

IV.D

Systems and Facilities Design

CHAPTER 55

Facilities Size, Location, and Layout

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1. INTRODUCTION

Site selection for a new factory or distribution center is a complicated and arduous process and must be based on the strategic vision of the organization, the requirements of the supply chain, and the needs of the customer. Determined both quantitatively and qualitatively, proper site selection usually involves upper management, since the level of success of the new facility will have a major impact on the bottom line of the organization.

The purposes for site selection are relocation, expansion, and/or decentralization. Motivations for selecting a site can vary depending on the purpose (e.g., the urgency of the matter may eliminate some complex quantitative assessment or some site research), but we will treat the process in the aggregate, touching on generic steps taken to make a good decision.

Many stakeholders will give different reasons for selecting a site for a new industrial facility. When the word gets out that your organization is in the market, several individuals and companies eager to help you find the right location will be in contact. The Chamber of Commerce, realtors, local and state governments, and developers will offer substantial incentive packages to locate in their location.

The objective of all site selections is to turn a property or an existing facility into a weapon of competitive advantage. As Figure 1 indicates, an organization must transition from a big-picture analysis of its strategies and mission (macro analysis), to an assessment of addressable locations (micro analysis), to the construction phase. Though construction can happen without the comprehensive analysis discussed in this chapter, competitive advantage is rare when the upfront evaluation work is not done completely.

Among the more common mistakes made by corporations when selecting a site are:

- *Proceeding with a site search without a plan for the new facility:* Do not start looking until you know what you are looking for. You must establish criteria for the site's requirements. This will tell you what size warehouse your organization needs, what its footprint should look like, what the column spacing should be, dock and road requirements, etc. From this information, the site selection process can be narrowed to those properties that will accommodate the footprint of the original building design, as well as any planned expansions. Do not try to fit a round peg into a square hole. Immediately eliminate sites that do not accommodate the facility as designed.
- *Allowing premature publicity:* There are advantages and disadvantages to keeping your search for a site confidential as long as possible. Announcing your plan to the public may result in free publicity, support from local communities, and a head start on employee recruiting. On the other hand, announcing your intentions may drive up land prices, open the door to an onslaught of people and organizations hoping to influence your decisions, and feed the rumor mill in a way that might be detrimental to the company.
- *Failure to use a good criteria checklist:* The only way to find a site that fits your specific needs is through the use of a detailed customized criteria checklist. If you are using a one-page document, you've left out a lot of important details. To be an effective tool, the checklist must be as comprehensive as you can make it, and should include both long- and short-term economical, community, and quality of life factors.
- *Failure to align project plans with future requirements and technological trends:* Do not build for today or tomorrow; build for 2, 5, or even 10 years from now. How will the new facility accommodate increased sales, need for crossdocking, and different product lines? These are questions to be answered before you move, rather than after occupying the building.
- *Failure to accurately estimate the true cost of doing business at each proposed location:* The lowest cost site may not be the most economical place to do business. Your comparison of sites must include a thorough and detailed analysis of projected production costs. Do not let yourself be surprised by the cost of services and utilities like water, electricity, waste disposal, local special taxes, or site security. These factors can have a dramatic long-term cost impact on the bottom line.
- *Giving consideration to intangibles at the wrong time:* The purpose of the macro analysis is to precisely determine how best to utilize the site for competitive advantage. Allowing personal preferences about location and style only serves to shift the emphasis of the process from strategic and organizational requirements.
- *Failure to use consultants to supplement staff skills:* Collecting data on possible sites, accurately projecting operating costs, and evaluating incentive packages is a time-consuming process that cannot be rushed. Few owners have the time or in-house resources to do this job correctly. Facilities-planning consultants can collect the data and provide an unbiased source of advice on each facet of the site-selection process. With a wide breadth of knowledge and accessibility to time-saving planning tools, consultants make for an efficient and effective means of moving the process forward.

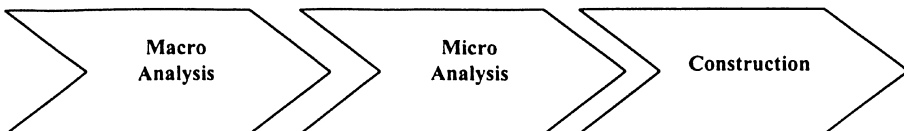


Figure 1 The Progression from Concept to Reality.

2. PROCEDURE—THE MACRO ANALYSIS (LSMP)

As Figure 2 illustrates, the macro analysis methodology is comprised of five parts:

- Organizations must envision themselves as an element of a supply chain that requires continuous improvements among all of its links, as opposed to the siloism of the past. Future competitive advantage hinges on examining the continuous improvement process as it relates to the aggregate supply chain.
- Customer satisfaction is the understanding that customers’ perceptions and expectations rather than the organization’s idea of what the customer wants, are key to profit maximization.
- Network analysis is the determination of the distribution plan that will provide the customer with the right goods in the right quantity at the right time and place while minimizing distribution costs through the correct balance of warehouses and transportation costs.
- The strategic master plan is the expression of future space, labor, and equipment requirements in order to analyze and justify alternative plans.
- Team selection is the establishment of a cross-functional group of people, internal and external to the organization, who bring their talents to the process.

2.1. Supply Chain Needs

The vision for the future of the site and for the aggregate supply chain must address the concepts of change and integration. Customer requirements, commerce structures, and market demands fluctuate faster than organizations can adapt to them. By understanding the impacts of change and integration and designing facilities around these concepts, organizations can improve chances for competitive advantage.

- *Total integration:* An ultimate customer focus where material and information flow will be designed into the system and the supply chain will be fully optimized.
- *Blurred boundaries:* Traditional customer/supplier and manufacturing/warehousing boundaries will be shifted to simplify, add value, and increase responsiveness.
- *Consolidation:* Efficient and effective transportation infrastructures will allow for high levels of customer satisfaction from fewer points along and throughout the supply chain.
- *Reliability:* Robust, redundant, and fault-tolerant systems will enable organizations to increase up time.
- *Maintainability:* A 24/7 schedule will mandate increased predictive maintenance and self-assessment.

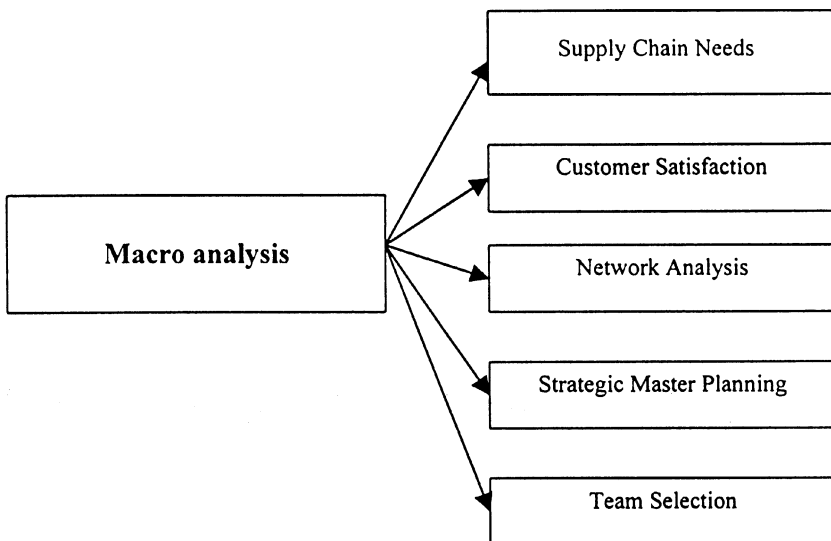


Figure 2 The Macro Analysis.

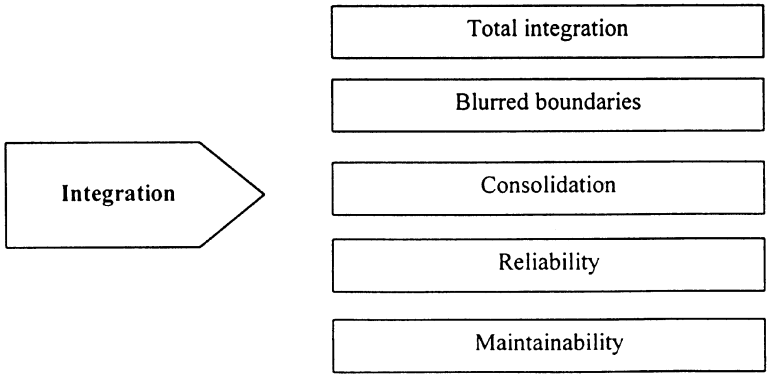


Figure 3 The Challenges of Integration.

- *Flexibility:* Addressing change in product variety and rate of new product introductions through soft, friendly systems that handle products of different sizes and weights.
- *Modularity:* Accommodating the change in product volumes through systems that operate at a variety of rates.
- *Upgradeability:* Gracefully incorporating technology, process, and methodology changes into current systems.
- *Adaptability:* Responding to systems requirements on the fly.
- *Selective operability:* Operating in segments without degradation of the overall supply chain.
- *Supportability:* Maintaining the system while automated and nonautomated elements are brought online.

2.2. Customer Satisfaction Standards

Customer requirements are changing constantly, and the one-size-fits-all philosophy is obsolete. The growth of e-commerce has affected the size (decreasing) and frequency (increasing) of orders. In the end, customer perception of quality, which may or may not be an accurate depiction of organizational quality, drives the success of the business. The needs of the customer must be the focus.

Customer satisfaction is a means by which companies attempt to differentiate their products, keep customers loyal, improve profits, increase sales, and thus become the supplier of choice. Customer satisfaction is not based on what the supplier does; rather, it is based on what customers think the supplier does. Since customer satisfaction is an ongoing process of meeting and exceeding expectations, organizations must embrace continuous improvement and always look toward the consumer for affirmation.

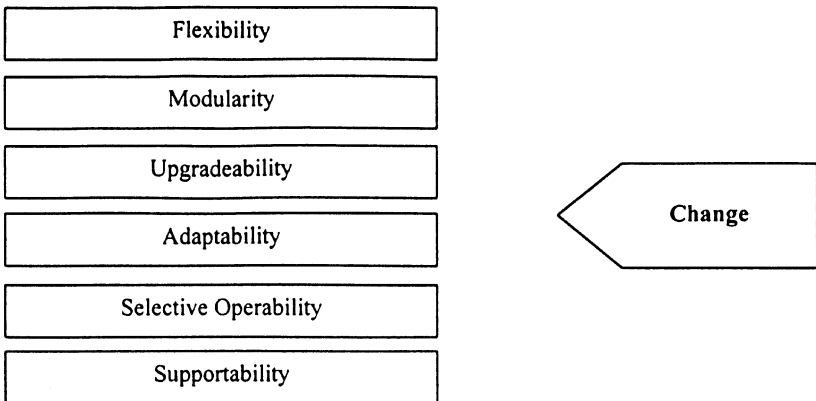


Figure 4 The Challenges of Change.

How does customer satisfaction factor into the macro analysis stage of site selection? Beyond product quality and price, it impacts such processes and methodologies as:

- On-time delivery: From where is the customer order originating? Is the network configuration such that the customer is receiving a shipment as quickly as possible?
- High fill-rate percentage: Is the site large enough to accommodate a distribution/warehousing/manufacturing center that promptly produces, stores, and ships merchandise?
- Ability to adapt: Does the site have the potential to adapt to peak/seasonal shifts?

Customer satisfaction is achieved through an understanding of requirements and expectations. Organizations should ask themselves the following questions when defining their strategic master plan:

- What are the pipeline requirements and expectations?
- What is the organization's impact on achieving customer satisfaction in the supply chain?
- How do the customers perceive current operations, processes, and resources?
- Are there gaps between what is currently possible and what is currently being done for customer satisfaction?
- What service offerings can be created based on pipeline requirements?
- How will the organization measure, track, and improve performance?

