**7 Keys to Facility Location**

*John T. Mentzer*. [**Supply Chain Management Review**](http://proquest.umi.com/pqdweb?RQT=318&pmid=57034&TS=1292248258&clientId=29440&VInst=PROD&VName=PQD&VType=PQD). New York: [May 2008](http://proquest.umi.com/pqdweb?RQT=572&VType=PQD&VName=PQD&VInst=PROD&pmid=57034&pcid=39619311&SrchMode=3&aid=7). Vol. 12, Iss. 5; pg. 25, 1 pgs

**Abstract (Summary)**

Computer models can help you make the decision on where to locate your supply chain facility. But they can't make the decision for you. Ensuring that you make the right choice for your particular situation requires a deep understanding of the seven factors in effective facility location - land, labor, capital, sources, production, markets, and logistics.

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| **Full Text** (4147  words) |

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Computer models can help you make the decision on where to locate your supply chain facility. But they can't make the decision for you. Ensuring that you make the right choice for your particular situation requires a deep understanding of the seven factors in effective facility location-land, labor, capital, sources, production, markets, and logistics.

A hundred-mile move in another direction, and millions of dollars saved. A location a few hundred yards off, and millions of dollars squandered.

The first example describes the recent experience of a fast-growing regional clothing retailer whose executive team fine-tuned the decision on where to locate a new distribution center. The second example refers to another company's siting of a new warehouse close to a rail line-but with no rail spur to the warehouse itself.

Site location matters. Indeed, it has become a more critical decision for supply chain leaders as supply chains have stretched, companies have expanded, and transportation costs have soared. Today, a poor location decision can have much greater and more immediate effects on operating efficiencies and cash flow.

Yet it is surprising how few of the executives responsible for the location of a new distribution center (DC) or production facility can explain the basic principles behind choosing the location. In fact, it is alarming that more and more business leaders are relying on the results of sophisticated computer analyses to make their location decisions without fully understanding the underlying logic-or its potential impact on their supply chains.

Having been involved in a number of facility location and facility network analysis projects over the last 30 years, I am impressed with the great strides made in network analysis computer models. From the rather primitive mainframe models of the 1970s, we have progressed to the sophisticated, zip code-based models of today that operate on notebook computers. But the speed and ready availability of computing power should be seen not as the solution to complex location puzzles. It should only ever be the means for solving those puzzles.

Just as in other operations activities, the computers should not be "making" facilities-location decisions. Executives should be looking to the location network analysis tools for more than a flat recommendation on where to build a new building. They should be demanding reports on how sensitive any decision might be to underlying factors such as regional infrastructure plans, local tax incentives, long-term production plans, and much more.

It is not the purpose of this article to do a deep dive into the details of the network analysis computer models that are designed to recommend facility location. Rather, my objective is to review the business logic that should underpin those models. Specifically, I want to emphasize the seven factors-land, labor, capital, sources, production, markets, and logistics-that any executive must consider before approving a new facility location. This article takes a close look at each factor and how it should affect a facility location decision.

Classic Economic Factors:

1. Land, 2. Labor, and 3. Capital

Let's start our discussion with the three factors that derive from classic economics: land, labor, and capital. These are, in large part, the reasons why so much of U.S. industry has migrated over the last few decades from the traditionally industrialized Northeast to the Southeast. Where the Northeast has constrained land availability and higher priced labor, the Southeast has had-and continues to have-a more abundant supply of low-cost land and labor. It is these two factors that draw new facilities in this direction. Exactly the same dynamics have played out globally as businesses have located expansion facilities in nations such as Brazil, Mexico, China, and India.

Many would argue that capital is a global commodity, and as such, it does not affect location decisions. However, that view ignores the realities of the political climate surrounding today's global supply chains. It also fails to consider the economic benefits that accrue to a locale where a company chooses to build and operate new facilities. The U.S. auto industry has seen considerable growth in the Southeast over the last 20 years (think of the U.S. operations of global titans such as Nissan, Toyota, BMW, and Mercedes-Benz, to name a few) not only because of cheaper land and labor, but also largely because of the capital incentives offered by states such as Kentucky and Tennessee. Tax incentives, low-interest economic development loans, and a plethora of other devices to lower local costs of capital all have an impact on the location decision.

