs seek to operate lean supply chains to reduce waste, production in Mexico improves speed-to-market and reduces transportation costs. In the World Trade 100 survey, the top reason specified for near shoring was transportation cost (68 percent of respondents), followed closely by total landed cost. Product/service quality and late delivery also ranked above 50 percent, with political stability coming at 49 percent. Higher labor costs were given as a reason for 41 percent of respondents who indicated they would increase near-shoring. That puts cost and quality issues as top reasons for near-shoring.⁴⁶

³⁹Selko, A., “What to Consider When Nearshoring in Mexico,” *Industry Week*, March 13, 2013.

⁴⁰ProMexico, www.promexico.gob.mx.

⁴¹“Mexico’s Evolving Sweet Spot in the Globalization Landscape,” *The Boston Consulting Group*, April 2008.

⁴²Szakonyi, M., “Made in Mexico,” *The Journal of Commerce*, September 3, 2012.

⁴³Walz, M., “Bienvenidos a Mexico (Again),” *World Trade 100*, April 1, 2012.

⁴⁴Selko, A., “What to Consider When Nearshoring in Mexico,” *Industry Week*, March 13, 2013.

⁴⁵Szakonyi, M., “Made in Mexico,” *Journal of Commerce*, September 3, 2012.

⁴⁶*Ibid.*

Industry clusters have emerged in various areas across Mexico, the most prominent being vehicles; automotive parts; aerospace components; white goods (washers, dryers, refrigerators, etc.); electronics (cell phones and other small electronic devices); medical devices; and pharmaceuticals. Mexico is the second largest supplier of electronic products to the U.S. Over the years, white goods manufacturers, including General Electric, Samsung, Whirlpool, and Daewoo, have increased production in Mexico. Mexico has attracted about 250 aerospace companies, including Honeywell Aernnova, Bombardier, Cessna, Eurocopter, Hawker Beechcraft, and Messier Dowty. This industry employs approximately 29,000 people. The Mexican government expects exports of engines, landing gear, and other equipment to reach \$12.3 billion by 2020.⁴⁷

For products such as autos and automotive components that employ JIT manufacturing processes, Mexico offers shorter and more nimble supply chains, as well as a skilled workforce. The production of auto parts in Mexico has increased dramatically in the past decade, largely because the automotive manufacturers in Mexico have encouraged and often required their suppliers to locate proximate to their auto assembly plants to facilitate JIT production processes. Ford, GM, Fiat/Chrysler, VW, Nissan, BMW, Audi, Honda, Daimler Trucks, and Mazda, in a strategic alliance with Sumitomo and Toyota, have assembly plants in Mexico. Moreover, in 2008, Mexico became the largest supplier of auto parts to the U.S., with more than 1,100 manufacturers operating in Mexico.⁴⁸ Table 2.1 below provides relevant statistics of this industry.

⁴⁷ Szakonyi, M., "Made in Mexico," *Journal of Commerce*, September 3, 2012.

⁴⁸ "Nearshoring Fuels Mexican Manufacturing Growth," *Industry Week*, March 14, 2012.

**Table 2.1 Main Indicators of the Auto Parts Industry in Mexico 2012
(U.S. Dollars)**

Production of auto parts in Mexico \$74.795 billion Source: Industria Nacional de Autopartes (INA) and INEGI	Consumption of auto parts in Mexico \$59.156 billion Source: ProMexico with data by Global Trade Atlas and Global Insight
Foreign direct investment in the auto parts industry, 2006-2012 \$9.687 billion Source: ProMexico with data by the General Directorate of the National Registry of Foreign Direct Investment, Ministry of Economy	Number of Jobs in the auto parts industry, as of December 2012 583,706 Source: INA and INEGI
Mexico's exports from the auto parts industry in 2012 \$51.872 billion Source: ProMexico with data by Global Trade Atlas and INA	Mexico's imports to the auto parts industry in 2012 \$36.233 billion Source: ProMexico with data by Global Trade Atlas and INA
Economic units ¹ 2,559 Source: ProMexico with data by National Statistics Directory of Economic Units, INEGI	Clusters of the auto parts industry in 2012 – Northeastern, Northwestern, Southeastern, and Central-Bajío Region Source: ProMexico
Fifth largest exporter of auto parts worldwide Source: ProMexico with data by Global Trade Atlas and INA	Fifth largest producer of auto parts worldwide Source: ProMexico with data by Global Insight Source: Industria Nacional de Autopartes (INA) and INEGI

¹ The term “Economic Units” is explained in this document:
http://www.unece.org/fileadmin/DAM/stats/documents/ece/ces/ge.42/2011/mtg1/Mexico_nationalstatistics.pdf.

In 2012, light-vehicle production in Mexico reached a record of 2.8 million units, which is 12.8 percent more than in 2011. The industry is expected to grow, with production estimated at more than 3.7 million light vehicles by the end of 2016. Growth in the automotive industry will create demand for auto parts for assembly lines, aftermarket, and spare parts market segments. In 2012, the U.S. was the main destination for Mexican auto parts, with 90 percent share.⁴⁹

Table 2.2 below depicts the magnitude of recent investments in Mexico by automotive manufacturers.

⁴⁹“The Auto Parts Industry,” Research and Analysis: Juan Carlos Ávila Pompa, SE Ministry of Economy, PROMEXICO, Business Intelligence Unit, Trade and Investment, May 2013.

Table 2.2 Mexican Auto Investments, 2011 to 2012

Operation	Location	Investment	Jobs
Audi New Plant	Puebla, PU, MEX	\$1.3B	N/A
Ford Plant Expansion	Hermosillo, SO, MEX	\$1.3B	1,000
GM Expansions	San Luis Potosi, SL, MEX & Silao, GJ, MEX	\$420M	1,000
Honda New Plant	Guanajuato, GJ, MEX	\$800M	3,200
Nissan New Plant	Aguascalientes, AG, MEX	\$2B	3,000

Source: "A Driving Force: Texas-Mexico Automotive SuperCluster (TMASC)," David Marquez, Executive Director, Bexar County Economic Development, August 21, 2013.

Automakers continue to view Mexico as an excellent place in which to assemble vehicles, as demonstrated by the statistics in Table 2.3 below. Labor rates are low and holding steady. Employee skills are improving rapidly. The work ethic of the work force is solid. Other costs such as land and construction are economical.

Table 2.3 Foreign Direct Investment in Mexico by Automaker, 2007 to 2012
(Millions of Dollars)

Company	2007-2009	2010	2011	2012	Accumulated
Daimler Trucks	871				871
General Motors	3,870	435	540	420	5,265
Volkswagen	1,053	1,020			2,073
Ford	3,000			1,300	4,300
Fiat/Chrysler		550	620		1,170
Nissan		600		2,000	2,600
Honda			800		800
Mazda			500		500
Audi				1,300	1,300
Total	8,794	2,605	2,460	5,020	18,879

Source: ProMexico based on media information.

Nearly all the major automotive manufacturers have factories clustered in several areas in Mexico, as depicted in Figure 2.5 below. This clustering provides synergies and benefits to these assemblers.

Figure 2.5 Locations of Light Vehicle Manufacturing Plants in Mexico



Source: "Growth Perspectives and Opportunities in the Automaking and Automotive Parts Industries," Secretaria de Economía ProMexico, Unidad de Inteligencia de Negocios, 2013.

Though there are tangible benefits of adopting a near-shoring to Mexico strategy, some drawbacks and challenges exist as well. Some considerations are listed below.

- Investments in multimodal transportation infrastructure have brought the national network closer to standards in more developed countries, but more work remains. Rail was deregulated in the late 1990s, which enabled the growth in intermodal rail. Kansas City Southern operates a concession granted by the Mexican government; and UP has partnered with Ferromex, the Mexican railroad. In 2014, Ferromex invested approximately \$500 million.⁵⁰ Yet, rail lags truck as a mode of transport, with only about 26 percent of cargo using this mode. In comparison, 60 percent of cargo in Canada move on rail, and 42 percent in the U.S. Many critical corridors need to be upgraded to handle double-stack trains.
- Trade flows are imbalanced, favoring southbound moves into Mexico, which presents challenges for Mexican manufacturers to find adequate supplies of empty trucks for their exports, particularly during peak seasons when agricultural products are harvested. The supply of refrigerated equipment is usually in short supply. A major reason is that most motor carriers are small, with fewer than 100 trucks. Without critical

⁵⁰Bowman, R. J., "The Logistics Challenges of Manufacturing in Mexico," Supply Chain Brain, July/August 2014.

mass, it is difficult for them to expand geographically and/or in terms of volume capacity. This forces BCOs to contract with multiple motor carriers, increasing administrative time and effort.