2.3. The Strategic Master Plan and Establishing a Baseline

The strategic master plan (SMP) is a seven-step process from which a baseline, or foundation on which costs are analyzed, is developed. Without a baseline, site selection is based on "crystal ball" methodology, and crystal balls are known to give wrong answers from time to time.

Step 1: Document the existing operation:

- What are your operations costing you now?
- What are your current throughput and storage requirements?
- How much safety stocks does your operation keep now?
- What are the documented standard operating procedures? How do they compare with what actually happens in the warehouse?
- What policies are in place to govern the acquisition, the utilization, and the disposal of resources?
- Establish a baseline against which recommendations for improvements can be measured.

Step 2: Determine facility requirements for a specified planning horizon:

- What will your operations cost in the next three years? Five years?
- What will be your processing, material handling, and storage requirements in the next three years? Five years?
- Is there sufficient safety stock to meet the forecasted demand?
- What are your firm's objectives? What resources are needed to meet those objectives?
- How do your firm's objectives take into account the dynamic, global business world?
- What is the impact of customer ordering changes on order picking requirements?

Step 3: Identify deficiencies in current operations:

- Are your firm's customers requiring faster delivery, more variety, and more adaptability?
- Does your firm succeed in delivering on-time?
- Are existing facilities, methods, equipment, and/or labor the most efficient and effective means for handling capacity requirements and forecasts?

Step 4: Identify alternative plans:

- What alternate sites and operation methods can be considered? What are the quantitative and qualitative issues connected with these alternatives?
- How do these alternate sites and methods reduce or eliminate the deficiencies in the current operation?

Step 5: *Evaluate alternative plans:*

- What are the after-tax costs of the alternatives? The returns on investment?

Step 6: *Select and specify the recommended plan:*

- What are the space, equipment, personnel, and standard operating procedure requirements of the facility over the planning horizon?

Step 7: *Update the SMP:*

- How will changes in the business climate affect the first six steps of the SMP?

Note: The process of developing a SMP is continuous; completion of the first six steps is no cause for celebration, since your business continues to evolve. Recognize that a static plan is as good as no plan at all.

2.4. Network Analysis

Basically, a distribution network is a series of nodes and transportation links. Distribution networks can range from direct shipments from the source to demand points for job shop items to complex multisite networks. The design of a distribution network is dependent on factors such as the type of products, range and volume of products, geographic spread of service area, the level of service required, and the number and type of customers. However, since distribution is a dynamic environment, it is challenged by business issues such as the global marketplace, the level of government involvement, the environment, and energy. At the same time, the customer requirements of increased pace, variety, and adaptability while reducing costs must be understood. Of course, these issues impact the internal pressures of distribution requirements to centralize, utilize third parties, improve information systems, increase productivity, and more fully utilize people. Therefore, the only way to enhance distribution excellence is to pursue the integration of distribution by applying strategic planning.

Strategic planning is the process of deciding on objectives of the firm; changes in the objectives; resources to attain these objectives; and policies to govern the acquisition, use, and disposition of resources. The objective of strategic planning is to define the overall approach to stocking points, transportation, inventory management, customer service, and information systems and the way they relate in order to provide the maximum return on investment.

Strategic planning is an offensive tool designed to guard against a predictable change in requirements, the timing of which can be anticipated. Strategic planning is directed at forecasting future needs far enough in advance of the actual requirements to allow sufficient lead time to meet those needs efficiently. Granted, forecasting with a long planning horizon is a risky business and distribution plans based on such forecasts often prove unworkable. Nevertheless, the forecast is the best available information concerning the future, and it is foolish not to use that information to one's advantage. In fact, the only way to survive the rapidly changing distribution environment today is to have good strategic plans that address the future needs of distribution and the factors influencing distribution. These factors are:

- **Global marketplace:** The global marketplace is a distribution issue. In fact, in today's world there is no choice but to understand the global strategy implications on all distribution decisions. As shifts occur in the world's trading patterns, this changes the distribution requirements, alters the location and number of warehouses, increases pipeline inventories, and creates new transportation opportunities and problems.
- **Government involvement:** A global trend is for governments to deregulate many activities, most notably transportation. It is important that distribution professionals understand that just as government involvement has an impact on distribution, distribution leadership has an obligation to have an impact on government on behalf of distribution.
- **Reverse distribution:** An issue that is closely tied to the issue of government involvement is the issue of reverse distribution. Reverse distribution is the task of recovering packaging and shipping materials and backhauling them to a central collection point for recycling. Handling the mechanics of reverse distribution will require significant attention by distribution professionals. Not only will they need to understand a diverse set of state and federal laws, but they will have to deal with backhauls, handling the waste packaging in their warehouses, and the customer satisfaction issue of recycling.
- **Off-highway vehicles:** The EPA is pushing to regulate off-highway vehicles; this effort will include lift trucks and will further push warehouses in the direction of electric vehicles. The internal combustion lift trucks that will be sold in the future will need to meet much stricter emission standards, but in many applications these vehicles will be replaced by electric vehicles.

- **Energy:** Another issue, like the environment, that has not been a major topic of consideration by distribution professionals is the issue of energy. Nevertheless, the cost of energy is a major concern to transportation companies. In the United States, 60% of all energy consumption is for transportation. Although these costs tend to be buried in the overall cost of transportation, any significant shift in the cost of energy could have an impact on the costs of transportation and therefore on distribution. It is therefore important that, at least as a sensitivity issue, the issue of energy costs be viewed in making all distribution decisions.
- **Pace:** There exists an accelerating rate of change in all aspects of human endeavor: social, political, economic, technological, ecological and psychological. It is not surprising, then, that the reduction of lead times, shorter product lives, and increases in inventory turnover are resulting in significant increases in the pace of change in distribution. Distribution must be more responsive because the demands being placed upon it by customers.
- **Variety:** The variety of tasks to be handled by distribution will continue to increase. Special packaging, unitizing, pricing, labeling, kitting, and delivery requirements will become the norm. Distribution will be required to perform operations that traditionally have been viewed as manufacturing operations. Systems and procedures will be put in place to handle information consistent with the desires of the customers.
- **Flexibility:** The most important aspect of flexible distribution is *versatility*—in equipment, systems, and workers. The design, specification, and implementation of versatile equipment is required to achieve flexible distribution. Warehouse storage rack and material-handling equipment, as well as transportation equipment, should be selected with sufficient versatility to handle today's distribution requirements and, when justifiable, future requirements. Similarly, versatile systems have an impact on adapting customer labeling, automatic identification, communications, and documentation requirements. We never want to find ourselves saying to a customer, "I am sorry, our system does not allow us to accommodate your request." Lastly, we must have multiskilled personnel to achieve flexible distribution. Overly restrictive work rules, excessive job classifications and labor grades, and insufficient training have often resulted in a lack of flexibility in distribution. Multiskilling eliminates barriers between tasks, and workers can better understand the implications of their performance. Throughout distribution organizations, there is a need to destroy the traditional barriers between tasks.
- **Modularity:** The three most important aspects of modular distribution are modular distribution assets, modular work assignments, and time modularity. The issue of modular distribution assets has to do with the expansion and contraction of warehouse space and the increase or decrease of transportation equipment. Similarly, for transportation equipment, purchase and lease decisions, as well as contract terms, should be evaluated while considering both the long-term and short-term fluctuations in traffic. The challenge of modular work assignments has to do with the daily balance of work within a warehouse. Once people have been given multiple skills, it is important to be certain that people are assigned in such a way to allow for a continuous flow of materials through distribution. Lastly, to provide modular distribution is the issue of time modularity. Creativity in employee work schedules can have a significant impact on an operation's output. Many distribution operations have been significantly improved by adjusting work schedules so that there is a balance between the staff on hand and the tasks to be performed. Not addressing the issue of time modularity often results in distribution operations having very low productivity.
- **Price:** A prerequisite for the success of free enterprise is efficient, effective, and low-cost distribution. Although the cost of distribution is less than 10% of the price that the customer must pay, it is of the utmost importance to the customer that even this price be reduced. As a percentage of Gross National Product, distribution costs are down from a high of almost 15% to 11%, and as a percentage of Gross Domestic Product, they are down from a high of almost 18% to below 12%. Thus, it is very important that the cost of distribution be even further reduced.
- **Centralization:** There will be fewer large centralized warehouses in the future to replace the more numerous, smaller, decentralized warehouses of the past. There will be fewer managers and administrative people involved with distribution as integrated distribution is pursued and distribution staffs are centralized. Along with the centralization of warehouses and staffs will come the centralization of order entry, customer service, and data processing. The increased responsiveness of transportation at lower costs, the focus on the total cost of distribution, the realities of customer satisfaction, pace, variety, and adaptability—all are pointed toward the centralization theme. The trend toward centralized distribution will result in higher inventory turnover, which will in turn lead to new opportunities for automation and sophisticated information systems.

- **Third-party logistics:** Third-party logistics (3PL) is the utilization of an outside firm to perform some or all of the distribution functions presently performed internally. As companies better understand integrated distribution and as distribution leadership better understands the costs of distribution, there will be an increasing trend toward the outsourcing of portions of the distribution function.
- **Information systems:** Information technology is impacting everything from business to education to entertainment. It is not surprising, therefore, that information technology is having, and will continue to have, a major impact on distribution. It has become clear that all distribution documentation must be electronically transmitted and not mailed. All distribution paperwork needs to be scrutinized and eliminated whenever possible. It is important for distribution leadership to realize that paperwork means delays, errors, additional work, and therefore wasted time and money. Distribution information systems must be real-time and paperless and standardized throughout the distribution supply chain.
- **Productivity:** Accountability for performance in distribution must be increased. Distribution management must establish standards, identify opportunities for improvement, measure performance, and take action to ensure continuous distribution improvement. The entire distribution function must realize that productivity must be increased. The option of maintaining the status quo is totally unacceptable. The improvement of distribution productivity includes labor productivity, but it goes well beyond labor productivity.
- **People:** Customers drive the business of distribution, but performance depends upon distribution people. Customer satisfaction results from contact with distribution people, and so an important, ongoing distribution issue remains in people. In the past, distribution people were narrowly focused, having a specialized skill or technical strength. These distribution people do not conform to today's distribution needs. The people needed in distribution today must adopt a broader view of distribution, a more integrated understanding of distribution, a team-based, participative organization culture, and a total dedication to the supply chain and to customer satisfaction.

2.4.1. Strategic Distribution Network Planning

Distribution network planning is one of the main areas to which strategic planning is applied. A strategic distribution network plan is developed to meet a specific set of requirements over a given planning horizon. A good plan will determine the best network that will provide the customer with the right goods, in the right quantity, at the right place, at the right time, and minimize the total distribution cost. As the number of warehouses increases, delivery costs decrease and warehouse costs increase. The opposite is also true: as the number of warehouses decreases, the delivery cost increases. Therefore, to minimize total distribution cost it is important to find the best balance of these costs.

The objective of strategic distribution network planning is to determine a plan that indicates the most economical way to ship and receive product while maintaining or increasing customer satisfaction, or simply put, to maximize profits and optimize service. Strategic distribution network planning typically answers the following:

1. How many distribution centers should exist?
2. Where should the distribution center(s) be located?
3. How much inventory should be stocked at each distribution center?
4. What customers should be serviced by each distribution center?
5. How should the customers order from the distribution center?
6. How should the distribution centers order from vendors?
7. How frequently should shipments be made to each customer?
8. What should the service levels be?
9. What transportation methods should be utilized?

Planning a distribution network is a sequential process that continually needs updating. Some companies run into the pitfall of performing steps 3 through 6 before collecting and understanding the most important steps, which are 1 and 2. The answer to distribution network planning is only as good as the data put into the analysis. The steps taken in distribution design are listed below:

1. Document distribution network.
2. Identify delivery requirements.
3. Establish database.
4. Develop alternative networks.
5. Model annual operating costs.