To illustrate, consider this scenario in which executives of a company asked the right kinds of questions about capital. With facilities close to the I-95 interstate freeway in southern Virginia, they wanted to know what the cost picture would look like if they asked the development authorities in nearby North Carolina about incentives for building a distribution center there, just 40 miles south on I-95. The result: The company was able to cut its capital expenditures by $3 million because North Carolina effectively built the new DC for free.

Countries have long followed similar strategies of economic development incentives to attract global supply chain facilities to their borders. For instance, the pharmaceutical industry for years has maintained manufacturing facilities in Puerto Rico to make product for the U.S. and European markets. As the demand for pharmaceutical products has become more global, and inexpensive manufacturing facilities have become available around the world, the pharma companies depend less on Puerto Rico for low-cost land, labor, and capital and they now have many facilities worldwide. In many cases, their moves to new global sites were prompted by promises of low-cost capital by the host country. Such shifts in production location, of course, lead to major shifts in storage facilities worldwide. But what's remarkable is how frequently supply chains must now be substantially reconfigured as a result.

Much the same has been typical of the automotive sector. Hyundai recently announced a $1 billion capital expenditure in Georgia to build a manufacturing complex in partnership with its suppliers. The South Korean automaker's move is effectively a three-way partnership with its key suppliers and Georgia's economic development authorities to take advantage of that states's low land, labor, and capital costs. As we will discuss later, the location of Hyundai's markets, and its partnership with its suppliers, makes this a total supply chain facility location decision.

Although obviously not the only factors in making any facility location decision, land, labor, and capital have significant bearing on the long-term costs of operating any facility. As such, they must be carefully weighed no matter what means are used to guide management's decision-making.

Questions managers should ask:

What is the relative cost of land, labor, and capital in the various locations we are considering?

Do we already own properties near the locations we are considering?

Are the local countries, states, counties, etc., willing to consider tax breaks, free land, low interest financing, or other capital incentives to move the facility to their area?

4. Sources of Supply

Certain characteristics of sources of supply tend to pull facilities toward them. The need to consolidate freight, especially in global supply chains, creates a tendency to build facilities near clusters of suppliers. The economics of such decisions work when the savings in consolidated freight are greater than the cost of operating the consolidation facility. Facilities based on or largely centered around sources of supply also make the most sense when companies follow increasingly popular production postponement strategies-in other words, in situations where companies do not want to commit to ship product to market until it is clear which geographic markets will drive what demand. When the strategy is to ship product direct to market as soon as it is ready in anticipation of future demand (a speculation strategy), there will be less demand for facilities determined largely by sources of supply.

China offers many great examples of facility locations centered on sources of supply. Many U.S. and European marketers have contract manufacturers in China. Since it makes little economic sense to ship containers that are not full (any empty space on a container is literally paying to ship air when the shipper is charged on a per-container basis), most of those companies' supply chains include source-of-supply-positioned facilities in order to consolidate freight into container loads. One company in the home appliance industry has a global rule of thumb: Never ship air. To implement its philosophy, the shipper must have a consolidation facility positioned at each global source of supply to accumulate product until full container shipments are achieved.

Companies that do not have sufficient volume to achieve economies of scale in container consolidation often find that China-based manufacturing cost savings are elusive. Although unit production costs may be drastically reduced, the cost of holding inventory too long in China to achieve consolidation savings (resulting in increased customer service costs) or the risks of incurring higher per-unit container shipping costs may mean that China sourcing is not the best decision. Companies in such situations often form facility consortia and shipping groups to pool the costs of the China-based holding facility or the costs of shipping containers. Such consortia, of course, require crisp market timing, joint facility locations for consolidating shipments, and products that are compatible travelers (toxic chemicals and foodstuffs clearly cannot travel in the same containers, for instance).

Questions managers should ask:

Are your sources of supply concentrated in a few geographic areas?

How high is the cost of shipment for products from this area?