- Despite the success of the Mexican government’s campaign to reduce drug gang violence and cargo theft, these issues continue to be problematic in certain areas. FreightWatch, a firm supplying global security information, considers Mexico the highest-risk country, and much of the cargo theft consists of hijacking. The use of global positioning systems (GPS) in trucks and other security measures like armed escorts help to deter thefts, but incrementally increase transportation costs. Transit by rail provides less risk on the whole than by truck.
- Cargo insurance is not the same as in other parts of the world. BCOs are responsible for obtaining insurance, not the motor carrier; and all-risk insurance is difficult to get in Mexico.⁵¹ It is essential to comprehend the differences and complexities in Mexico to mitigate risk.
- Labor laws are different in Mexico. For example, the concept of hiring and firing at-will does not exist, and unions operate differently from in the U.S. Rules are specific regarding hours worked, overtime, holidays, sick leave, bonuses, and holidays.⁵²
- Even though Mexican Customs has worked to modernize operations and be more business friendly, customs clearance and cargo inspections can be onerous. Because of drug smuggling, U.S. Bureau of Customs and Border Protection inspects a high percentage of cargo imported from Mexico, which delays shipments and increases costs.⁵³

Re-shoring

Since the Obama Administration has made a major push to encourage a return of manufacturing from offshore locations to the U.S. and increase the level of exports, U.S. factory payrolls grew annually in the period of 2010 to 2014, with gains of about 650,000 jobs, compared to 6 million lost in the previous decade. In year 2013 was the first time since the offshoring trend began that factory jobs returning to the U.S. matched the number lost, at about 40,000 each, indicating offshoring and re-shoring were roughly in balance.⁵⁴

Figure 2.6 indicates job growth in the U.S. grew 1,500 percent between 2003 and 2013.⁵⁵

⁵¹ Ibid.

⁵² Selko, A., “What to Consider When Nearshoring in Mexico,” *Industry Week*, March 13, 2013.

⁵³ Bonney, J., “Crate and Barrel: Mexico Sourcing Has Pluses, Minuses,” *The Journal of Commerce*, May 30, 2014.

⁵⁴ Lee, D., “U.S. Manufacturing Grows with Re-shoring,” *Los Angeles Times*, May 18, 2014.

⁵⁵ Ibid.

Figure 2.6 U.S. Job Growth, 2003 to 2013**Companies looking to return**

After years of sending production overseas to China and other low-wage countries — known as offshoring — manufacturing jobs are returning to the United States. Executives are confirming the trend as more are actively “re-shoring” jobs, or are planning to return production in the next few years, according to The Boston Consulting Group.

Estimated change in manufacturing jobs, by year			
	2003	2013	Percentage change
Jobs lost overseas	150,000	30,000-50,000	-70%
Jobs gained	2,000	30,000-40,000	1,500%
Net loss	-148,000	0	-100%

Source: Moser, H., The Boston Consulting Group, Reshoring Initiative.

The Boston Consulting Group (BCG) conducted a survey in 2012 of 106 executives about their manufacturing location plans and presented the findings in the *U.S. Manufacturing Nears the Tipping Point* report. More than one-third of U.S. manufacturers with sales greater than \$1 billion is considering or planning to relocate production facilities to the U.S. from China. The response rate rose to 48 percent among executives at companies with \$10 billion or more in revenues. This applies for products being manufactured for domestic and foreign markets.⁵⁶ These findings are being corroborated elsewhere. Massachusetts Institute of Technology polled 108 American manufacturing firms with multinational operations in 2012 and found 14 percent intended to bring some manufacturing back to America, and one-third was actively considering such a move. In the same year, Hackett Group predicted the outflow of manufacturing from high- to low-cost countries would slow during 2014 and 2015; and re-shoring would double over the previous two years, with a net effect of zero offshoring.⁵⁷

The conclusion should not be drawn that China will fall off substantially as a manufacturing juggernaut, as it continues to enjoy modest growth and is already moving up the value-added ladder by producing more sophisticated products.⁵⁸ Manufacturing sourcing decisions are complex. In 2014, the Council of Supply Chain Management Professionals (CSCMP) published *Best Practices in Offshoring and Reshoring*, which examines key factors affecting manufacturing location decisions of BCOs. “The study examined the factors that influence manufacturing location decisions for 319 companies that currently do some manufacturing offshore. About 40 percent perceived a trend toward re-shoring in their industries. That trend appears to be strongest in the aerospace and defense, industrial parts and equipment, electronics, and medical and surgical supplies industries. From a logistics perspective, more than 60 percent said that the stability of transportation costs would become more important in their location choices in the next three years. Transportation availability and reliability, as well as the availability of knowledgeable

⁵⁶Kulisch, E., “Right Shoring,” *American Shipper*, June 2012.

⁵⁷“Coming Home – A Growing Number of American Companies are Moving Their Manufacturing Back to the United States,” *The Economist*, January 19, 2013.

⁵⁸Perez, E., “Globalization Is in Retreat? Not So Fast,” *The New York Times*, September 16, 2014.

logistics service providers, also are expected to become more important. The relative importance of these factors varies by industry. In making the manufacturing location decision, the companies also place increasing importance on where their customers want them to locate, as well as how a location could help them expand into new markets. Competitors’ location choices also are an increasingly important factor in the manufacturing location decision. Companies are reexamining their manufacturing location decisions in an effort to go beyond cost, and are considering risk combined with a total cost perspective.”⁵⁹

Not all manufacturing lends itself to re-shoring. Products coming back to the U.S. are in a fairly narrow range. The BCG report identified transportation goods, appliances and electrical equipment, furniture, plastic and rubber products, fabricated metal products, and computer and electronics as prime candidates for re-shoring as China’s cost advantage erodes, primarily because factory wages generally account for only a modest portion of total production costs of these goods. Three-fourths of the manufacturing that migrates from China is predicted to shift to the U.S. in the next 10 years. The U.S. tire industry may be a sector that will transition production back to the U.S. One-half of appliance manufacturing returning to North America will likely end up in the U.S.⁶⁰

As the volume of oil and natural gas extracted from U.S. fields has increased, plastics, fertilizer, and petrochemical manufacturers that use oil as a raw material are now able to purchase their supplies in the U.S.⁶¹ Chemical manufacturers have seen a resurgence of re-shoring because the byproducts from natural gas are cheaper and production costs are lower in the U.S.⁶² Items requiring highly skilled labor or those in which the labor component is small relative to the overall price of the product are also good candidates. Manufacturers of computers and electronics, appliances, and electrical equipment, primary metals, machinery, furniture, plastics and rubber, paper, and fabricated metals are setting their sights on the U.S.⁶³ Table 2.4 below indicates which industry sectors are adopting a re-shoring strategy.

Table 2.4 Recent Re-shoring Cases

Industry	Number of Cases	Percentage of Industry
Electrical equipment, appliance, and component manufacturing	33	22
Transportation equipment manufacturing	24	16
Computer and electronic product manufacturing	17	11
Plastics and rubber products manufacturing	13	8

⁵⁹“Offshoring and Reshoring – What’s Really Going On?,” Staff, Council of Supply Chain Management Professionals Supply Chain Quarterly, September 19, 2014.

⁶⁰Kulich, E., “Right Shoring,” American Shipper, June 2012.

⁶¹DePass, D., “Reshoring Trend Picks up in Minnesota,” Star Tribune, October 25, 2014.

⁶²Branham, M., “Made in the USA,” Capital Ideas, Council of State Governments, March/April 2014.

⁶³den Bossche, V., P. Gupta, H. Gutierrez, and A. Gupta, “Solving the Reshoring Dilemma, Patrick Supply Chain Management Review, January/February 2014.

Fabricated metal product manufacturing	10	7
Machinery manufacturing	10	7
Apparel manufacturing	7	5
Furniture and related product manufacturing	7	5
Chemical manufacturing	5	3
Food manufacturing	4	3
Other manufacturing	12	8
Other nonmanufacturing	10	7

Source: A. T. Kearney.⁶⁴

The growth in re-shoring can be attributed to a number of factors:

- The average hourly wages of U.S. workers has stagnated; at the same time, wages in China have increased substantially.
- The trend is towards manufacturing automation; further reducing labor’s significance in the cost equation.
- U.S. gasoline prices have decreased 25 percent as a result of the rapid increase in natural gas production, while China’s gas prices rose 138 percent.
- Quality control issues with Chinese manufactured products make producing closer to customer (i.e., the U.S.) more attractive and make supply chains easier to control.⁶⁵

Since 2010, the economics that made off-shoring attractive have changed. Top decision drivers for companies to re-shore include:

- Reduce time-to-market (73.7 percent);
- Reduce cost (63.9 percent);
- Improve product quality (62.2 percent);
- Gain more control (56.8 percent);
- Reduce hidden supply chain management costs (51.4 percent); and
- Protect intellectual property (48.5 percent).⁶⁶

Rising rates for ocean, rail, and truck impact BCOs that manufacture products with relatively low-value density, such as consumer goods, appliances, and furniture.⁶⁷ The desire to

⁶⁴Ibid.

⁶⁵Lee, D., “U.S. Manufacturing Grows with Re-shoring,” Los Angeles Times, May 18, 2014.

⁶⁶2012 Annual Re-Shoring Report, MIT Forum.

⁶⁷“Coming Home – A Growing Number of American Companies are Moving their Manufacturing Back to the United States,” The Economist, January 19, 2013.

shorten supply chains to reduce transportation costs contributes to the attractiveness of U.S. factories for such items.