6. Evaluate alternatives.
7. Specify the plan.

2.4.1.1. Document Distribution Network The steps for documenting the distribution network, identifying delivery requirements, and establishing the database can be done simultaneously. The main goal of these steps is to gain an understanding of the current system and define the requirements of the future system. In order to document the existing systems, information must be collected on the distribution centers and the transportation system. In gathering information on the distribution centers, it is critical to collect from all existing sites considered, since the study could result in making recommendations on closing, moving or expanding the facilities. The following information needs to be collected for each site:

- *Space utilizations:* Determine the utilization of the distribution center. This will allow you to determine the amount of physical inventory space that will be required if this facility is to be closed when the analysis is complete. It also identifies how much more inventory can be combined into this location.
- *Layout and equipment:* List the equipment and layout of each facility. If you have a list of equipment available, it will be easier to determine the investment requirements of a new or expanded facility.
- *Warehouse operating procedure:* Understand the order picking and shipping procedures. If there are two product lines in one location, are they picked and shipped together? Understand the differences in operating methods between facilities. This may explain why one facility achieves a higher throughput efficiency per person. Understand how replenishment orders are placed or pushed to the distribution center.
- *Staffing levels:* Document levels by position. Understand which jobs could be consolidated. Collect labor rates by level, including fringe benefits.
- *Receiving and shipping volumes:* Understand the number of incoming and outgoing trucks and the number of docks. This will be important if the facility is required to increase throughput.
- *Building characteristics:* Collect building characteristics such as clear height, lighting levels, column spacing, etc. Collect this for the same reason as layout information, but keep in mind to review expansion capabilities.
- *Access to location:* Review the access to main highways. Determine whether this will have an effect on freight cost.
- *Annual operating cost:* Collect lease cost, taxes, insurance, maintenance, energy cost, and other facility cost.
- *Inventory:* Collect information on inventory turns and levels, fill rates, safety stock levels, and ABC analysis. By having this information, the savings of consolidating facilities can be determined. Also collect which, and how much, stock is slow moving or seasonal to help determine if it should be centralized in one location or whether public warehouse space should be used. Get future inventory goals.
- *Performance reporting:* Understand the performance measures for service requirements, order completeness, shipping accuracy, etc.

The following information should be collected for the transportation system:

- *Freight classes and discounts:* Collect the freight classes and rates used. In addition to freight classes, get the discounts by carrier or location. It is also important to understand where the discounts apply (under which parameters, i.e. routes, minimum weights).
- *Transportation operating procedures:* Understand how a certain mode of transport is selected and how a carrier is selected.
- *Delivery requirements:* What are the delivery requirements (days of delivery) to the customer in days, and how is carrier performance measured? Is order completeness measured?
- *Replenishment weight/cube:* At what weight is a trailer cubed out? Get this information from each replenishment point and for a typical load of general merchandise.

At the end of the site visits, a project team meeting should be held that summarizes the data collected and the assessment of each site. This assessment will give the team insight into its operation, and more than likely they will discover information unknown to management that will be useful in developing alternatives.

To document the future distribution network requirements, it is not only important to understand the factors influencing distribution but also to understand the marketing strategies and sales forecast. The following list identifies questions that should be answered by marketing and sales:

- Are there any new products coming out? From where are they sourced? What is the target market area (geographically)?
- What are the ordering parameters right now? For example, what is the minimum order size? Are they changing any terms of order (i.e., charging for expedite service)?
- What is the direction of the market? (Packaging changes, wholesalers, mass merchants having more volume.)
- Are sales increasing each year?
- Are customer shifts becoming apparent? Are fewer customers handling more volume?
- Have geographic shifts emerged? Have sales increased by geographic regions?

2.4.1.2. Identify Delivery Requirements One of the key data requirements in analyzing a distribution network is that of the delivery requirements (time order placement to receipt of the shipment). If the requirements are not identifiable, a customer satisfaction gap analysis must be undertaken. The gap analysis is a series of questions directed at internal staff and customers. The purpose is to identify discrepancies between customer perception of satisfaction and satisfaction requirements. At some point, the sales sharply decline because competition exceeds both your delivery and your cost (assuming equal product quality). The key is to find the best customer satisfaction that maximizes profits.

2.4.1.3. Establish Database The database of orders that are to be modeled can be established while the existing network is being documented. This information should include ship-to locations, weight of the shipments, products ordered, and the quantity ordered. Once the data are established, the next step should be to validate the data. In order to ensure that the information was transferred properly, print out a few records of invoices and compare these to hard copies. Also, it is a good idea to prepare a summary report (sales, cases sold, weight shipped) for a sanity check to ensure all the data in the files were transferred. Once the data are valid, various analyses such as ABC analysis by picks, location (geographical), volumes, and product volumes by regions of the country should be run. These reports should be used to help determine alternatives.

2.4.1.4. Develop Alternatives Once the data have been collected, the next step consists of developing alternative site locations and operating methods. The input used to determine alternatives consists of site visits, future requirements, database analysis, and customer service surveys. The methods used for the selection of each site will vary.

Sites are not the only option to consider as alternatives. Operating methods must also be considered. Consideration must also be given to criteria such as consolidating vendor shipments, centralizing slow-moving items in one place, keeping company divisions separate, and direct shipment by vendors. Once alternative sites are determined, data must be collected on freight rates, warehouse cost, and labor cost for the alternative sites.

2.4.1.5. Model Annual Operating Cost Modeling software doesn't guarantee the right answer. Modeling should only be used as a tool to aid in the decision process. The real value in distribution planning is the knowledge gained from understanding the working of a company's distribution system, knowledge on distribution planning, and the imagination to use the model in ways to really benefit the distribution network. Alternatives can be close in cost but have a wide range in number of facilities; therefore, it is important to have some other criteria to judge the modeling runs, such as:

1. **Central administrative costs and order processing cost:** Typically, these costs increase with the number of warehouses. It takes more effort to coordinate and manage a larger network of facilities.
2. **Cycle and safety stock carrying costs:** More warehouses means more total system inventory. Inventory theory supports that safety stocks will increase with the number of facilities.
3. **Customer order size effects:** Customers who are close to a warehouse generally tend to order more frequently and in smaller quantity than customers who are farther away. This implies that delivery costs tend to increase on a \$/cwt basis as the number of facilities increases.
4. **Interwarehouse transfer cost:** The more distribution centers there are, the greater the coordination problems and the more likely the tendency to transfer inventory between facilities due to imbalanced inventory availability.
5. **Negotiated reduction in warehousing and delivery costs:** The fewer facilities, the greater their individual volume, and hence the more opportunity there is to negotiate more favorable arrangements for warehousing and delivery service.

No matter what modeling method is used, the overall approach should closely resemble the following steps:

- *Validate the existing network:* Run computer model to simulate the existing cost. Compare this cost to actual cost.
- *Run alternative networks:* Once the model is valid, alternative networks should be run for present volumes and forecasted volumes.
- *Summarize runs and rank:* Create a table to summarize cost by alternative. The table should list distribution center cost individually.
- *Summarize all annual costs and satisfaction factors:* Create a table that indicates by alternative all the cost and service factors.
- *Perform a sensitivity analysis:* Sensitivity analysis is based on the idea of setting up runs that fluctuate some components of the data. This could be a cost that is uncertain or has potential to change. By modifying this single parameter, the effect on the run can be determined.
- *Determine all investment costs associated with each alternative:* Such as cost of new warehouse equipment required to save space, expansion, and construction cost or any building modifications such as adding dock doors. This information will be of use in the next step.

2.4.1.6. Evaluate Alternatives The economic analysis compares the recommended network plan to all alternatives. To do this analysis, you must determine all the investments and savings associated with each alternative. Costs such as new warehouse equipment, construction cost, and any building modification should be included. Additionally, the following information must be identified: personnel relocation, severance, stock relocation, computer relocation, taxes, equipment relocation, and the sale of existing land and buildings.

The result of this step should be a return on investment of each alternative compared to the baseline. Once this step is completed, a sensitivity analysis that fluctuates various costs and savings to see which alternatives are the most stable should be performed. To round out the analysis, a qualitative analysis should be performed, looking at such factors as customer service and ease of implementation. Once a conclusion has been reached, a time-phased implementation schedule should be drawn up listing the major steps involved in transferring the distribution network from the existing system to the future system.

2.4.1.7. Specify the Plan The final step in the distribution network planning process is selling the results to top management. This must be expressed so that management can understand the impact of the strategy on the total business. This communication should express not only the finances relating to transportation and warehouse costs, but overall sales and customer satisfaction.

2.4.2. Do Not Underestimate the Importance of Distribution

Distribution is the management of inventory to achieve customer satisfaction. Today, many companies have realized that distribution is a major frontier for both customer satisfaction enhancement and cost reduction. It is important to remember that a good strategic distribution network plan is a requirement of success and that it should not be composed simply of ideas, thoughts, or possibilities whose validity has not been researched. The distribution network plan is based upon a set of premises concerning future sales volumes, inventory levels, transportation cost, and warehouse cost. Requirements should be defined, analyzed, and evaluated and should result in the development of a specific set of strategic requirements. A good distribution network plan is action oriented and time phased and keeps the ultimate customer's requirements at the forefront at all times.

2.5. Team Selection

Once the need to identify a site is realized, an in-house selection team should be established. Facility management can make the site-selection process easier by also establishing alliances with external resources such as:

- Brokers
- Economic developers
- Government agencies
- Utilities
- Consultants

Once a prime geographical area for the new facility has been settled on and management has approved the SMP, the job of selecting the best community and site begins. This is the most difficult and time-consuming part of the process; support from outside sources will help the in-house team narrow down the list of potential candidates.

2.5.1. *Real Estate Brokers*

Real estate brokers are typically tied into a multiple-listing service that lists all available property in an area. Many agencies also employ state-of-the-art technology so prospective buyers can see many views of a particular site without leaving the broker's office. Be careful to select a broker comfortable with industrial site searches; many advertise commercial expertise, but industrial requirements are different from generic commercial ones, especially insofar as environmental regulations. Remember that brokers are compensated only for successful transactions, and hard-sell approaches may or may not create pressure for the selection team.

2.5.2. *Government Agencies*

State and local government development agencies, as well as chambers of commerce, are reliable information sources. Economic developers are sometimes hired employees of a city or county to promote area growth; they can also be commercial real estate brokers. A good economic developer will be able to save you time by showing you only properties that meet your needs; they will also steer you away from properties that may have watershed or zoning restrictions that would prohibit locating your facility. An economic developer most likely will have important political connections that can help cut through "red tape" and therefore speed up the process of site selection. Since government staff is motivated to attract new industry to its area, make certain that the area is compatible with company objectives before relying on this information source. A plus is that economic developers are usually aware of all incentive possibilities.

2.5.3. *Utilities*

Once a general area has been chosen, gas and electric companies can provide useful information on specific sites. Utilities are unbiased sources of advice and often work with brokers on specific land and building details.

2.5.4. *Consultants*

Facilities planning consultants provide an unbiased source of advice on each facet of the site selection process. With a wide breadth of knowledge and accessibility to time-saving planning tools, consultants make for an efficient and effective means of establishing important quantitative information such as the baseline and for "flushing out" all possible and feasible alternatives.

3. PROCEDURE—THE MICRO ANALYSIS (SITE SELECTION)

Once the "big picture" has been analyzed and a macro analysis developed, the microlevel work, in which a specific site must be chosen, begins. This is illustrated in Figure 5.

3.1. *Community Selection*

Once the general area for site selection has been determined by means of the macro analysis, the selection team should identify specific communities within that area for serious consideration. Since each community will interpret and administer legislation and government mandated/funded programs differently, the site-selection team must take special care to assess each community against company criteria and objectives. The team must therefore view and evaluate communities as they are likely to exist when the proposed facility comes on-line.