Is the cost of shipment for products from this area tied to the costs of containers?

Do you follow a postponement strategy for most of your markets?

Are there other companies with which you could combine shipments and facilities?

5. Production

Facility location analysis typically treats production facilities as weight-losing, weight-neutral, or weight-gaining processes. A weight-losing process is one in which the final product weighs less than the sum of the inbound raw materials; that is, the outbound freight is lighter than the inbound freight. In such cases, there is usually an economic incentive to reduce system-wide transportation costs by building production facilities as close to the sources of supply as possible. Think of the lumber industry: Since logs lose a considerable amount of their weight (and volume) in being converted to lumber, lumber mills tend to be located near the forests. Thus, the expensive-to-ship logs move a short distance and the more-efficient-to-move lumber, while not greatly increasing the wood's value, gets shipped the longer distance to market.

In industries where the production process reduces weight but significantly increases value, production facilities tend more toward the markets and away from the sources of supply. For example, the assembly of desktop computers for sale in the U.S. often occurs in the U.S. rather than near the sources of the components in Southeast Asia, due to the greater value of the assembled final product compared to that of the sum of the component parts. Dell, for example, assembles its desktops in Austin, Texas, and Nashville, Tennessee, after a facility location analysis showed that it was cheaper to ship the component parts from Southeast Asia and create the final product near the markets.

Weight-neutral scenarios typically are found in distribution centers. Although DCs do not actually produce anything-with the exception of some light value-add assembly, perhaps-they are considered weight-neutral production processes. As a result, they tend to be located near sources of supply or near the marketplace. We'll look more closely at this situation in the next section.

On the face of it, weight-gaining supply chain processes might seem to be an anomaly. How can a final product weigh more than the sum of its component parts? That is the case when a production process adds a component that does not need to be transported because it is available everywhere. Water is the most common example of this type of component (called a "ubiquitous component"). When water is added, it affects the weight and cost of transportation, and thus, the location of production facilities differently in different industries. For example, since water must be added when beer is brewed, the brewing supply chain incurs the cost of moving water once the beer is made. To avoid this cost, breweries tend to be located near their markets to reduce the cost of moving the ubiquitous component. This has resulted in an industry with many market-positioned production facilities rather than one central production facility.

Contrast this with soft drink supply chains, where the water does not have to be added until the last minute (literally, at the fountain machine in restaurants). Coca-Cola, for instance, only makes the syrup for its products in several locations worldwide because it does not have to incur the cost of shipping the water. The ubiquitous water is added locally by the bottler or in the soda-counter machine. Thus, weight-gaining processes lead to many local market-positioned production facilities.

Questions managers should ask:

Does your product gain or lose weight (or neither) in the production process?

Does your product significantly gain value in the production process?

Are there any "ubiquitous components" involved in your production process?

6. Markets

It makes sense to locate where land, labor, and capital are cheap-but only up to a point. Why so? Because where those factors cost less is seldom where customers are located. The very cost factors that draw us to inexpensive locations draw us away from our customers. Yet the consequent increased costs of getting to market tend to pull back, drawing the product to be near the market. Exhibit 1 provides a sample list of these push-versus-pull forces.

The push-pull dilemma is very evident in the retail sector, where sellers want to place inventory as close to stores as possible with the ultimate goal of every-day delivery to each store. The market-based rationale for this is to never be out of anything in any store for more than one day. However, the counter-argument is to keep inventory at a central location (supplier-positioned) and to deliver once a week, for example. Although that response involves a higher customer service cost, the cost to deliver to the stores is minimized.

Several years ago, for example, a leading office supply retailer announced it was shifting from a once-per-week to a once-per-day store delivery schedule. The announcement was clearly motivated by management's frustration with in-store availability. But the announcement eventually had to be retracted upon analysis of the total system cost. It revealed that the annual cost of daily transportation and additional facilities would exceed $45 million. Upper management wanted higher availability in the stores, but did not have the financial wherewithal to add $45 million to supply chain costs-that is, to take $45 million off the bottom line if the new delivery schedule failed to boost sales.