All the optimistic talk about re-shoring should be tempered and viewed from a broader perspective, as other industry experts disagree about the real gains and level of momentum. “The number of firms known to have ‘reshored’ manufacturing to America is well under 100. Doubtless many more are doing so quietly. Most of the multinationals involved are bringing back only some of their production destined for the American market. And for many of the biggest firms, the amount of work that they are still sending abroad outweighs the amount that they are bringing back onshore.”⁶⁸

In 2010, 27 companies and trade associations collaborated to establish the Re-shoring Initiative designed to bring back lost production to the U.S. The group offers a “free software tool that helps manufacturers calculate the aggregate impact of offshoring on their profitability.”⁶⁹ This is valuable because the decision to offshore production is often not well thought-out. “Location decisions are so complex and dynamic that they are often made on the basis of simple rules of thumb (follow the customer, focus on wage rates), rough estimates, biases against the U.S. business environment or corporate history.”⁷⁰ “It also requires a company to develop a network of local suppliers to support the operation.”⁷¹ An example of this clustering of finished goods and component manufacturers is evident in industries, such as autos and auto parts, which have located in the U.S. Southeast to foster JIT production processes. Unless the supply of raw materials and components is located in relative proximity to the factory producing the finished product, the cost to produce in the U.S. might not warrant re-shoring from countries like China.

Implications for the SCAG Region

“Outsourcing is clearly slated to continue, even to expand. Much of the motivation for outsourcing is cost driven, and that is also what is most often measured to determine results.”⁷² If near-shoring to Mexico increases substantially over a short period of time, the following could be potential impacts to Southern California, with varying degrees:

- Potentially reduced share of imported goods, particularly of components and semi-finished goods, from China through San Pedro Bay Ports;
- More congestion and delays at Baja/California border crossings;
- Greater competition to secure empty trucks for moving products northbound as a result of a wider trade imbalance north to south; and
- More demand for suitable greenfield and brownfield parcels for cargo-handling facilities near the border.

⁶⁸Ibid.

⁶⁹Kulisch, E., “Right Shoring,” *American Shipper*, June 2012.

⁷⁰Ibid.

⁷¹Ibid.

⁷²Trunick, P. A., and J. P. Dittman, “Nearshoring on the Rise,” *World Trade 100*, July 2014, pages 22 to 24.

An increase in near-shoring suggests a potential increase in the clustering of complementary functions in the SCAG region as suppliers group near manufacturers.

Re-shoring of production to the SCAG region will likely not approach the volume of near-shoring to Mexico and could slightly increase road congestion and marginally reduce the volume of imports, mainly production inputs, flowing through the Ports of Los Angeles and Long Beach.

Re-shoring and near-shoring also could impact the demand and location of warehousing in the region. There could be less demand for “port-related” warehouse space and less demand for facilities located close to the Ports.

Warehouse Automation

Description

The characteristics of cargo-handling facilities are evolving rapidly. Those built for bricks and mortar store replenishment are very different from those now in operation and performing complex Internet order fulfillment. Companies are more willing to invest in innovative equipment and systems to help them gain increase market share, reduce costs, increase operating effectiveness, and improve customer service. “In the 21st century, more companies are recognizing that warehousing is a strategic business consideration, so they are viewing warehouse operations as an opportunity to gain significant competitive advantage. This sharply contrasts with 20th century thinking, when the warehouse was seen as a ‘necessary evil.’ While some companies have maintained their 20th century warehouse philosophies, continuing with the same systems and processes that they started in the 1940s and 1950s, others are moving forward by incorporating their warehouses as pivotal distribution centers in their supply chains that can move them ahead of the competition.”⁷³

BCOs, particularly large retailers and importers of fast moving consumer goods, are increasingly investing in material-handling systems; conveyor sortation and controls; advanced technologies including robotics, advanced storage and retrieval systems (ASRS), and picking/packing technology to more efficiently manage their DCs and better meet customer demands, particularly for rapid order delivery. Yet, smaller BCOs, for the most part, continue to rely on the traditional model of manual fulfillment using paper orders.⁷⁴ Only an estimated 15 percent of warehouse operations are automated.⁷⁵ Person-to-goods is defined as a process in which the worker physically moves to a pick location to retrieve the items for a particular order. This is contrasted with a goods-to-person process where the products are moved in an automated manner to the worker, a modern and efficient model that more and more large BCOs are implementing.

In a person-to-goods model, “inventory is stored in racking or on the floor, and the most efficient pick paths are determined by routing logic. This order picking paradigm has been used for decades with case picks and pallet picks with an established level of success. For e-commerce fulfillment, however, small-quantity, multiple-SKU orders are becoming

⁷³ Shacklett, M., “The 21st Century Warehouse,” World Trade 100, March 1, 2011.

⁷⁴ McMahan, J., “Smart **Robotics** Meet e-commerce,” World Trade 100, July 2014.

⁷⁵ DeCesare, J., “Warehousing’s Reach,” The Journal of Commerce, July 21, 2014.

increasingly difficult to handle with conventional manual-pick systems. Where a picker had to spend 60 percent of the time traveling and 40 percent of the time picking, as is typical in a person-to-goods model, supply chain executives dealing with the rise of e-commerce orders are looking for more efficient solutions to minimize the amount of wasted time between picks and to increase the number of orders processed per person. In most e-commerce centers, picking is the most labor-intensive function and can usually provide the most cost-savings when automated. Because e-commerce fulfillment deals almost exclusively with each (one piece rather than cartons) or piece-picked orders, reducing the number of times the picker handles the product is critical to improving efficiency. The right automated solution should facilitate the minimization of touch points, which will result in more accurate orders, improved ergonomics, lower labor costs, reduced worker travel time, and fewer returns.”⁷⁶

Highly automated cargo-handling facilities will eliminate “batch and wave” operations, where orders are batched up during the picking process to improve labor efficiency, but lengthen order cycle time.⁷⁷ In a goods-to-person automated process, both software and hardware, such as robotic shuttles and conveyor systems, are implemented. “Incoming goods are placed into totes, which are stored in high-density automated storage and retrieval systems (AS/RS). As orders are required to be fulfilled, the appropriate SKUs are automatically retrieved from storage and brought to the picker at the pick/pack station,”⁷⁸ reducing the chance of workers picking the wrong items. The photos below in Figure 2.7 demonstrate the goods-to-person concept in action.⁷⁹

Figure 2.7 Photos of Goods-to-Person Technology



Source: iBOT by OPEX.

“The iBOTs roam horizontally or vertically throughout the aisle to reach designated SKU/tote locations and pick stations, operating in real time. About 20 or more iBOTs could be deployed per aisle, with each iBOT having access to 100 percent of the inventory in its aisle. This system allows orders to be stored and retrieved simultaneously, as opposed to sequentially. This capability can make a significant difference in the speed and efficiency for optimum handling of orders on a high-throughput basis. The inventory identifies itself

⁷⁶ Ibid.

⁷⁷ Ibid.

⁷⁸ McMahan, J., “Smart Robotics Meet e-commerce,” World Trade 100, July 2014.

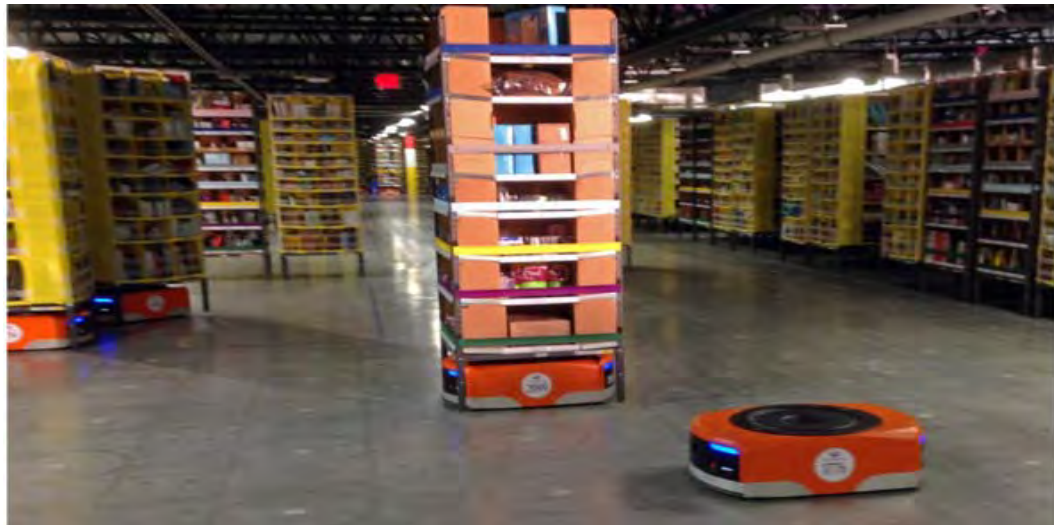
⁷⁹ Ibid.

to the worker, and the worker picks and packs it. It reduces the number of times that the inventory has to be ‘touched’ during the pick and pack operations.”⁸⁰

Goods-to-person systems are capital-intensive, so at present, it is generally the larger e-commerce retailers and large BCOs that can justify such investments because the return-on-investment (ROI) horizon will be much shorter than for BCOs that process a relatively small amount of Internet orders. So compelling is this payoff, that in 2012, Amazon purchased Kiva Systems, a producer of automated warehouse fulfillment systems, which enabled Amazon to gain competitive advantage by enhancing automation in its cargo-handling facilities.⁸¹

Depicted in Figure 2.8 below is a Kiva robot drive unit before it moves under a stack of merchandise pods. This one is in Amazon’s newest 1.2 million square foot DC in Tracy, California, which was refitted to use new robot technology in 2014. Amazon is in the process of deploying more than 15,000 of these wheeled robots in 10 of its biggest DCs to deliver certain products to workers, enabling pick speeds to increase two to three times. “The robots navigate by scanning coded stickers on the floor, following digital commands that are beamed wirelessly from a central computer. Each can slide under and then lift a stack of shelves that is four feet wide and holds up to 750 pounds of merchandise. The system uses barcodes to track which items are on each shelf, so a robot can fetch the right shelves for each worker as orders come in. Because the robots travel underneath, the shelves can be stacked closely together, which means the warehouse can hold more goods. The Tracy center holds about 20 million items, representing 3.5 million different products. It can ship 700,000 items a day. The robots will cut the Tracy center’s operating costs by 20 percent. But they won’t eliminate jobs.