A checklist is an ideal method for measuring community attitudes and trends. The following presents some general subjects against which a community might be evaluated:

1. Are attitudes of government favorable to industry and progress?
2. How acceptable are the educational and training systems, from daycare through university?
3. Are municipal services operating on a level acceptable for community progress?
4. How is the quality of life as far as shopping, entertainment, and medical facilities?
5. Are there accessible support services for industry, such as maintenance and machine shops?
6. What are the residential neighborhoods like?
7. Can a labor force be built without compromising skill and productivity requirements?
8. Are construction and contracting services sufficient to build a facility?
9. What economic incentives are being offered?

One important economic factor is the local tax on inventories, primarily because this cost can vary significantly from one location to another. States or other taxing authorities have used the presence of inventory in storage as a basis for levying franchise, income, or other taxes on the owner of the property. Rates of taxation within states, or even within counties or towns, can also show

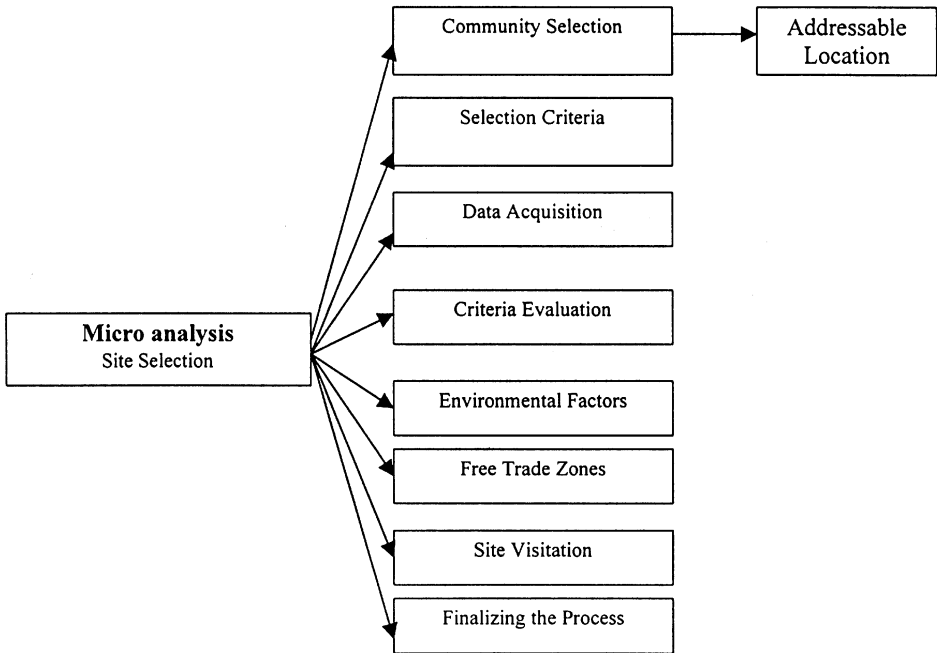


Figure 5 The Micro Analysis.

significant differences. Because state and local tax situations change frequently, expert advice should be sought when comparing tax policies of different communities.

3.2. A Site-Selection Checklist

One must utilize a comprehensive site selection checklist as part of an assessment of a particular location. A sample checklist is provided below. Checklists such as the one below are useful when establishing contacts in prospective site areas. It is not recommended that site-selection teams solicit information “cold”; in other words, observation, rather than someone else’s perception, will provide an accurate depiction of the site and its advantages and disadvantages.

Site Factors

1. General Information

- Site location
 City _____
 County _____
 State _____
- Total acreage
- Approximate cost per acre
- Approximate dimension of site
 Width _____
 Length _____

2. Zoning

- Current _____Residential _____Light _____Medium _____Heavy Industry
 _____Commercial _____Other
- Can zoning be changed? _____Yes _____No
- Check which, if any, is required: _____Rezoning _____Variance _____Special Exception
- Probability for success: _____Excellent _____Good _____Fair _____Poor

- Applicable zoning regulations (attach copy)
 - Parking/loading regulations
 - Open space requirements
 - Office/portion
 - Maximum building allowed
 - Warehouse/DC portion
 - Percent of lot occupancy allowed
 - Setbacks if required
 - On-site waste treatment required
 - Height restrictions
 - Noise limits
 - Odor limits
 - Are neighboring uses compatible with proposed use? Yes No
 - Can a good title be secured? Yes No
 - Can protective easements, protective covenants, or mineral rights be tolerated? Yes No
 - Is expansion allowed? Yes No
 - If yes, how much?
3. Topography
- Grade of slope level rolling mostly level steep
 - Lowest elevation _____
 - Highest elevation _____
 - Drainage Excellent Good Fair Poor
 - Are there any: Marshlands Ponds Streams Brooks Ditches Lakes
 - Are they: On site Adjacent to Site Bordering Site
 - What is the 100-year flood plan?
 - Is any part of the site subject to flooding?
 - What is the groundwater level? _____feet
 - Describe surface soil:
 - Does site have any fill? Yes No
 - Soil percolation rate: Good Fair
 - Load-bearing capacity of soil: _____ lb/ft²
 - Is site wooded? Yes No
 - How much?
 - Cost of removal
 - Cost of grading
 - Storm water discharged: storm sewer other
 - Roof drainage discharged: storm sewer other
 - Collection required Yes No
4. Landscaping requirements
- Building and parking lot
 - Access road
 - Loading zones
 - Site buffer
5. Access to site
- Is site visible from the highway? Yes No
- Describe access including distance from site to:
- Interstate highways
 - Major local roads
 - Central business district

Rail

Water

Airport

Describe availability of public transportation

Will access road need to be built? _____Yes _____No

If yes, who will build?

Who will maintain?

Cost of maintenance?

Is rail extended to site? _____Yes _____No

Name of railroad(s)

If no, how far?

Cost of extension to site

Who will maintain extension?

6. Sanitary sewage

- Is sanitary sewage on site? _____Yes _____No
- Reserve capacity in treatment plant _____GPD
- Tap charges
- Special regulations
- Anticipated long-range plans for permanent disposal of sewage

7. Water

- Is water line on site? _____Yes _____No
- Location of water main
- Size of main
- Static pressure _____PSI
- Residual pressure at 1000 GPM flow _____PSI
- Hardness of water
- Is supply adequate? _____Yes _____No
- Capacity of water plant _____ gallons
- Are fire hydrants metered? _____Yes _____No
- If water and sewer not on site:

What is distance to nearest line

Water

Sewer

Line size

Water

Sewer

Cost to extend line

Water

Sewer

8. Sprinklers

- What type of sprinkler system does code permit?
- Is there sufficient water pressure for sprinkler system? _____Yes _____No
- Is water for sprinkler metered? _____Yes _____No
- Is separate water supply required for sprinkler system? _____Yes _____No
- Where can sprinkler drainage be discharged?

9. Electric power

- Is adequate electric power available to site? _____Yes _____No
- Capacity available to site
- Describe high-voltage lines on site
- Service is _____ underground _____overhead
- Is submetering permitted? _____Yes _____No

- Indicate if reduced rates are available for:
Heat pumps _____Yes _____No
Electric heating _____Yes _____No
Insulation _____Yes _____No
- Rates

10. Gas

- Type of gas available _____natural _____LP
- Capacity
- Line size _____inches
- Pressure of gas _____ PSI
- Is submetering permitted? _____Yes _____No
If not, cost of extension
- Rates

11. Other utilities

- Coal
Source of supply
Reserves
Quality
Cost per million BTU delivered
Method of delivery
- Oil
Source of supply
Volume
Quality
Cost per million BTU delivered
Method of delivery

12. Taxes

- Date of most recent appraisal
- Real estate tax history, last five years
- History of tax assessments, last five years
- Proposed
Increases
Assessments
Tax rates
- Are abatement programs in effect? _____Yes _____No
If yes, describe
- Is site in an Enterprise Zone? _____Yes _____No
- Are industrial revenue bonds available? _____Yes _____No
- Services provided for taxes paid

Community Factors**1. Labor history**

- Does labor force have deep community roots?
- Do most workers own their own homes?
- Is labor force largely transient?
- Can you determine prospects of future favor tranquillity as evidence by labor turnover or absenteeism?
- Has labor group maintained a good reputation for accepting technological change?
- Do employees have a good reputation for housekeeping practices and care of equipment?
- Labor availability survey
- Population at last census
- Population density per square mile

- Percent agriculture
 - Total employed in manufacturing
 - Total employed in nonmanufacturing
 - Percent men in labor force
 - County-wide potential employment
 - Unemployed available workers
 - Shift willingness
 - Distribution of available labor
 - Skilled
 - Semiskilled
 - Unskilled
 - For women: average family income and whether basic need exists for supplemental income
 - Do farm areas serve as good labor pool?
 - Is there high degree of farm mechanization?
 - Does community have increasing supply of women seeking industrial jobs?
 - Can you complement rather than compete with existing industry?
 - Will seasonal jobs in nearby resort areas affect labor availability?
 - Is community subject to other seasonal labor variations?
 - Does adequate labor pool exist within reasonable radius?
 - Are young people taking jobs elsewhere?
 - Would better opportunities keep young people at home?
 - Influence of local industry on labor
 - Principle community factors
 - Wage rates, by skill
 - Working hours
 - Shift patterns
 - Hourly or piece rates
 - Fringe benefits
 - Degree of competition for skills
 - Pattern of productivity
 - Seniority provisions
 - Layoff provisions
 - Grievance
 - Presence of any unusual or radical tendencies
 - Does industrial accident rate for community compare favorably with national averages?
 - Will you be direct (or indirect) competition with an industrial pace-setter?
2. Maturity of citizens
- Do local civic and religious leaders have enlightened and progressive attitude toward business and industry?
 - Do people of community display political awareness?
 - How many voters went to the polls in the last municipal election?
 - How many voters went to the polls in the last national election?
 - Do local people understand how business operates in the American economy?
 - Are there community educational programs directed at young people?
 - Do social and economic backgrounds of community point toward maturity?
 - Is standard of living at or above normal average?
3. Management potential
- Can prospective workers be expected to grow into added responsibilities?
 - Can you translate evaluation into estimates for potential supervisors and executives?
 - Can you expect to recruit certain management echelons locally?
 - Are specialized skills available such as specific and technical manpower?
 - Have local people responded well to in-plant training?

4. Water pollution
 - Will you have waste disposal problems?
 - Can streams nearby accommodate waste water?
 - Will good business practice plus local or state ordinances call for waste treatment?
5. Transportation
 - Rail
 - On a rate-blanketing basis, are rates to principle markets satisfactory?
 - Has pattern of differential freight rate increases been relatively favorable for your proposed area?
 - Area?
 - Are there amply freight forwarders for LCL
 - Does railroad give transit or stop-off privileges for partial unloading and loading enroute?
 - Are there adequate truck handling facilities at freight terminals?
 - Is pick-up and deliver service available?
 - Which of these principal rail considerations are important?
 - Branch or mail line
 - Freight schedules
 - Switching per day
 - Yard limits
 - Direction of turnout to private siding from yard
 - Orientation of site to roadbed
 - Relative elevation of site and roadbed
 - Potential construction difficulties such as culvert, fill, bridge, cut
 - Does prospective rail carrier favor the use of technologically improved equipment to meet shipper needs?
 - Truck
 - Are there state laws re: truck size and weight restrictions Is site near a trucking gateway in order to reduce in-transit times?
 - Are state gasoline taxes in line with alternate sites?
 - Is the pattern of recent truck freight rate increased reasonable?
 - Will the new Federal Highway Program help solve trucking problems?
 - Is there good access to bridges and culverts?
 - Which of these factors are important?
 - Natural traffic flow
 - Specific routes
 - Schedules
 - Rates
 - Transfers
 - Common, contract, or private carrier
 - Air
 - Is site near a good airport?
 - Are rates and schedules or scheduled airlines satisfactory for hire shipment?
 - Are there good air-freight forwarders nearby?
 - Is airport service convenient for transport of personnel?
 - Is there helicopter shuttle service?
 - Ocean
 - Is proximity to inland water transport important?
 - Is proximity to overseas shipping important?
 - Does area have alert and progressive port authority?
 - Are port facilities closed in winter?
 - Is ample lighterage available?
 - Is access to port convenient and economical?
 - Are water transport rates and schedules competitive?