So in such situations, how do supply chain managers decide which makes most sense: near-market locations or near-low-cost areas? The answer lies in the customer service and cost sensitivities of the product. Products where customer service is particularly sensitive-where customers are not willing to wait and will quickly buy competitive substitutes-mean that the cost of a stock-out can be a lost sale or perhaps even a lost customer. For example, one consumer goods company (let's call them Company A) found that every time the product of its competitor (Company B) was not in stock, an otherwise loyal Company B customer bought the Company A product. Eventually, however, that customer went back to the Company B product. Yet every time Company A's product was out of stock, its once-loyal customers bought the available Company B product and never bought Company A products again. These customers convinced themselves that Company B products were superior-even though the products were identical!

In a case like this-where lack of availability means a permanent loss of the customer-customer service cost is so sensitive that product must be stored near the markets to maintain customer service levels. But when a lost sale results only in the customer waiting until the product is back in stock, there is less urgency to maintain a high customer service levels and less need for market-positioned facilities.

Thus, there is a tendency to inventory customer-service sensitive products close to larger markets to ensure quick replenishment. Products that are expensive to store tend to be located at consolidated locations. This is an important force in drawing inventory away from market positions.

Questions managers should ask:

Where are the markets for our products and how large is each market?

What are the customer service costs (lost sale, lost customer, expediting costs, etc.) of a stock-out in each market?

What are the costs to store product near each market?

7. Logistics

Once we have analyzed the land, labor, and capital factors, accounted for the locations of suppliers and customers, and factored in our production processes, we still have to consider the logistics factors. Where are the railroads? The interstate highways? Ports of entry? Airports? What is the cost to store our products? Answers to all of these questions affect the final decision about the location of the new DC or production facility. Logistics factors are often the "fine tuning" for a facility location, taking into account the required physical movements of goods and the proximity of highways and rail spurs, for instance.

Developers in AllianceTexas, a 17,000-acre master-planned, mixed-use community located in north Fort Worth, made sure they factored logistics into their decision to include a major distribution hub in the plan. They looked at the fact that the BNSF and Union Pacific railroads had facilities nearby. They knew that the Port of Houston was distant, but viable as a logistics channel. Interstate highways came through the area. And since Dallas-Fort Worth airport was more than 20 miles away, the developers built their own airport. They also built production and storage facilities that clients could readily occupy, thus reducing their storage costs. AllianceTexas is also close to a huge potential market for many companies: the Dallas-Fort Worth metro region. By taking into consideration logistics factors as well as the other six influencers, the AllianceTexas developers built a facility location hub that now makes sense for more than 170 companies, with over 28 million square feet of facilities and over 27,000 employees.

Key questions for managers to ask:

Where are the railroads? Are there rail spurs to the facility?

What is the quality of the highways near the facility? How close are the interstate highways?

What are our ports of entry?

Where are the airports, and what is their air cargo capacity?

What is the cost to store our products in facilities?

The Seven Factors at Work

Much as AllianceTexas' developers and customers weighed all seven factors, so too did the management team at Stages Stores, Inc. (SSI), a U.S. regional clothing retailer with a unique marketing strategy. Building stores mostly in small towns where it has little or no competition, SSI has gained a distinct competitive advantage in its chosen markets. But one outcome is that the retailer has a very dispersed geographic map of ship-to points-its stores. Among its three store brands (Stage, Bealls and Palais Royale), SSI had more than 500 stores across the southern United States.

Given the store locations and ports of entry primarily at the Port of Houston and the U.S. west coast, SSI built its original distribution center in the small Texas town of Jacksonville where land, labor, and capital were very favorably priced. Proximity to markets, good access to interstate highways, and partnership with a reliable trucking company allowed low costs of operation and twice-weekly store delivery.

Then several years ago, SSI bought the Peebles retail chain. Peebles' stores looked much like Stage Stores in design, merchandise, and types of towns served. But they were located along the eastern seaboard, thus adding significant market coverage for Stage. Peebles had a distribution center in South Hill, Virginia-a good location given Peebles' store placements and its use of the Port of Norfolk for importing product. Similar to Jacksonville, Texas, South Hill is a small town with great land, labor, and capital factors.