Figure 2.8 Kiva Bots at Work in Amazon DC



The company has increased its workforce by more than a third over the last year to 149,500 full-time employees. Workers are needed for more complex tasks such as

⁸⁰ibid.

⁸¹ Whiting, G., “Amazon Buys Shipping Robotics Firm,” *American Shipper*, March 20, 2012.

shelving, packing, and checking for damaged items. However, a 10,000-strong fleet of robots could help Amazon save \$450 million to \$900 million a year in labor expenses. By allowing Amazon to store and ship more goods from each shipping center, the robots will likely reduce the number of new centers that Amazon will have to build and staff as it grows.”⁸² Because Kiva-equipped facilities eliminate the need for wide aisles for humans, such highly automated facilities can hold 50 percent more inventory than less modern warehouses. “More storage capacity means a wider selection of merchandise, fewer chances of products being out of stock, and more possibilities for same-day delivery.”⁸³

Wynright Corporation, a provider of intelligent material-handling systems, began marketing its innovative, patent pending Robotic Truck Unloader(RTU) in 2013. The RTU is the first “self-guided, autonomous robot that can fully automate the process of unloading unpalletized cartons of different sizes, shapes and weights from semi-truck trailers and ocean containers. An advanced visual perception system allows the RTU to scan the overall configuration of the trailer or container, then navigate inside and sense its surroundings as well as the size and shape of cases or even irregular products. It uses that information to determine the best way to remove a carton from the stack, then unloads it onto a telescoping 24V motor driven roller conveyor to transfer product back into the warehouse or DC. As it finishes each row, the RTU moves forward on its own, completely automating the entire unloading process.”⁸⁴ One operator with a higher skill level can manage up to three RTUs, enabling other workers to perform less physically demanding work. If the RTU encounters a problem, it can request help from the operator, or be reprogrammed to solve the problem itself.

Implications for the SCAG Region

Automation of cargo-handling equipment will likely reduce demand for unskilled workers in the SCAG region labor market over time, and increase demand for skilled workers capable of operating machines and computers and software engineers able to deal with the complex data elements in the warehouse setting.

The physical characteristics of these facilities also might evolve in terms of ceiling height and usage of floor space for various activities. Existing older facilities may not be able to be economically retrofitted, necessitating the construction of modern buildings with the desired interior configurations.

Automation improves productivity and utilization of warehouses, facilitating the storage and movement of more cargo with the same square footage, which in turn means higher truck trip generation rate per square foot.

⁸²Bailey, B., “Amazon’s New Robot Army Is Ready to Ship,” Supply and Demand Chain Executive, December 2, 2014.

⁸³Chang, A., “Amazon’s Robots Picking, Shipping Your Holiday Gifts This Year,” Los Angeles Times, December 4, 2014.

⁸⁴“Wynright Begins Production on Robotic Truck Unloader,” press release August 2, 2013.

Retail Order Fulfillment

Description

Traditional single-channel retailing refers to bricks and mortar stores that customers physically visit, and DCs that replenish store inventories. With the advent of retailers offering products on Internet web sites, a new way of selling and fulfilling orders has emerged known as “omnichannel retailing.” Customers increasingly desire to compare across a wider range of products and prices, have flexible methods to purchase, and select delivery speed. These desires and the rise of powerhouse game-changer Amazon are driving the evolution of the omnichannel retailing trend.

Omnichannel retailing is a shopping experience in which the customer can:

- Buy on-line and pick it up in the store;
- Try it on in the store and get it delivered at home if the color they want is out of stock at the local store;
- Place an order on a mobile device and be assured that the item is not only available, but also be able to choose how much to pay for shipping and know exactly when it will be delivered; and
- Order on-line, have it delivered at home, and return to the store if it is not satisfactory.⁸⁵

Beyond these options, there are many other permutations as depicted in Table 2.5 below. All of these activities traditionally occurred in stores or DCs. “The Bottom Line: the customer wants what they want, when they want it, where they want it and at the price they want it. And if you don’t have it, you better get it to their house tomorrow, or they’ll buy it from Amazon who will – with free shipping.”⁸⁶

Table 2.5 Omnichannel Retailing Options

Shop		Order		Fulfill		Return	
(Browse)		(Buy)		(Pick up or deliver)		(Return unwanted merchandise)	
1	In store	1	In store	1	Pick up in store	1	In store
2	On-line or catalog	2	On-line or catalog	2	Ship from store	2	On-line ¹
3	On phone or other mobile device	3	On phone or other mobile device	3	Ship from DC	3	On phone or other mobile device ¹
				4	Ship from fulfillment center		
				5	Ship from vendor or OEM		

Source: Cambridge Systematics, Inc.

⁸⁵“Five Steps to Designing Omni-channel Fulfillment Operations,” Fortna, www.fortna.com.

⁸⁶Ibid.

¹ Item returned via Integrator (USPS, FedEx, DHL, or other express package carrier).

“Buyers no longer see a distinction between e-commerce and brick-and-mortar. The key word describing today’s omnichannel is ‘seamless.’ They want identical service whether they’re obtaining product in a store, through parcel delivery or from locker locations. Retailers are scrambling to provide that level of service across all channels. The same level of flexibility has to apply to DCs. Many are being retooled to handle multiple channels within the same facility. Material-handling systems must be able to process shipments no matter how the orders are being fulfilled.”⁸⁷

Though experts predict different rates of growth in on-line sales, it is clear there is consensus that robust growth will occur. FTI Consulting forecasts on-line sales will grow at a double-digit rate for the next several years. E-commerce’s share of total retail sales (excluding autos and gasoline) is approaching 11 percent, compared with 7.4 percent in 2010. The on-line channel accounts for approximately 15 percent of General Merchandise, Apparel and Accessories, Furniture and Other Sales (GAFO) category spending during the holiday season. Nearly three-quarters of the growth in sales will come from the on-line channel.⁸⁸ According to a Tompkins International 2012 study, 22 percent of U.S. manufacturers were selling on-line, but by the end of 2014, 50 percent will be. By 2022, 65 percent of orders will be either placed on-line or influenced by web searches, as opposed to 50 percent in 2012. Forester Research estimates on-line retail sales in the U.S. will increase to \$370 billion in 2017 from \$262 billion in 2013.⁸⁹ Dematic predicts that by 2025, e-commerce will represent 30 percent of all retail sales and account from \$2.7 trillion in total sales. Home Depot anticipates double-digit growth in its on-line sales, which represented approximately \$2 billion in 2014. To meet the new demand generated by e-commerce, it launched a major upgrade of its fulfillment processes.⁹⁰ Though small- and medium-sized retailers sell on the Internet, 80 percent of the revenue from on-line sales are being generated by only about 10 percent of e-commerce retailers,⁹¹ meaning the biggest retailers like Amazon, Wal-Mart, Apple, and Dell have captured the majority of business in this new model.

Tomkins International indicated that, prior to a decade ago when retailers began offering products for sale through their Internet web sites, customers visited retail outlets or purchased by phone using paper catalogs. Since then, options began to proliferate with increasingly higher dollars per sale. Figure 2.9 below represents how consumer buying choices have impacted earnings per sale.

Retailers are challenged to balance inventory to meet demand, fulfill orders in the timeframes desired by customers, and maintain high customer satisfaction in a very

⁸⁷“Driving Toward Excellence in the Omni-channel,” OPEX Material Handling Supply Chain Brain, June 11, 2014.

⁸⁸“Online Retail Sales Predicted to Hit \$512Bn by 2020,” FTI Consulting Inc., Supply Chain Brain, December 4, 2014.