- Other
 - Is railway express service available?
 - Are pipelines used as common carriers?
 - Does community have desirable level of passenger transportation facilities?
 - Are there toll roads or bridges?
 - Do winter conditions adversely affect transport?
 - Does community have public or private warehouse available to help out with short-range inventory storage problems?
- 6. Raw material supply
 - Are raw material sources reliable? Close enough?
 - Are the raw materials committed to others?
 - Are terms of sale and delivery right?
 - Are multiple supply areas available?
- 7. Residential housing
 - Are there plentiful rental properties?
 - Are houses available in several cost brackets?
 - Does extent of home ownership among hourly employees indicate stability and community pride?
 - Are residential property values increasing?
 - Are attractive suburbs within convenient distance of selected community?
 - Is community saddled with submarginal or slum areas? Is rehabilitation in progress?
- 8. Education
 - Assess the number and sufficiency of
 - Public schools
 - Vocational colleges, trade schools, and apprenticeships
 - Foremanship courses
 - Adult education, degree programs
 - Is school growth keeping up with community growth?
 - What is the overall education picture?
 - Expense to public
 - Teacher salaries
 - PTA enthusiasm
 - Building program
- 9. Health and welfare
 - Are there satisfactory
 - Hospitals
 - General practitioners
 - Dentists
 - Clinics
 - Nurses
 - Public health facilities
 - Do hospitals have adequate ratings by State Board of Health?
 - How large an area is served by hospitals?
 - Are Blue Cross and allied plans available?
 - Does community have a workable disaster plan?
 - Are there reasonable state industrial safety and health laws?
 - Does the community have adequate and well-enforced sanitary laws?
- 10. General community aspects
 - How sufficient is the community recreation system insofar as:
 - Family recreation (e.g. parks and playgrounds)
 - Outdoor activities (e.g. golf and tennis)
 - Libraries

Civic attractions (e.g. museums)
 Fraternal organizations

- Sufficiency of public buildings
 - Gyms
 - Churches
 - Auditoriums
- Is the physical center of town attractive?
- Are there good hotels, motels, and restaurants?
- Is banking adequate?
- Are shopping and commercial districts well laid out?

11. Commercial services

- Evaluate quantity and quality of commercial services typically required by industry

Major repair shops

Industrial distributors

Lumber and allied materials

Stationery

Local trucking

Air freight services

Blueprint services

HVAC repair

Testing labs

Electric motor maintenance

Lubricants

Engineering department supplies

Food and sundry vending

Railway express

Postal service

Industrial repair

Janitorial service

- Evaluate quantity and quality of construction services and facilities in or near the community

Architects

Prime contractors

Mechanics

Engineers

Subcontractors

Electricians

Piping

Construction labor

Special equipment

Plasterer

Painting

Paving

Carpentry

Rigger

Mason

Tiling

Landscape

12. Police

- Does police department have high standards of personnel, equipment, training, and morale?
- Is police patrol provided for industrial properties?
- Are private watchmen or uniformed detective services available?

- Is incidence of crime as low or lower than in surrounding area?
 - Does community have disproportionate number of bars?
 - Is judiciary system well organized?
- 13. Fire department**
- Does fire department have high standards of personnel, equipment, training, and morale?
 - Is community fire insurance classification up near the top?
 - Is site within fire hydrant limits?
 - Are adjacent communities near enough to send apparatus in case of serious fire?
- 14. Infrastructure**
- Does quality of construction and maintenance indicate an efficient highway department?
 - Are roads kept free of ice and snow?
 - Is there a satisfactory highway improvement program in place?
 - How adequate is garbage collection?
 - Does the sewage department have realistic plans for expansion and improvement?
- 15. Planning and zoning**
- Is the city planning commission active and progressive?
 - Are smoke, noise, and odors controlled?
 - Can facilities expect protection from undesirables?
 - Do building inspectors have a reputation for honesty and integrity?
- 16. Community financial picture**
- Does community indebtedness present a healthy picture?
 - Is community taxation well balanced between residential, commercial, and industrial sources?
 - Is pattern of community expenditures well balanced between needs and income?
 - Is total community tax picture in line with services received?
 - Are community tax inducements offered to prospective industries?
- 17. Community business climate**
- Is attitude of local officials sympathetic and enthusiastic toward existing and new industry?
 - Is record of local government good insofar as honesty, efficiency, and principles?
 - Does community have business-sponsored civic organizations dedicated to improving business climate? Have results been achieved?
 - Is community industrially well diversified?
 - Have any manufacturers migrated from the community recently?
 - Are the industries dynamic and growing?
- 18. Community employer evaluation**
- Have most employers demonstrated enlightened management policies?
 - Have employers kept pace with rising wage standards voluntarily?
 - How do you rate employee/employer communications within the manufacturing community?
- 19. State taxes**
- What is the existing gross debt of the state?
 - Do state corporate taxes compare favorably with those of competition elsewhere?
 - Is there a state individual income tax?
 - Does the state levy property taxes?
 - Is there a state sales tax?
 - Does the state grant permission to deduct Federal Income Tax?
- 20. State business climate**
- Are state legislative, executive, and judiciary branches performing as well as counterparts in other states?
 - Are state salaries attractive enough to get and keep good people?
 - Are state wage and hour laws fairly written and administered?
 - Is state workman's compensation satisfactory?
 - Is state unemployment compensation equitable?

- Does state have an active and progressive development commission?
- What are state laws regarding:
 - Unreasonable union acts?
 - Secondary boycotts?
 - Illegal strikes and picketing?
- Have other industries been asked whether there are hidden restrictive laws?

3.2.1. Comparing Specific Sites Based on Organization-Specific Criteria

The following example shows how specific sites can be compared. The matrix established is based on weighted criteria deemed important to the client; both qualitative and quantitative factors are included in the assessment. Information is gathered from a variety of sources, including:

- U.S. government agencies
- State economic developers
- County development agencies
- City governments
- Trade groups
- Commercial real estate agents

3.2.2. Evaluation of Addressable Locations

Step 1 is the establishment of criteria and the respective weights each criterion holds. Company X has determined that the following general categories are significant in the determination of the best site for their new warehouse. Further specification of each criterion is noted in step 2.

- Customer service 15%
- Cost 15%
- Infrastructure 15%
- Suppliers 15%
- Labor 20%
- Community 5%
- Incentives 13%
- Climate 2%
- 100%

Step 2 is the information-gathering stage. Information is taken from government and community sources.

Criteria	Location X—Greenfield	Location Y—Greenfield
Customer Satisfaction		
1. Number of days to market		
Boston	4	3
Chicago	3	3
Miami	3	3
New York	4	2
Dallas	3	3
2. Distance to market (mi)		
Boston	971	1118
Chicago	411	542
Miami	839	681
New York	986	899
Dallas	776	894
3. Carriers available	2 terminals, 21 carriers	1 terminal, 9 carriers
4. Parcel service	All	All
5. Interstate access	18 miles to interstate	6 miles to interstate
6. Freight rates—outbound	\$2.09M	\$1.98M
7. Freight rates— inbound	\$570K	\$680K

Criteria	Location X—Greenfield	Location Y—Greenfield
Cost		
1. Land cost		
Per acre	\$20K	— ^a
Total land cost	\$440K	— ^a
2. Construction cost		
Distribution	\$30/ft ²	\$28/ft ²
Manufacturing	\$45/ft ²	\$40/ft ²
3. Incentives	LEDA	KEA Land \$75,000
^a Financial incentive offered by economic developers was the “donation” of a Greenfield site.		
Infrastructure		
1. Fire main supply	2400 GPM	1286 GPM
2. Fire department rating	4	3
3. Power source	LA Utility	KY Authority
4. Sewer	X	Y
5. Service roads	45 ft.	30 ft.
6. Park lighting	Installed	Add
7. Security	Fence optional	Fence optional
8. Data transmission lines	56 KB \$941/mon	56 KB \$856/mon
9. Telephone lines	Fiberoptic	Fiberoptic
10. Commercial airport (distance)	96 mi	30 mi
11. Local airport runway length	5000 ft	5000 ft
Suppliers		
1. Tool and die	3	4
2. Corrugated	1	2
3. Material-handling vendors	2	2
4. Pallets	2	2
Labor		
1. Major employers	XeronTech—300 Tachion Inc.—220	CirrinePlex—500 Handle Tire—350 Goodson Snacks—110
2. Labor Pool	87,400	15,540
Employed	81,500	13,396
Unemployed	5,900	2,144
Rate of unemployment	7%	14%
3. New employers	XeronTech—300 Duplexus Packaging—86	Goodson Snacks—110
4. Industry leaving	None	Nechcon Laminate—200 Abernathy Textiles—640
5. Right to work	No	Yes
6. Union activity	ACTW LIU UFCW	IAM BCTW UGWA
Community		
1. Local government	Mayor 5 Council members	Mayor Alderman
2. Population	11,295	7,056
3. Schools		
Enrollment	7,000	4,500
Student:teacher ratio	17:1	18:1
Post-secondary schools	(1) Community college (1) Technical school (1) 25,000-student university	(2) Community colleges (1) 4,500-student liberal arts college

Criteria	Location X—Greenfield	Location Y—Greenfield
Community		
4. Hospitals		
Beds	227	91
Doctors	90	16
Dentists	22	2
5. Recreation		
Parks	10	4
Golf	3	1
Country clubs	2	1
Theaters	4	1
Hotel rooms	350	164
6. Housing		
<\$125,000	166	45
>\$125,000	71	23
7. Closest metropolitan area	75 mi	25 mi
Financial Incentives		
1. Economic developer	LEDA	KEA
2. Fire protection	\$60,000	\$230,000
3. Site preparation	\$75,000	\$75,000
4. Tax abatements	\$150,000	\$300,000
5. Other		Land—\$300,000
Climate		
1. Average annual temperature (F)	57.6	60
2. Average annual rainfall (in.)	47	52
3. Average annual snowfall (in.)	12	9
4. Prevailing winds	NE	S

Step 3 is the development of a matrix for each constituent. Each constituent of each criterion is further weighted within its category and ranked on a 0–10 scale, with 10 representing an “ideal.” One example is provided in Chart 2. The process will be conducted for all of the criteria.

Criterion	Weight	Location X—Greenfield		Location Y—Greenfield	
		Value	Weighted	Value	Weighted
Customer Service					
Number of days to primary market	25%	5	1.25	5	1.25
Number of days to secondary markets	10%	4	0.40	6	0.60
Carriers available	15%	7	1.05	5	0.75
Parcel service	15%	10	1.50	10	1.50
Interstate access	15%	5	0.75	5	0.75
Freight rates (outbound)	10%	5	0.50	5	0.50
Freight rates (inbound)	10%	6	0.60	5	0.50
Totals	100%		6.05		5.85

Step 4 is the development of a matrix showing each general category, its values and weights. A final recommendation is based on this matrix.

Criterion	Weight	Location X— Greenfield		Location Y— Greenfield	
		Value	Weighted	Value	Weighted
Customer service	15%	6.05	0.91	5.85	0.88
Cost	15%	3.50	0.53	9.60	1.44
Infrastructure	15%	7.67	1.15	5.00	0.75
Suppliers	15%	5.61	0.84	4.87	0.73
Labor	20%	6.22	1.24	7.15	1.43
Community	5%	6.45	0.32	4.33	0.22
Incentives	13%	4.00	0.52	9.75	1.27
Climate	2%	5.22	0.10	5.85	0.12
Totals	100%		5.61		6.84

The methodology by which information is gathered is to establish an open, fruitful dialogue with these sources; this can be through a phone call, fax transmission, e-mail, or postal correspondence. It is vital to the success of any site-selection process that the information be shared on an immediate basis and follow-up (including questions) be timely and constructive.