However, neither Jacksonville nor South Hill was well-positioned to serve SSI's planned expansion into the Midwest. Where was the best location for a third DC that could help SSI move into the Midwest and then into the Pacific Northwest, but that would not significantly overlap with the geographic coverage of the existing two DCs? Land, labor, and capital analysis led to a number of possible sites in Indiana and Ohio. Supplier analysis pushed the facility more toward Chicago despite that area's high costs of land, labor, and capital. Market forces pulled back toward South Indiana, South Ohio, and even Northern Kentucky. Finally, the logistics factors of highways, rail spurs, and the inland port of Columbus airport pointed more toward Ohio.

The final factor that SSI had to consider was the ability to work with a third-party logistics provider to develop an outbound network structure for twice-per-week delivery of existing and planned stores-over a four-year projection. A third party company specializing in site selection analysis was hired to analyze all these cost and service factors, work with various state development authorities to identify specific sites, and make recommendations for final site selection. SSI's leaders took the analysis into account, but they also closely examined the assumptions behind the analysis.

This comprehensive analysis, combined with economic incentives from the three states under consideration, led to SSI management's selection of a site in southwestern Ohio. Although significant location modeling was carried out throughout the decision process, the crucial difference was that SSI's supply chain leaders made sure they guided the input and analysis, reviewed all the resulting analyses, and made their final decision with full awareness of the dynamics of the seven factors discussed here.

Nothing Beats Sound Judgment

These days, supply chain managers find themselves having to make more frequent decisions about facilities locations. Shifting global supply chains cause big shifts in markets, sources of supply, production locations and costs, and available logistics infrastructures. The shifting supply chains also impact the dynamics of costs and availability of land, labor, and capital. In other words, everything that the senior manager should consider in a facility location decision is constantly in flux. Paradoxically, the wealth of data and the tools available to analyze the data mean that managers are at greater risk of making poorer decisions. There is a temptation to "turn the decision over to the analysts." The danger is that the analytics tools become appealing substitutes for good judgment.

Stage Stores' leaders understood the need to pair the right perspectives with the right network analysis software. They did not simply leave the data inputs to their computer analysts. And they did not simply accept the recommendations that came back. They knew that the company's long-term capital structure, vendor relationships, and costs to serve customers would be substantially affected by their decision, and should not be left up to the computer models.

Supply chain leaders everywhere should take note. As global supply chains continue to evolve, facility location will continue to be a critical decision for upper management.

Exhibit 1 Forces that Push or Pull Facilities Toward Markets

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| **[Table]** |

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| Push Toward Markets | Pull Away from Markets |
| Number of potential customers. | Higher cost of labor. |
| Income levels of customers. | Lack of available labor. |
| Demographic match between customers | Higher land costs.  |
| and market.  | Higher capital cost. |
| Level of competition. | Traffic congestion leading to logistics disruptions. |
| Substitutability of products. |  |

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| **[Sidebar]** |
| Summary of the 7 facility location keys |
| John T. Mentzer |
| 1. Land: Check to see whether the area you are considering is constrained and cramped by other facilities, or a wide-open space. Make sure you can live with your neighbors, if there are any. |
| 2. Labor: One of the primary factors driving corporations to other countries such as China and India. Locations are often determined by the workforce likely to be employed there. |
| 3. Capital: Different states or countries often offer economic incentives to companies that decide to set up shop there, including tax incentives and low-interest economic development loans. |
| 4. Sources of Supply: Be sure to check out how far away your regular suppliers are from a potential location. Some of them may not want to suddenly have to travel twice the distance to get to you. |
| 5. Production: Compare your supplies to the final product, considering whether value, weight, volume or other factors change.  |
| 6. Markets: Maintain a balance between an inexpensive location and proximity to customers. Don't get too close, or go too far away. |
| 7. Logistics: Check to see how close a location is to the nearest airport, port of entry, rail line, or major highway. Assess what changes will need to be made to get goods to and from the new location. |

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