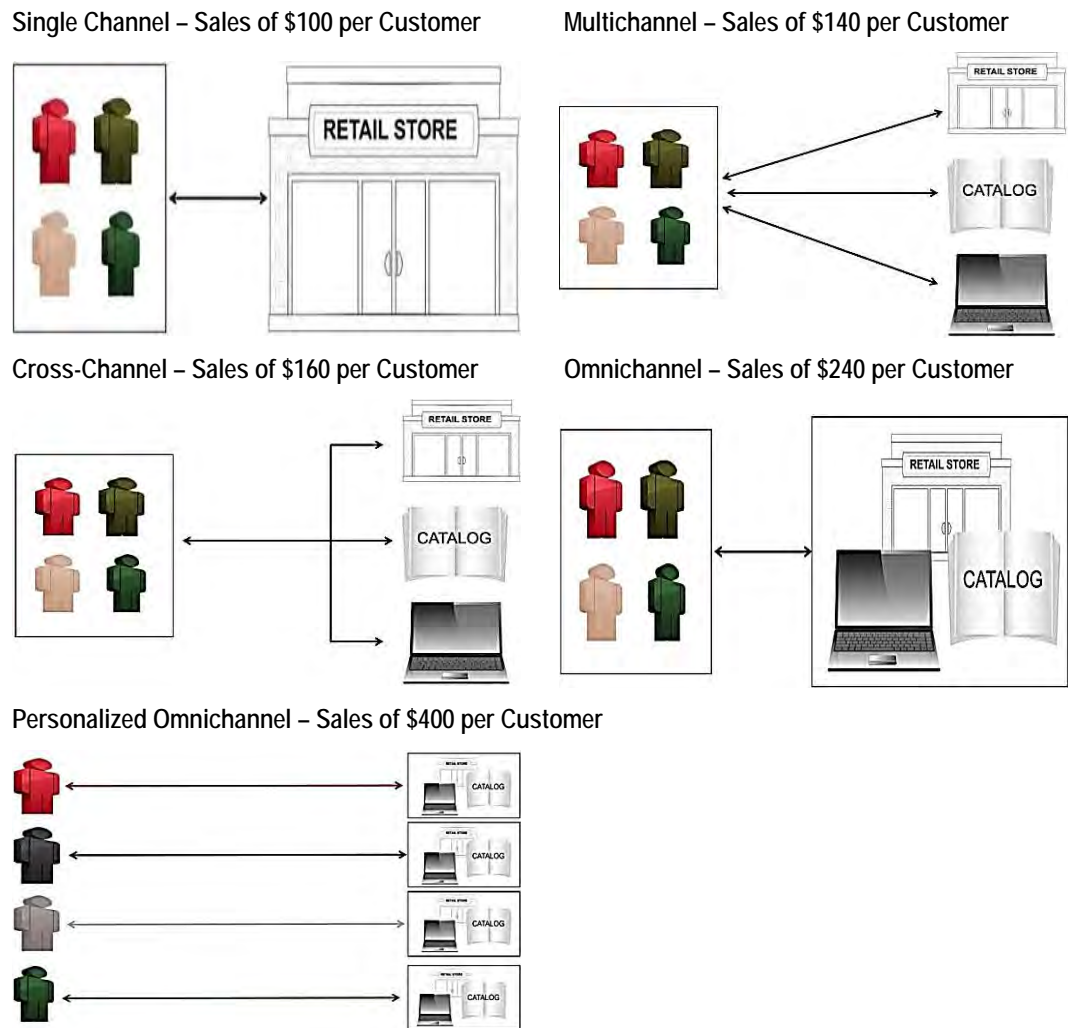
⁸⁹Cassidy, W. A., “Less Holding, More Selling,” The Journal of Commerce, March 3, 2014.

⁹⁰Ibid.

⁹¹McMahon, J., “Smart Robotics Meet e-commerce,” World Trade 100, July 2014.

competitive environment. Figure 2.10 below depicts the “order from anywhere – fulfill from anywhere” concept that many retailers are attempting to adopt, albeit with difficulty because of the added complexity on both ends. Challenges extend from web site design to facility location, staffing, cargo-handling operations, and technology. As the omnichannel retailing trend evolves, it is certain that fulfillment in the future will no longer be done from DCs only, as has been the historical model.⁹² Reverse logistics (the process of managing returns) also is undergoing changes as retailers give consumers more options to return unwanted purchases.

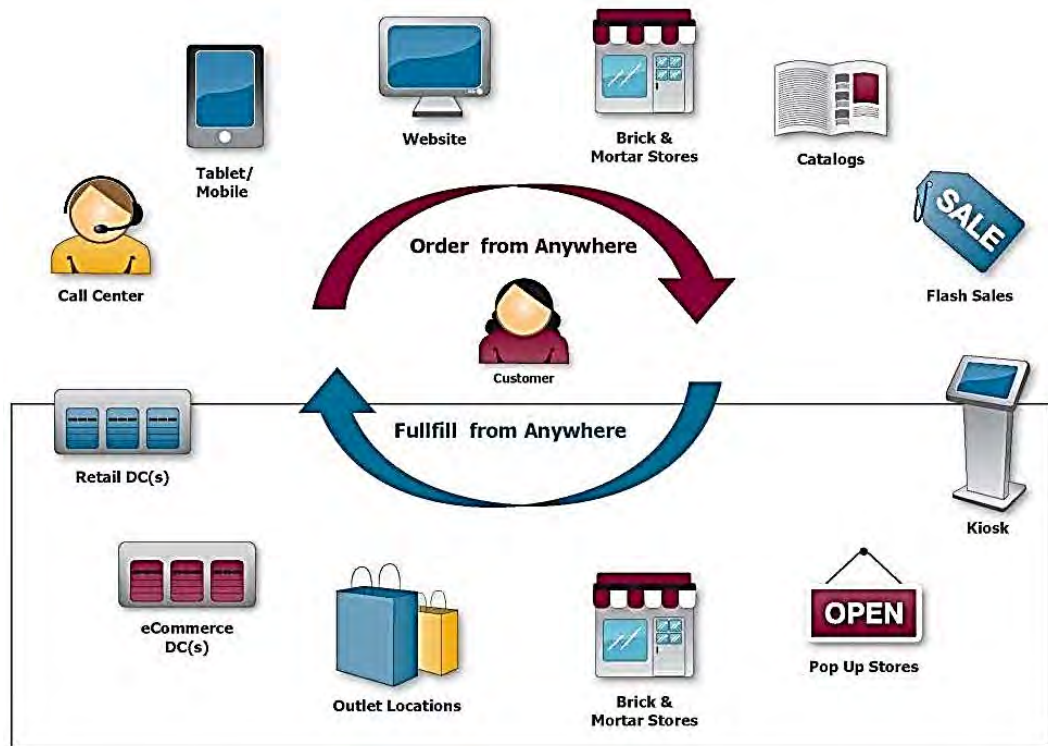
Figure 2.9 Evolution of the Customer Retail Connectivity



Source: Tompkins International 2014.

⁹²“Five Steps to Designing Omni-channel Fulfillment Operations,” Fortna, www.fortna.com.

Figure 2.10 The Omnichannel Experience



Source: Fortna.

Once a retailer moves from dabbling to fully engaging in Internet sales, the company has a myriad of decisions to make about how it will execute this part of its business effectively and cost efficiently. These decisions affect people, IT systems, and operations across the entire organization; not just in the DC. To accomplish a “order from anywhere – fulfill from anywhere” model, changes are necessary throughout the organization, requiring a more integrated, holistic strategy across channel owners, merchandising, store operations, and DC operations.⁹³ Questions like the following need to be addressed:

- If one channel is out of stock, when should you borrow from another channel?
- What if that other channel has an urgent order pending?
- Can you postpone product packaging so you can share inventory that is normally packaged by channel (in a box, poly-bagged, and on a hanger)?
- Are your information systems set up for inventory sharing?
- If you combine the volume from two channels, could you get transportation savings? For example, zone skipping.
- If a store associate places an on-line order for a customer, which channel gets credit for the sale?

⁹³Ibid.

- Are you aligned across a broader set of stakeholders? And does that include metrics and incentives to encourage that alignment?⁹⁴

In 2014, SPS Commerce, Inc. released its third annual Retail Insight industry benchmark report. The findings confirm the cross-functional challenges retailers, suppliers, and logistics service providers encounter as they develop omnichannel capabilities in their operations. The study revealed the following:

- Only 5 percent consider their omnichannel capabilities to be advanced in, and 35 and 40 percent believe they are lagging.
- Retailers and suppliers are under pressure from rising consumer expectations; 75 percent of retailers are encountering increased demand for more rapid fulfillment, and 44 percent of suppliers report greater demand for more robust item information.
- About 11 percent are prepared for cross-channel fulfillment.
- About 52 percent of retailers and suppliers are too distracted to prioritize and focus on their omnichannel strategies.
- About 43 percent of retailers reported their legacy systems are impediments to progress in omnichannel.
- One-quarter of retailers made the transition to store-based fulfillment of on-line orders, but expect this to decline over the next three years to balance shipping costs.⁹⁵

Retailers are dealing with the issues of “inventory productivity, flexible fulfillment, and the ability to adapt to the unknown caused by shifting customer demand. Inventories must be integrated across the supply chain if retailers are to fulfill orders placed on-line, as well as items purchased at brick-and-mortar stores. They need to avoid situations in which product is sitting in one sales channel while it is out of stock in another. Retailers are in the early stages of their journey toward omnichannel fulfillment. Some are turning their stores into fulfillment hubs, while others are transforming traditional DCs into operations that can serve e-commerce purchases. The result is a blurring of the lines between store and e-commerce activity. It’s really the retailing of the future. New investments are being targeted at boosting inventory productivity. Retailers need an accurate picture of where product resides, and how much is there.”⁹⁶

One-third of all demand for DC space to support big-box retail in the U.S. in 2012 was tied to multichannel retail or e-commerce.⁹⁷ The e-commerce generation of industrial warehousing is up to five times more labor intensive than traditional retail/distribution. More parking, mezzanine build-outs, and increased automation are some of the features difficult to retrofit to older buildings, but many can be converted.⁹⁸ Approximately 85 percent of

⁹⁴Ibid.