The deliverable of this comprehensive study of sites is the recommendation of the best fit for expansion or location/relocation.

3.3. Environmental Factors

Even “clean” facilities need to be cognizant of the many regulations protecting the environment. Site-selection teams should be aware that cases can be cited of companies buying sites at low prices but having “to eat” prohibitive cleanup costs, a legacy left by the previous tenant. Even though firms that have potential pollution problems are supposed to notify the United States Environmental Protection Agency (U.S. EPA) of these problems, site-selection teams need to be alert to certain red flags when considering previously inhabited sites.

- Landfills and other solid waste depositories should be excluded from the selection process. Remediation costs normally exceed land value.
- Any site with underground storage tanks (USTs) should be thoroughly assessed. Older tanks need to be checked for rust and leaks, and all USTs must be evaluated and maintained regularly. Underground gasoline tanks must, by law in many states, be noncorrosive; replacement of old, corrosive tanks is an expensive process.
- Any facility with asbestos will require abatement or encapsulation, which is a costly procedure.
- Sites with potential for soil and groundwater contamination, due to inadequately treated sewage, discharge of manufactured or agricultural wastes, the dumping of toxic wastes, or even runoff from nearby golf courses, should be considered problematic.
- Storm water is considered one of the three leading causes of pollution in U.S. waters. Permits are required for storm water discharge, and contingencies must be made for storm water to be separated from sanitary sewer systems.
- Sites where solid waste disposal is necessary must be located near a licensed outlet. Burning of waste materials is not permitted in most locales.

Site-selection teams must learn all about pertinent regulations that govern the use of a site for specific operations. Teams should never assume the site is “clean”; this is an expensive assumption to make.

3.4. Free Trade Zones

One of the considerations in selecting a site is whether or not the site is in a free trade zone (FTZ) and whether or not the FTZ meets the company’s needs. FTZs are secured areas within the United States but they are legally considered outside the company’s territory. The purpose is to attract and promote international trade and commerce. Foreign and domestic goods may be stored, manufactured, and processed duty-free in the FTZ, which is typically a fenced-in area with warehouse facilities and industrial park space and access to all modes of transportation. Subzones, which fall beyond the perimeter of the public zone, are set up to accommodate industries that satisfy specific government criteria (e.g. ability to generate public benefit through employment).

Companies that intend to import products for manufacture or sale should research the feasibility of the FTZ. The advantages are:

- Customs duty and internal revenue tax, if applicable, are paid only when merchandise is transferred from a foreign trade zone to a custom territory for consumption.
- Goods may be exported from a zone free of duty and tax.
- Merchandise may remain in a zone indefinitely, whether or not subject to duty.

Companies should note that certain commodities and industries are excluded from zone consideration: alcoholic beverages, tobacco, firearms, white phosphorous material, sugar, and material operations that may prove to be a detriment to public health and welfare. No retail trade is allowed in FTZs.

3.5. Site Visitation

The team should visit the final round of site candidates. Items either misrepresented or unrepresented in previous information can be determined, and the final assessment may be based on this new information. Extensive research should be done at each site visitation, including in-depth interviews with managers of similar businesses. The project team should keep in mind labor market dynamics, business costs, and support infrastructure.

3.6. Finalizing the Process

Once the site has been selected, productivity should be maintained; in other words, a “business as usual” atmosphere must be generated so as to meet supply chain and customer requirements as seamlessly as possible. The following steps should be taken to ensure that the relocation or expansion plans of the company move forward smoothly:

- Identify and communicate with employees.
- Address training and recruitment issues for the new facility.
- Schedule all official announcements with discretion—premature public disclosure may alienate and demoralize employees.
- Assign either an individual or a team to monitor all aspects of the new facility, not just the construction or the move (taxes, regulations, human resources, and telecommunications all play major roles in successful site accommodation, so these must be considered and handled as diligently as the building or the relocating itself).

Site selection is the next logical step after the strategic distribution network planning, which analyzes the company’s distribution network and develops facilities requirements and customer service requirements based on the warehouse strategic master plan. Site selection is the microanalysis of the company’s needs, and through the use of a structured approach, where criteria are identified, sourced, quantified, weighted, and evaluated, it enables the company to see what the best choice is for expansion or relocation.

The team must be fully cognizant of restrictions and limitations (e.g., pollution controls or energy consumption) placed on parcels of land by governmental bodies before making lasting decisions. Through the careful processes of distribution network analysis, site evaluation and negotiation, companies can select a site that offers flexibility, versatility, and utility for many years.

4. MOVING FROM SITE SELECTION TO CONSTRUCTION

As if site selection is not difficult enough, then comes the actual construction of the facility. On a blueprint, the requirements have little more than conceptual meaning; once brought into reality with bricks and mortar, the structure will either prove immensely effective and efficient or be a capably intensive reminder of an organization not fully comprehending its strategy.

Building an industrial facility such as a manufacturing plant or distribution center is an arduous undertaking, taking up to two years from start to finish. There should not be a question about why something is being done, who is doing it, or how much more efficient it will make your operations. Unfortunately, many projects are overwrought with conflict, unexpected changes and delays, and ultimately a realization that the building doesn’t reflect, much less satisfy, the needs of the company: today, tomorrow, or next year.

The following will provide an overview of project methodologies and make suggestions on how to choose the right architect/engineering firm and contractors. Construction is not a “let your fingers do the walking through the Yellow Pages” type of endeavor. In order to make a concept a reality, careful planning and implementation of the four major elements of construction, as illustrated in

Figure 6, must be in order. Know what you want out of your manufacturing plant, warehouse, or DC and stick to the plan.

The construction or expansion of a DC or manufacturing facility is a complex undertaking that, if not properly managed, can overwhelm an organization, delay the occupancy of a much-needed facility, and adversely affect a corporation’s bottom line. Effective facilities construction requires a balancing act among expectations, cost, scope, schedule, quality, and ongoing operations.

A typical distribution facility can cost over 10 million dollars, take six months to plan, nine months to build, three months for fit-up, and two months to bring on line. It can include the participation of consultants, architects, engineers, realtors, bankers, lawyers, economic developers, state, local, and federal officials, general contractors, subcontractors, and suppliers. During design, construction and start-up, many employees are called on to assume additional responsibilities related to the new facility while continuing to perform their normal jobs. Day-to-day operations must continue, and customer service must not suffer.

No wonder the building process is often viewed by participants as a painful interruption of business as usual rather than as a celebration of growth and financial success for the corporate team.

With proper planning and with use of internal and external resources, the building process can be managed. Projects can be brought in on time, budgets can be maintained, and quality can be achieved. The process will not be painless, but the pain can be reduced if the following steps are taken:

- Establish realistic criteria for site selection.
- Select the contracting or project delivery method that best fits your needs.
- Select the best construction team for your project.
- Vigorously manage the project.

As the site-selection process proceeds, it is easy to lose sight of the ultimate goal: to locate and build a facility in accordance with your strategic master plan. This is the only way that strategic master plan forecast results can be achieved. Resist the temptation to make compromises to the site criteria that will change the building’s functionality. Your objective should be to build around the process, from the inside out. Stick to your plan.

4.1. Methods of Project Delivery

With the conceptual design in hand and with a suitable site selected, it is time to decide what contracting method you will use to turn concepts into detail design and detail design into concrete and steel.

There are several methods of project delivery commonly used in today’s market. Each method has advantages and disadvantages. Before deciding which method to use for your project, answer the following questions:

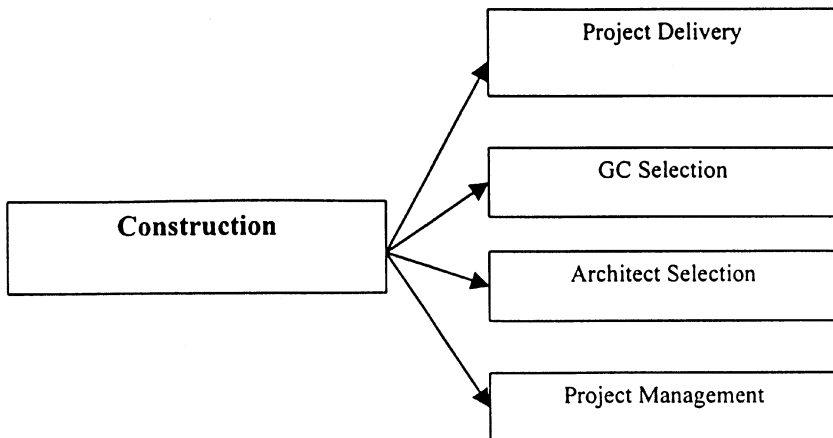


Figure 6 Construction Process.

- *How involved in the details do you want to be?* Different methods of project delivery require different degrees of owner involvement. You must be clear about what your role and responsibilities will be. After the project starts, delays caused by the owner can be costly.
- *What schedule requirements and constraints do you have?* Different contracting methods support different schedule requirements. Make sure that you understand the typical time line for each project delivery method.
- *What budget constraints do you have?* What contracting method best fits your budget?
- *What resources do you have in-house to devote to the project?* Do you have qualified people on staff that can act as your representative, or should you assign this role to a consultant?
- *What are your priorities—scope, schedule, budget, aesthetics, quality?* Each project-delivery method has advantages and disadvantages in these areas. Only through a thorough understanding of the methods can the correct selection be made.

The success of a project is often directly related to the delivery method used. The following section outlines four commonly used methods of project delivery. Once the above questions are answered, the appropriate method for your project can be selected.

4.1.1. Design-Bid-Build (Traditional Method)

The conventional fixed bid method of delivery project approach is characterized by a clear separation between the design phase and the construction phase. The owner hires an architect/engineering firm (A&E) that turns the functional requirements of the building into a detailed set of construction drawings and specifications. These drawings and specifications, as well as schedule requirements and special conditions, become the basis of a request for proposal (RFP) that is issued to general contractors (GC) for bids. Bids are received and evaluated and a fixed price or lump sum contract is awarded to a GC. The GC purchases materials and awards subcontracts as required to satisfy his obligations as detailed in the contract documents.

The GC assumes the entrepreneurial risk of completing the work in accordance with the plans and specifications for the lump sum amount agreed to in the contract. The owner's liability in theory is limited because he has a firm price to do the work. The key thing to remember here is that the contractor has given a lump sum price to perform the scope of work that is detailed in the bid documents; he has not given a lump sum price to do "whatever it takes."

As in any method of project delivery, changes in the scope are grounds for additional compensation. Likewise, changes in the schedule (e.g., delays caused by someone other than the GC or their subcontractor) can be grounds for requesting an extension time and additional compensation. Generally, delays caused by weather are covered under an excusable delay clause in the contract. In this case, the contractor would not be eligible for additional compensation to cover his extended presence on the job but would receive an extension of time equal to the time lost.

This is still the most common method of contracting in today's commercial market. Most public projects, both state and federal, use this traditional method. It is well suited to projects where aesthetics are important and elaborate or very specialized design is required. Examples would be churches, government buildings, schools, hospitals, and multistory office buildings. Figure 8 is a typical organizational chart for a design-bid-build project.

- *Advantages of design-bid-build:*
- Construction drawings and specifications are very complete and depict in detail how the project is to be constructed prior to breaking ground.
- The A&E is retained directly by the owner and represents his interest throughout the project.
- Owner has a good estimate of the final project cost before construction begins.
- A&E and GC are retained separately by the owner with clear divisions of responsibility.
- *Disadvantages of design-bid-build:*
- The entire process takes longer than other methods.
- It generally costs more than other methods.

TRADITIONAL PROJECT FLOW DIAGRAM

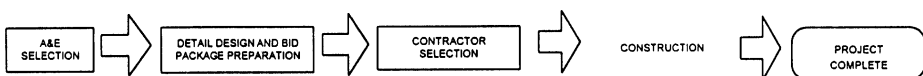


Figure 7 Design-Bid-Build Method.

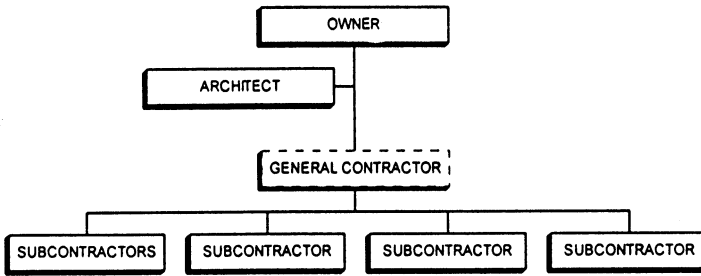


Figure 8 Organization Chart for Design-Bid-Build.

- The A&E and GC may develop an adversarial relationship, with the owner caught in the middle.
- It requires extensive owner involvement on an ongoing basis throughout the project.

4.1.2. Construction Management (CM method)

In the past 20 years, the technique known as construction management (CM) has evolved, flourished, and to some degree lost favor. It was touted as a method of speeding the construction process through fast tracking while giving the owner additional control of the project by eliminating the general contractor. Instead of awarding the project to a GC through a competitive bidding process or through negotiations, the owner hires a construction manager just as he hires an architect. The GC system is eliminated in favor of a system designed to have the architect and CM both work for the owner on a fee basis. A typical organizational chart for a CM project is shown in Figure 9.

The CM provides managerial services and acts as the owner’s agent in construction matters. Rather than the owner contracting with a single GC, he contracts directly with multiple prime contractors and specialty subcontractors. The construction manager schedules, coordinates, and directs the day-to-day activities of these contractors. He generally does not perform any work himself, but he may provide essential services normally included in a GC’s overhead cost, such as temporary facilities, utilities, cleanup, and security. These services are provided on a cost-reimbursement basis and are not part of the CM’s fee.

The construction management system, which is depicted in Figure 10, is best suited to large, complex projects requiring substantial full-time, on-site support staffs. A typical CM staff for a major industrial or public works project might include engineers, accountants, purchasing agents, safety representatives, inspectors, and construction specialist. Extensive owner representation is also required.

In theory, the overall schedule is reduced by maximizing the fast-track approach. As drawings are completed, contracts are awarded and work begins. There is no doubt that the project duration can be reduced by overlapping design and construction. However, in a case where multiple contractors are proceeding simultaneously at breakneck speeds, disputes between contractors and the CM/owner are common. This gives rise to an unnecessarily formal, and often adversarial, project climate. The owner becomes an arbitrator of disputes in a no-win situation. No matter what he does, it will ultimately cost him money. This type of project is typically characterized by disgruntled contractors, continuous change order requests, claims for additional compensation, and sometimes litigation.

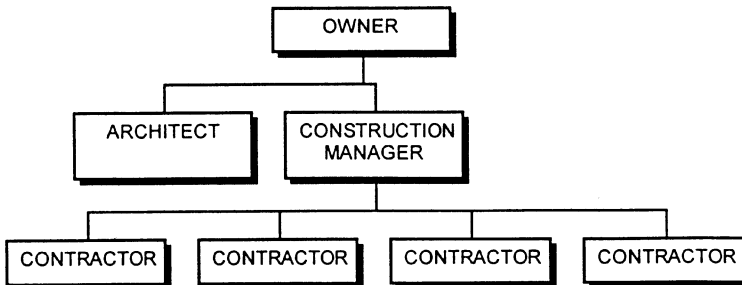


Figure 9 Construction Management Method.

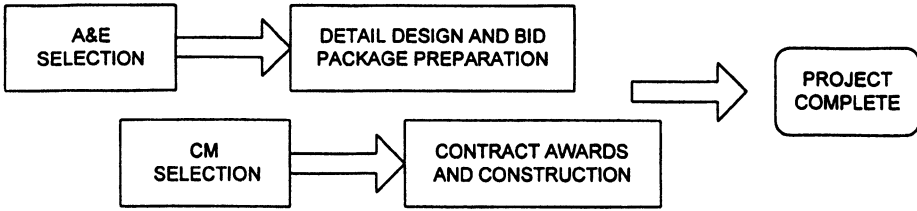


Figure 10 Organization Chart for Construction Management.

Because the construction manager is retained on a fee basis, he does not warrant or guarantee results, and may have little incentive to keep the cost down. In contrast to a fixed price contract with a GC, here the owner must assume ultimate liability for the final cost of the project no matter what the circumstances.

- *Advantages of a CM system:*
- Total project duration is reduced by fast tracking.
- Reduces owner's staffing requirements for large or complicated projects.
- Architect and construction manager both work directly for the owner.
- *Disadvantages of a CM system:*
- Often leads to disputes between multiple prime contractors.
- Final cost of the project is not known until late in the process.
- Owner's exposure is increased since CM is retained on a fee basis.

4.1.3. Design-Build

The design-build method of project delivery, which is illustrated in Figure 11, has become increasingly popular as an alternative to the traditional (design-bid-build) process. Here the owner contracts with a single source for both the design and construction of the facility. The single source is usually a contractor who specializes in this type of construction. He may have design capabilities in-house or may subcontract this phase to an A&E firm. In either case, the design-build contractor assumes full responsibility for the adequacy of the design and its constructability.

The design-build project begins with the owner (or owner's agent) developing a RFP, including a functional bid specification. This document will include:

- Layout drawings
- Project overview
- Summary of key building characteristics
- Construction completion date requirements

The RFP package is issued to a group of prequalified design-build contractors. Bids are received and evaluated by the owner/agent, and a contract is issued to the successful contractor.

The design-build contractor begins the development of detailed building specifications that are submitted to the owner for approval. The detailed building specifications are completed in sequential packages, phased with the construction sequence. This allows construction to begin prior to completion of the total design process, reducing the total project lead time. A typical design-build project organizational chart is shown in Figure 12.

The most important advantage of design-build is that it can significantly shorten the total project duration by overlapping or fast-tracking design and construction without exposing the owner to change order requests, claims and litigation due to errors, omissions, or ambiguities in the plans or

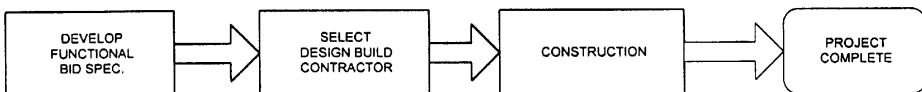


Figure 11 Design-Build Method.

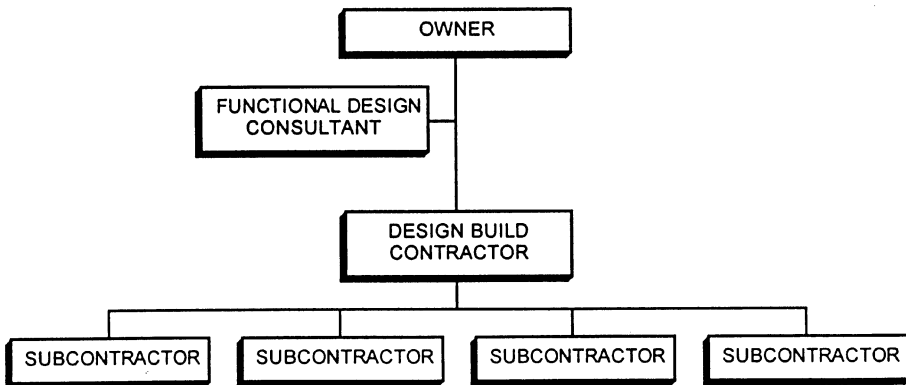


Figure 12 Organization Chart for Design-Build Method.

specifications. Likewise, the owner will not have to referee disputes between his architect and general contractor.

Design-build gives the owner a single source of responsibility and a single point of communications for all project-related issues, including schedule, budget, quality, and warranties.

A disadvantage of the system is that the owner loses the benefits of having an independent architect working directly for him. The designer now works for the contractor. His selection may have been based on price rather than qualifications and experience, and his primary objective may be to turn out a generic design quickly rather than interpret the owners needs and expectations. Drawings prepared by design-build contractors are typically intended for field use rather than owner review and are characterized by a lack of detail and much standardization. It can be difficult for an owner to visualize the details of the finished facility based on these drawings. It can also be difficult to coordinate the purchase, detail design, and installation of owner-furnished equipment and materials, using the information provided by the design-build contractor.

Since the owner does not communicate directly with the designer on a regular basis, his influence is diminished and his control of the details is lost. He also loses the advantages of having the architect act as an unbiased quality control auditor who inspects the work for compliance with plans and specifications.

- *Advantages of design-build:*
 - Gives the owner a single point of responsibility.
 - Minimizes change order request.
 - Promotes continuity between design and construction.
- *Disadvantages of design-build:*
 - Less owner control—designer is working for contractor.
 - Loss of checks and balances.
 - Drawings may lack details.

4.1.4. Team Design/Construct

The team design/construct project approach, as depicted in Figure 13, is set up with separate contracts between the owner and the A&E and GC, like the design-bid-build process, but the detail design is completed in sequential steps like the design-build process.

The process begins with the owner/agent developing an A&E RFP that is submitted to qualified firms. The RFP can request either a fixed cost bid throughout the project or a fee for time plus expenses. After evaluating the bids and interviewing candidates, an A&E firm is selected and a contract is signed.

Next, the owner/agent and the A&E develop an RFP for the selection of a GC. The request for proposal includes:

- Layout drawings
- Project overview
- Summary of key building characteristics

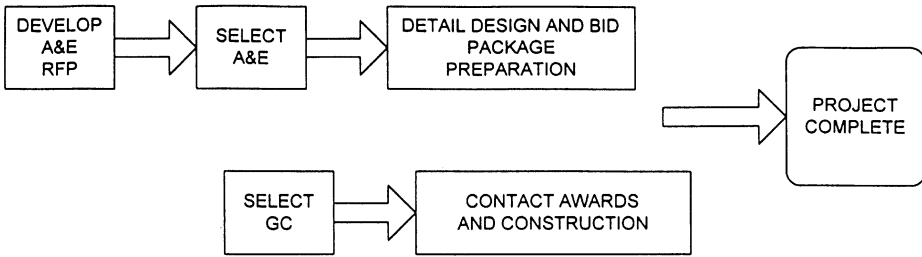


Figure 13 Team Design/Construct Method.

- Construction completion date requirements
- The general conditions governing the project
- The general requirement specifications
- The project bid form

The bid form requests the GC to state the fee to cover the project's general conditions and requirements (this is essentially the project overhead) and a fixed profit percentage for the cost of the work. This essentially creates a cost structure of time and materials with an agreed-upon profit margin for the contractor.

Once all bids are received, the owner/agent and A&E evaluate the bids and select a GC to become a member of the project team. While the selection process is taking place for the GC, the A&E is concurrently developing the building construction documents. Six different performance specification bid packages are developed and released at different points in time in order to expedite construction of the project. Each of the packages is reviewed by the entire project team, including the GC. Once all parties agree on a performance specification bid package, the GC solicits fixed bids from appropriate subcontractors.

All subcontractor bids are evaluated and summarized by the GC and reviewed with the owner/agent and A&E. The team mutually selects the subcontractor that will be used. With this process, the owner still receives the cost advantage of a competitive bid and is directly passed all project costs. Once contracts have been awarded for all six packages, a guaranteed maximum price (GMP) is established. Generally, the contract with the GC is structured such that any savings between the GMP and the actual final cost is shared, 75% returned to the owner and 25% to the GC. This keeps the GC aggressively seeking ways to save the owner money. A typical project organizational chart for the team design construct process is presented in Figure 14.