⁹⁵“Only 5 Percent of Retail Industry Has Fully Executed an Omnichannel Strategy,” SPS Commerce, October 17, 2014.

⁹⁶“The Supply Chain Meets the Omnichannel,” SupplyChainBrain, June 16, 2014.

⁹⁷Area Development Magazine, 2013.

⁹⁸Ibid.

respondents to Logistics Management’s 2012 Warehouse/DC Operations Survey reported operating omnichannel DCs to fulfill orders from retail stores, e-commerce, specialty retailers, wholesale, and catalogs. Housing multiple operations in one building enables them to reduce costs and improve operating efficiencies on labor, energy, inventory, and capital investment.⁹⁹ But other retailers have shifted to exclusive e-commerce fulfillment centers.

Many retailers are experiencing explosive growth in on-line sales that often is difficult to forecast. Some who anticipated even gains have been surprised by the rapid pace of the increases. Others have outgrown their warehouses and now have to use leased facilities or 3PLs. This unpredictability is compounded by fulfillment challenges that virtually all e-commerce retailers are attempting to deal with – challenges that include:

- Large SKU counts,
- Small number of pieces or lines per order,
- Extreme peak season volumes,
- Under-stocking due to unpredictable changes in market demand,
- Customer expectation of fast 24- to 48-hour delivery, and
- High volume of returns from customers.¹⁰⁰

E-commerce is changing the industrial landscape, with technological advances in fulfillment impacting demand for warehouse space, impacting the size of buildings, locations, and configurations of the facilities. A number of BCOs is expanding their distribution footprint. Some examples include:

- Amazon. 37 fulfillment centers in 15 states;
- Proctor & Gamble. 1.7 million-square-foot DC near Shippensburg, Pennsylvania;
- Clothing retailer Urban Outfitters. 1.2 million-square-foot direct-to-consumer order fulfillment center in Lancaster County, Pennsylvania, next to an existing facility that ships to Urban Outfitter stores;
- Nordstrom. New e-commerce fulfillment center in Lancaster County.
- Home Depot. 1.6 million-square-foot facility at the CenterPoint Intermodal Center in Joliet, Illinois.¹⁰¹
- Home Depot’s 1.1 million-square-foot direct fulfillment center (DFC) in Locust Grove, Georgia, is highly automated and stocks more than 100,000 SKUs, compared with about 35,000 SKUs at most Home Depot stores. Home Depot opened its second new DFC in Perris, California, in 2014. In 2015, one-third e-commerce DFC will open in

⁹⁹DeCesare, J., “Warehousing’s Reach,” *The Journal of Commerce*, July 21, 2014.

¹⁰⁰McMahon, J., “Smart Robotics Meet e-commerce,” *World Trade 100*, July 2014.

¹⁰¹ Cassidy, W. A., “Less Holding, More Selling,” *The Journal of Commerce*, March 3, 2014.

Troy, Ohio, designed at nearly 1.6 million-square feet. Home Depot also has smaller DFCs in Hagerstown, Maryland, and Mexico, Missouri.¹⁰²

A fundamental decision retailers must make is where to locate DCs, how many to operate, what functions to conduct, and what inventory to hold in each. Tompkins International presents a view of how some retailers historically have reconfigured their distribution operations to more efficiently hold inventory and fill orders placed through various channels:

- 1995. DCs;
- 2000. DC with fulfillment center (FC) in corner;
- 2005. DC with FC as problem;
- 2006. DC plus 3PL for FC;
- 2009. DC and separate FC; and
- 2013. Combined DC/FC.

As consumers demand more rapid delivery of their orders within one to two days and personalized service, retailers on the cutting-edge have modified their DC placement and uses to adopt a “Get Local” strategy.¹⁰³ An example demonstrating the complexity is captured below:

- **DCs:**
 - Level 1. National DC (DC1). Where all inventory is stored and distributed to nearby stores, nearby local DCs, and regional DCs, also potentially distributed to FCs.
 - Level 2. Regional DC (DC2). Where some inventory is stored and distributed to nearby local stores and local DCs, and also potentially distributed to FCs.
 - Level 3. Local DC (DC3). Where some limited inventory is stored and distributed to nearby stores.
- **Fulfillment Centers:**
 - Level 1. National Fulfillment Center (FC1). Where all inventory is stored and fulfilled to nearby customers, nearby lights-out stores,¹⁰⁴ nearby stores (click and collect),¹⁰⁵ and regional FCs.
 - Level 2. Regional Fulfillment Center (FC2). Where some inventory is stored and fulfilled to nearby customers, nearby lights out stores, nearby stores (click and collect), and local FCs.

¹⁰² Ibid.

¹⁰³ Tompkins International.

¹⁰⁴ Lights-out stores are where customers can collect their on-line orders and for fulfillment to local customers,
<http://www.parcelindustry.com/ME2/dirmod.asp?sid=&nm=&type=Publishing&mod=Publications%3A%3AArticle&mid=8F3A7027421841978F18BE895F87F791&tier=4&id=A8A3A9F890734C31AEEB4C8954BF8117>.

¹⁰⁵ Click and collect refers to consumers picking up orders placed on the Internet at a store,
<http://www.tompkinsinc.com/malls-click-collect-todays-pace-change-impacting-real-estate/>.

- Level 3. Local Fulfillment Center (FC3). Where some limited inventory is stored and fulfilled to nearby customers, nearby lights-out stores, and nearby stores (click and collect).
- Level 4. Lights-Out Store (FC4). Where customers can collect their on-line orders (click and collect) and for fulfillment to nearby customers.
- Level 5. Store (FC5). Where customers can collect their on-line orders (click and collect) and for fulfillment to nearby customers.

Warehouses used to be buildings in which pallets were stacked and stored. Retailing of the future is causing retailers to reconfigure their DCs and use different strategies for locating and sizing these facilities. In order to achieve the highest profit margins possible, retailers seek to ensure their DCs, regardless of the types of orders they fulfill, are scalable and their operations flexible. New types of facilities are emerging to serve the diverse and changing needs of the e-commerce market. For example:

- Mega e-fulfillment centers are large warehouses of approximately 1 million square feet to solely meet on-line orders. The facilities require access to a large labor supply and are located close to parcel hubs operated by the Integrators.
- Parcel hubs are highly automated warehouses with a low site density and many loading and unloading doors for trucks. The hub feeds local parcel delivery centers in hub and spoke networks.
- Parcel delivery centers are long and low-level buildings with extensive loading for vans and are situated on the edge of major cities and urban areas for home delivery or delivery to collection points.
- Returns processing centers are usually tailor made, depending on the operation and are designed to receive and return items to e-fulfillment centers.¹⁰⁶

Consolidating operations in one facility depends on the products and services each retailer offers. A big question that a retailer must answer is whether to consolidate fulfillment operations in one building or operate multiple facilities with distinct functions, which makes sense if multiple synergies are common across distribution channels. Some common synergies include:

- Shared inventory of common SKUs;
- Common order profiles such as item type and quantity;
- Similar service requirements like same-day shipping, etc.;
- Shared suppliers or supply points;
- Shared carriers (inbound and/or outbound);
- Shared geographic distribution area; and
- Cross-channel shopping within customer base.¹⁰⁷

¹⁰⁶ Knowler, G., "What is an e-commerce Warehouse?," *Journal of Commerce*, June 20, 2014.

¹⁰⁷ "Aligning Fulfillment Operations with Your Changing Channel Mix," Fortna, www.fortna.com.

Retailers are experimenting with strategies to manage omnichannel ordering and fulfillment, and some are farther along than others in becoming proficient at it. As retailers begin to simultaneously serve Internet, catalog, and store channels, they are discovering that there are unique supply chain challenges associated with that strategy.¹⁰⁸ Some of these challenges are described in Table 2.6 below.

Table 2.6 Aligning Fulfillment Operations with Changing Channel Mix

Areas of Impact	Challenges
Delivery on customer promises and demands	<ul style="list-style-type: none"> • Fulfillment processes not designed for same-day ship result in costs to expedite (shipping, processing, etc.) • Not meeting customer service expectations in one channel in order to meet the needs of another • Disappointment as customer experience is less than seamless (for example, customer expects to return or exchange goods purchased on-line to the retail store, which does not carry the SKU) • Frustration arises when customer wants to purchase items in a local store that are only available on-line, or cannot find size in store and SKU is not available on-line
Inventory planning and management complexity	<ul style="list-style-type: none"> • Wrong inventory in the wrong place resulting in markdowns, lost margin, or costly transfers • Confusion about inventory ownership and allocation • Multiple versions of the truth versus a single, consolidated plan for inventory management • Cross-channel transfer of inventory becomes especially difficult when each channel is under a separate Profit and Loss statement • Optimization in one channel potentially leads to cannibalization of sales in other channel(s)
People, process, and technology challenges	<ul style="list-style-type: none"> • Inability to smooth peaks and valleys or share labor, space, and equipment across functional areas inside the four walls • Order profiles require different material-handling characteristics across channels (for example, case pick versus each (single unit) pick, pack and hold pallets versus same-day shipping of eaches) • Systems and equipment designed for one channel may not meet the service requirements of other channels • Lack of systems integration across channels (merchandise, planning, order management, and warehouse management) • Efficient fulfillment processing may not equate to efficient use of labor in stores (e.g.; receiving shipments and replenishing shelf stock)

Source: "Aligning Fulfillment Operations with Your Changing Channel Mix," Fortna, www.fortna.com.

Macy's is an innovator in developing new ways to fulfill orders and is investing approximately \$1 billion in technology and infrastructure to support on-line and

¹⁰⁸ "Omnichannel Navigator," Council of Supply Chain Management Professionals's Supply Chain Quarterly, Quarter 1, 2014.

omnichannel efforts. Since launching its “Buy Online Pickup In Store” option in 2014, customers can pick up and return Internet orders at 675 full-line Macy’s and Bloomingdales stores. This BCO is taking a more holistic view of inventory to enable more effective and efficient satisfaction of customer demand from all directions.¹⁰⁹ Today, one-half of the customers ordering on Walmart.com picks up their purchases in a local Wal-Mart store.¹¹⁰ Nordstrom now ships from all 117 of its full-line outlets. Toys R Us launched its own program in all 800 of its Toy R Us and Babies R Us stores in 2011.¹¹¹ Footlocker, Ace Hardware, and Staples, among others, also are adopting this model.

Retailers seek the most opportune strategy, but achieving it is not always easy. For example, though it may appear to be the best solution, fulfilling orders from stores is more expensive than from a DC or FC and adds to the risk of “cannibalizing store inventory to the point of diminishing store-level selections.”¹¹² Back rooms may not be big enough to hold additional inventory, or pack, label, and store outbound cartons until the Integrator’s driver arrives. Moreover, store staff need to be trained to locate merchandise on the floor or in the back room, which takes them away from selling on the floor unless certain employees are dedicated to order fulfillment. Finding the merchandise may not be simple, as inventory accuracy in stores is low as a result of product not being restocked on the selling floor timely after customers have tried on the product or examined it in some way. On the other hand, DC staff typically receive more training and have tools to accurately fulfill orders, such as hand-held RFID readers; therefore, the cost to fill each order is lower than from the store.¹¹³

Home Depot will spend \$78.8 billion to construct an interconnected retail model that incorporates web and mobile apps to bring the store aisle to consumers wherever they are. In 2014 alone, the company spent approximately \$300 million on the FCs, mobile technology, facility enhancements, and a WMS.¹¹⁴ “Customers aren’t concerned about whether a product came from a direct fulfillment center or a store. They just want the product when you promised you could get them the product. Our job is to be able to take that order from a customer, understand where our inventory is, understand the optimal way to fulfill that customer’s needs and execute that. That entails leveraging all of our inventory, leveraging all our transportation and distribution assets.”¹¹⁵

These days, retailers are fulfilling orders not only from their own DCs and stores. Wholesale distributors are increasingly acting as the fulfillment vehicle for a portion of products, particularly slow-selling SKUs that are not cost-effective to warehouse in the retailer’s DC.

¹⁰⁹ Heller, L., “Macy’s to Invest \$1B in CapEx as Omnichannel Grows,” *FierceRetailIT*, August 27, 2014.

¹¹⁰ Caplice, C., “Impact of Macro Trends on Supply Chains: Diversification of Sales Channels,” *SupplyChain@MIT*, January 16, 2014.

¹¹¹ “Supply Chain News: Logistics Savvy May Determine Multi-channel Success, as Macy’s Revamps Fulfillment Network by Empowering Stores,” *SCDigest Editorial Staff*, *scdigest.com*, May 23, 2012.

¹¹² “Five Steps to Designing Omni-channel Fulfillment Operations,” *Fortna*, *www.fortna.com*.

¹¹³ Caplice, C., “Impact of Macro Trends on Supply Chains: Diversification of Sales Channels,” *SupplyChain@MIT*, January 16, 2014.

¹¹⁴ Cassidy, W. A., “Less Holding, More Selling,” *The Journal of Commerce*, March 3, 2014.

¹¹⁵ *Ibid.*

Some retailers ship only about 50 percent of the products that they offer, with the balance shipped from manufacturers, 3PLs facilities, and wholesale distributors.¹¹⁶

Retailers must determine the best location from which to pull inventory. To avoid reduced profit margins and customer dissatisfaction as a result of delayed deliveries, retailers play an ongoing balancing act that cuts across facilities, departments, and functions. Product characteristics also dictate different fulfillment strategies. “While fulfillment from the closest inventory stocking point seems to make sense, for fashion retailers, it often is better to pay more in transportation costs and ship from those stores that are selling that item more slowly. The approach avoids severe markdowns on the items that tend to dwarf the higher transportation costs.”¹¹⁷ Inventory visibility across channels and facilities is essential for omnichannel retailing to operate effectively. IT systems need to be integrated, and retailers are starting to move in that direction. Critical systems include order management, finance, WCS, WMS, and TMS. “A recent survey from Accenture and hybris software, a SAP company, pointed to silos and IT personnel gaps as big barriers to executing an omnichannel strategy. About 40 percent of retailers reported difficulty integrating back-office technology across all of their channels. About 46 percent of decision-makers said although they already have a dedicated omnichannel team – one that includes members of all functions – conflicting priorities and organizational silos remain a key challenge.”¹¹⁸

Assembling the right IT team is the first step. Next comes designing or purchasing, deploying, and integrating the software. Achieving close to 100 percent inventory accuracy is necessary if a customer has been promised an in-store pickup of an on-line order. This level of accuracy is rarely achieved in stores today, so software will be a more critical tool than ever before.¹¹⁹ Creating inventory allocation rules is a complex exercise in light of the unpredictable demand in the e-commerce channel. “Does the retail store or the on-line order get priority when it comes to inventory allocation? Do you fill an e-commerce order (immediate demand) if it means shorting a store (future demand)? These algorithms must be built in one or more of your systems. A strong order management system should balance factors like order fill rate, service levels, delivery times and freight costs to make decisions about how to allocate inventory and service the customer. Systems should support the goal of keeping inventory flexible for as long as possible to fulfill demand regardless of which channel it comes from. At some point in their omnichannel evolution most retailers will undertake significant order management projects because an aggregate view of demand and inventory is necessary to do omnichannel fulfillment effectively.”¹²⁰ Retailers are modifying their warehouse operations to address multichannel fulfillment, and this

¹¹⁶ Graves, J. B., and G. J. Swartz, Jr., *Omni-Channel Changes Wholesale Distribution*, WorldTrade, June 2014.

¹¹⁷ Caplice, C., “Impact of Macro Trends on Supply Chains: Diversification of Sales Channels,” SupplyChain@MIT, January 16, 2014.

¹¹⁸ Heller, L., “CVS to Create a New IT Team,” *FierceRetailIT*, April 23, 2014.

¹¹⁹ “Supply Chain News: Logistics Savvy May Determine Multi-channel Success, as Macy’s Revamps Fulfillment Network by Empowering Stores,” SCDigest Editorial Staff, scdigest.com, May 23, 2012.

¹²⁰ “The Impact of Omni-Channel Fulfillment on Distribution Systems,” www.fortna.com.

includes how they use their WMS, often indicating the need for a more sophisticated WMS or addition of a WCS.

Additional compelling benefits can be derived by modifying fulfillment strategies. Because it is difficult for retailers to accurately forecast sales and hold inventory in the right facilities to meet demand, “Omnichannel can serve as a ‘safety net,’ mitigating the risk of allocation error because it lets retailers service cross-channel demand from any source of inventory.”¹²¹ This can help maximize profit margins by reducing instances when merchandise must be heavily discounted to sell it. Moreover, when a customer is given the opportunity to buy anywhere and have product delivered anywhere or picked up a store, a win-win relationship between the retailer and its customer is facilitated and customer loyalty increases.¹²²

Implications for the SCAG Region

Omnichannel retailing and order fulfillment will continue to evolve in the near term, and perhaps in ways that are not readily apparent today. Impacts in this new retail fulfillment environment might be contradictory. Some BCOs will require bigger DCs; others will adopt a strategy of numerous, smaller facilities. Some will use buildings with a single purpose – order fulfillment. Others will continue to fulfill Internet orders in facilities that also replenish store inventories and serve other business-to-business (B-2-B) customers. Certain types of facilities will gravitate to urban areas; others on the outer edges.

Some BCOs will outsource Internet order fulfillment to wholesale distributors in smaller, regional DCs or to 3PL warehouse operators rather than doing it themselves. This will result in movement of merchandise from the BCO’s DC to the wholesale distributor or 3PL facility, meaning a greater number of trucks on the highway and road system as a result of increased interim stops. “On the physical distribution side, retailers need to adopt an agile model that minimizes buffer stock and stresses more frequent shipments. They’re cutting back on truckload services in favor of smaller loads and a greater reliance on parcel.”¹²³ This implies more orders will flow through the networks of LTL motor carriers and the Integrators, and fewer as full truckloads.

Certainly, the e-commerce phenomenon will create more demand for new industrial space, as older, antiquated buildings will not always be suitable for processing high-volume, small individual orders. Those outdated facilities may have to be converted to other uses if they cannot be refurbished for warehousing that is attractive to BCOs with less sophisticated requirements.

Innovative BCOs will evaluate and implement more novel approaches to delivering small orders to consumers, akin to what is being done in Western Europe. In concentrated city centers, they might employ bicycles that carry orders in small cargo boxes; or in the case of the Integrators, station lockers in strategic locations where consumers can retrieve orders

¹²¹ “Omnichannel Navigator,” Council of Supply Chain Management Professional’s Supply Chain Quarterly, interview with Kerry W. Coin, Quarter 1, 2014.

¹²² Ibid.

¹²³ Bowman, R. J., “Big-Box Retailing: Will E-commerce Blow the House Down?,” SupplyChainBrain, September 8, 2014.

at their own convenience 24/7/365. The prevalence of e-commerce has increased the number of small-package deliveries by Integrators like UPS and FedEx. In urban areas, increase in grocery home delivery is becoming evident. Other methodologies will surely emerge. More shoppers will travel to stores to pick up products they ordered on the Internet, so some order delivery will shift from trucks to autos. This will not, in itself, increase road congestion, but rather the type of vehicle used.

Because distribution models will vary and continue to evolve over time, it is critical that land parcels are available for new cargo-handling facilities of various sizes in urban areas and on the outskirts of the SCAG region. SCAG and its partner agencies should work to ensure their policies and regulations support warehouse operating efficiencies.

Compressed Time of Order Fulfillment

Description

As mentioned in the section above, consumers purchasing on the Internet are increasingly desiring near-instant gratification once they have placed their orders. In the past, delivery by the Integrators and U.S. Postal Service could take days to weeks, depending upon the distance from the FC, speed desired by the consumer, and cost he/she was willing to pay. Retailers are now racing to offer rapid delivery within one or two days. It started with Amazon's Prime program. Amazon is setting the bar even higher, pulling farther in front of the field with its recently introduced program of same-day delivery. Amazon now offers same-day delivery on more than a million eligible items with new 'Get It Today's' capabilities for customers in Los Angeles; Phoenix; San Francisco; Seattle; Baltimore; Dallas; Indianapolis; New York City; Philadelphia; and Washington, D.C. metro areas. Customers can order movies, video games, last-minute travel needs, back-to-school supplies, and family necessities; and have them delivered to their home the same day. Amazon Prime members pay \$5.99.¹²⁴ Delivery within hours approaches the threshold of instantaneous satisfaction.

Beyond using traditional methods of Internet order delivery via the Integrators and U.S. Postal Service, Amazon continues to push the envelope with its research and development of drone technology (see Figure 2.11 below). The company's goal is to deliver packages in 30 minutes or less using unmanned aerial vehicles. Jeff Bezos, founder and CEO of Amazon, said these drones will have a 10-mile radius. This implies this service will be available to consumers in urban areas rather than rural settings. Drones will be designed to carry items up to five pounds, which is about 86 percent of all deliveries Amazon makes. Amazon has hired roboticists, aeronautical engineers, and a former NASA astronaut. "Delivering packages by drones will one day be 'as normal as seeing mail trucks on the road today,'" according to the company.¹²⁵ To compete with Amazon, Google's lab is working to build a fleet of drones under the project name, Project Wing.¹²⁶

¹²⁴ "Amazon's Drone Delivery: How Would it Work?," Doug Gross, CNN, December 2, 2013.

¹²⁵ Seetharaman, D., "Amazon Drones: Internet Retailer Seeks FAA Permission to Test 'Prime Air' Delivery Service," Reuters, July 11, 2014.

¹²⁶ Liedtke, M., "Google Building Fleet of Package-Delivering Drones," Supply and Demand Chain Executive, September 5, 2014.

Figure 2.11 Conceptualization of Amazon Drone



Source: Google's secretive research laboratory is trying to build a fleet of drones designed to bypass earthbound traffic so packages can be delivered to people more quickly (www.amazon.com).

Drones clearly could help Google expand an existing service that delivers goods purchased on-line on the day that they were ordered. Although Google expects it to take several more years before its fleet of drones is fully operational, the company says test flights in Australia delivered a first aid kit, candy bars, dog treats, and water to two farmers after traveling a distance of roughly one kilometer.

Besides perfecting their aerial technology, Google and Amazon still need to gain government approval to fly commercial drones in many countries, including the U.S. Amazon recently asked the Federal Aviation Administration (FAA) for permission to expand its drone testing. The FAA currently allows hobbyists and model aircraft makers to fly drones, but commercial use is mostly banned.

Fully implementing Prime Air might take several years as the technology is further developed and FAA rules and regulations are established. On February 15, 2015, the FAA proposed rules governing the commercial use of nonrecreational drones weighing up to 55 pounds. Operators must be certified, operate the drone only during daylight hours, and keep the unmanned aircraft within sight without binoculars. This new development seems to prohibit the drone delivery services that Amazon, Google, and others are planning. It remains to be seen whether the FAA will relax these rules after the public comment period and additional study, which might take up to two years.¹²⁷

In late 2014, the FAA granted six movie and television (TV) production companies waivers from regulations on general flight rules for use of unmanned aircraft, pilot certification, and equipment mandates designed for traditional aircraft if they meet certain safety conditions. At least 40 other waiver requests are pending for commercial use of unmanned aerial systems, including ones from Amazon and Berkshire Hathaway's BNSF Railway.¹²⁸ Some foreign countries have less stringent regulations. Amazon is conducting tests in Canada and Google in Australia. German logistics company DHL tested drone delivery in Germany in September 2014, though the company indicated it does not intend to deploy drones on a widespread basis anytime soon.¹²⁹

Until drones become commercially viable, retailers are finding innovative ways to deliver orders to consumers in short timeframes. Google offers same-day delivery service by

¹²⁷ New York Times News Service, February 16, 2015.

¹²⁸ Levin, A., "It's Lights, Camera, Action... and Drones," Bloomberg News, September 26, 2014.

¹²⁹ Scott, M., "DHL to Begin Deliveries by Drone in Germany," The New York Times, September 25, 2014.

automobiles in parts of the San Francisco Bay Area, Los Angeles, and New York. Amazon is testing bike couriers in New York City in an effort to deliver on-line orders in one hour or less. The company has been holding time trials using riders from at least three courier services to find out which is the fastest and most conscientious to work in its bicycle-based delivery mode called “Amazon Prime Now.” This program operates out of Amazon’s new building in Manhattan,¹³⁰ rather than a DC, which is an added wrinkle in the evolution of order fulfillment.

Implications for the SCAG Region

Issues to be addressed in drone technology include privacy, security, safety, and environmental impact. The FAA insists it has jurisdiction over drones, though others disagree, and that is why litigation is underway in the courts.¹³¹ The outcome is unknown at this point.

With DHL leading the way, FedEx and UPS may implement drone technologies in upcoming years to some degree or at least in isolated situations where it makes commercial sense if permitted by law.

If drone technology actually becomes Federally approved, feasible and economically viable for Amazon, Google, and other retailers, it implies that FCs for that limited range of SKUs will need to be proximate to or within major cities. Because of existing building density in those population centers, cargo-handling warehouses that support drone technology will probably be fairly small and strategically located. It also is possible that Amazon’s existing FCs that support consumers in big cities also could handle fulfillment by drones. Airspace above major population centers is already crowded. It is unknown at this time what restrictions the FAA will place on the use of drones for order delivery, or when the rules will be implemented.

For the foreseeable future, it is likely Internet sellers will continue to rely on traditional delivery vans to achieve more rapid delivery of orders within one to two days, but the leaders are expanding into low-technology methods, such as bicycles and taxis, in certain situations, though this creates its own set of challenges. eBay reportedly scaled back the ambition of its eBay Now service, which dispatches “valets” to stores to retrieve merchandise, acknowledging the challenges of one-hour delivery.¹³² However, the environment could change dramatically and quickly as technology brings new, innovative capabilities like drones into widespread use. This will impact air space, traffic flow on roads and highways, and industrial warehousing – where buildings are located, their size, and functions – in ways that cannot be predicted today.

¹³⁰ “Many More Moves by Amazon,” Supply Chain Digest, December 12, 2014.

¹³¹ Bowman, R. J., “The Drones Are Coming! What Are the Legal Implications?” SupplyChainBrain, September 19, 2014.

¹³² “Many More Moves by Amazon,” Supply Chain Digest, December 12, 2014.



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