- *Advantages of team design/construct:*
 - All primary team members are on board from the outset of the project.
 - The GC is involved in the design process, allowing valuable cost savings input early on.
 - Reduces project lead time by facilitating a fast-track approach.
 - All project costs are available to owner.
- *Disadvantages of team design/construct:*
 - Total project costs are not established at start of construction.
 - Advantages of the competitive bidding process are lost.

Owners must familiarize themselves with the pros and cons of the various methods of project delivery. Ultimately, he should choose the method that best meets his needs and that he feels the most comfortable with. After contracts are signed and long-term commitments are made, is not the time to discover that you have selected the wrong contracting method for your project. In summary, the four methods are listed in Table 1.

4.2. Selecting an Architect

A&E firms come in all sizes with varying areas of specialties. One may concentrate on retail facilities like shopping centers and department stores; others may specialize in low-rise office complexes, public school facilities, or industrial complexes. Staffs can range from 2 or 3, to more than 100. Large firms typically have in-house engineering specialty capabilities such as civil/site, structural,

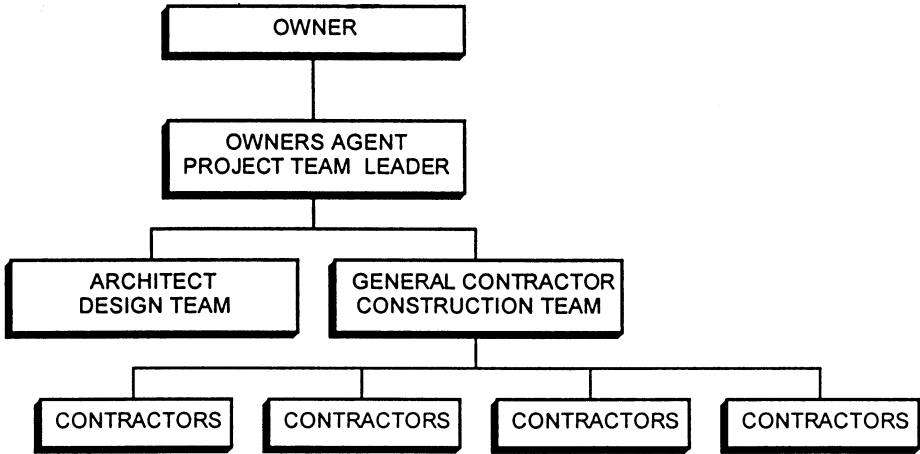


Figure 14 Organization Chart for Team Design/Construct Method.

mechanical, electrical, and so on, while smaller firms usually subcontract these phases to an outside consulting firm.

It is important that you find the right size and type of firm for your project. A very small firm is not capable of delivering the kind of service that a large or complex project requires. While the quality of the design work may be comparable, small firms just can't be as responsive as firms that keep the majority of the work in-house and have a large enough staff to work on multiple tasks at

TABLE 1 Methods for Project Delivery

	Design-Bid-Build	Construction Management	Design-Build	Team Design/Construct
Owner involvement	High throughout process	High throughout process since construction manager is retained on fee basis	Diminished influence since designer works for the contractor	Reduced because owner is represented by third party consultant or agent
Costs	Generally highest among the methods	High with no incentive to keep costs down	Reduced due to fewer change order requests; designs often generic or standard	Though not known up front, costs are managed through GMP process
Schedule	Generally longer than other three methods	Reduced by fast tracking	Reduced by fast tracking or overlapping	Reduced by fast tracking
Scope	Typically used in highly elaborate, aesthetic projects such as schools, churches, and hospitals	Seen in major public works or industrial projects	Not typical in projects requiring very specific, elaborate design	Seen in all types of projects

the same time. When the project gets started, any delay in completing design drawings on time, reviewing and returning contractor and supplier submittals, or responding to questions by any of the project participants can delay the progress of the work and have financial consequences for the owner. Likewise, if a firm has never designed a modern manufacturing or distribution center, it is unlikely that it will have the expertise that your project needs. Large firms may have the advantages of big staffs, but because of their size, workload, and number of clients, they may be unable to give your project the personal attention that a smaller firm can.

Start your selection process by compiling a list of potential candidates. Contact your local branch of the American Institute of Architects (AIA) to obtain a list of firms in your area who specialize in industrial facility design. Ask friends and business associates who have been through the process for their recommendations. Visit facilities in your area that you admire and find out who designed them. If there are firms in your area that specialize in the type of structure that you are planning, add them to your list.

From this initial list, interview only those firms that you think might be able to meet your needs. Consider the following when selecting finalists:

- Experience with similar projects (size, site conditions, functional complexity)
- Size of firm (is it the appropriate size for your project?)
- In-house capabilities (are they sufficient for your project?)
- Length of time in business (financial stability—will they be around next year?)
- Staff experience (experience of those assigned to your project)
- References (check references thoroughly)

Consider Company X: they're hoping to build a new, 1 million ft² facility to accommodate their distribution needs. Current management has never contracted out for an A&E firm, so they choose N Enterprises, basically out of the phone book. They're an A&E firm after all! Unfortunately, they have two architects and one structural engineer, each with three years of experience. They're working on two 2000 ft² residences currently. Company X fails to call but one reference: the engineer's mother, for whom they built an addition on her home. What's wrong with this picture?

Consider Company Y: they're hoping to expand their existing facility by 50,000 ft² to accommodate new manufacturing equipment. Their management wants "only the best," so they hire the leading architect in the country. Although the firm is large and well known throughout the world, its reputation was built on design of large, high-profile office complexes, not industrial facilities. This firm will essentially have to start from scratch. With little previous experience in designing industrial facilities to draw from, the process is likely to take longer and be more costly. The final design is adequate but lacks imagination and shows that the firm really didn't have an understanding of company Y's operation and requirements. The firm is so large and has so many projects going on that company Y's project doesn't get the attention it deserves.

These are extreme examples of poor A&E selection. Keep in mind, though, that it is better to err on the side of caution and do your homework slowly. RFPs and selection matrices will help this process.

From the information gathered, develop a short list of three to five firms to send RFPs. In order to be able to compare responses, the RFP must clearly define the scope of services that the architect is to provide. Basic services include information gathering, preparation of preliminary schematics designs, detailed design development, construction document preparation, assistance in awarding contracts, and contract administrative services during the construction phase.

The RFP should also include:

- A description of the project approach (organization, methods and procedures)
- An overview of the project's objectives (why the facility is being built)
- Design criteria and constraints (what must be included to achieve objectives)
- Schedule requirements and constraints (must start and/or must complete dates)
- Budget parameters (accurate estimate of the intended budget)

Generally, the more relevant and detailed information you can include in your RFP, the more responsive the A&E proposals will be.

The RFP can request either a fixed cost bid, an hourly rate plus reimbursable expenses, or a combination of the two. Whatever method of compensation you choose, make sure you clearly understand the agreement and have an accurate estimate of the final cost of services.

The final selection of an architect should be based not only on technical competence, experience, organization, cost, and schedule, but also on your personal confidence in the firm's ability to meet your expectations. An example of an A&E selection matrix is included in Table 2; each firm is ranked

TABLE 2 A & E Selection Matrix

	Company A	Company B	Company C	Company D	Company E
1. Project understanding	5	5	3	5	5
2. Scope of services	5	4	2	4	4
3. Scope of qualifications	5	5	3	4	4
4. Experience with similar projects	5	3	3	5	3
5. Cost not to exceed	\$352,000	\$497,000	\$430,000	\$370,000	\$295,000
6. Hourly rate	\$65/hr	\$70/hr	\$89/hr	\$53/hr	\$61/hr
7. Project staffing	5	4	5	5	3
8. In-house staffing	5	5	5	5	2
9. Schedule	3	2	5	4	3
Total	33	28	26	32	24

on a 1 (poor) to 5 (excellent) scale on a predetermined set of criteria. Results of interviews and written proposals are considered in these assessments. Based on the numbers below, Company A and Company D were in a dead heat for the project. In the end, however, Company A was chosen due to its stronger showing in services, deliverables, and staffing. Price alone should never be the motivating factor in an A&E selection.

Make sure that you have met and feel comfortable with the people who will actually be working on your project. Finally, select a firm whose style, personality, and project approach are compatible with yours.

4.3. Selecting a Contractor

The traditional way of selecting contractors is through the competitive bidding process. This may result in an initial low price, but it does not necessarily result in selection of the best contractor for the project. Price is an important consideration, but other factors, such as experience with similar projects, financial stability and strength, number of years in business, reputation, annual volume, and safety record, must be considered before entering into a long-term binding agreement with a contractor.

For this reason, RFPs should only be issued to a short list of prequalified contractors that meet acceptable standards in all categories, any of which you would be willing to award the project to. Below is an example of a prequalification form that can be used to screen prospective contractors. Here again, we are using a rating system of from 1 to 5, with 5 being the highest possible score. This is only an example; you will need to evaluate what categories to include on your form and what weights to assign to each factor. However, at this stage in the selection process, emphasis should be placed on financial strength, experience, and reputation.

The role of the GC has changed significantly over the years. Where once the GC employed his own tradesmen to perform the work, today most work is done by specialty subcontractors: electrical, plumbing, roofing, and so on. The GC is predominantly a supervisor. He assembles a group of specialists, generally through the competitive bidding process, and then has the responsibility of scheduling and coordinating their activities to ensure that the work is performed correctly and completed on time. Subcontractor administration is the GC's primary concern once construction begins. GCs may subcontract more than 98% of the work to be performed on a project. For this reason, the owner must reserve the right of final approval of all major subcontractor and material suppliers. During final negotiations with GCs, the owner should review the credentials of all proposed subcontractors (e.g., electrical, HVAC, fire protection, etc.) and critical material suppliers such as structural steel fabricators. If there is any question about the ability of any of these participants to perform, the owner should insist that they be replaced.

Obviously, selecting the right contractor is essential to the success of your building project. The right contractor is the one that has the appropriate balance between stability, technical competence, experience, organization, cost and that intangible element: your personal confidence.

4.4. Project Management

Having decided what to build, where to build it and who will do the work, you might be ready to wash your hands of the whole thing and let the process run its natural course. This approach can be disastrous. Construction projects are dynamic creatures requiring constant monitoring and guidance. If left to its own device, the project can take a wrong turn before you realize what has happened.

TABLE 3 GC Selection Matrix

Item	Description	Weight	Rating	Score
1	Number of years in business under present name		3	0.15
2	Annual volume	8%	3	0.24
3	Bondable for this size project (prerequisite) ^a	10%	5	0.50
4	Financial strength	10%	3	0.30
5	Overall experience	10%	3	0.42
6	Experience with similar projects	16%	5	0.80
7	Home office location	5%	1	0.05
8	Qualifications of key employees	8%	3	0.24
9	Safety record	12%	4	0.48
10	Reputation and references	12%	3	0.36
	Total	100%		3.54

^a *Eliminates contractor:* A performance bond is a guarantee by a surety to the owner that the contractor will complete the work in accordance with the plans and specifications. If the contractor defaults under the terms of the contract, the surety becomes responsible for the contractor's obligations and must complete the work in accordance with the terms of the contract.

Generally, performance bonds can only be obtained by contractors who have a documented history of financial stability and satisfactory performance.

Whether or not a bond is required from the successful bidder, requiring all potential contractors to furnish letters from a surety that they are bondable ensures that only financially sound companies will participate in the process.

Lost time or money spent is rarely fully recoverable. To avoid surprises, cost, schedule, and quality must be constantly monitored.

The nature of the construction process leads to natural differences of opinion among the participants. Everyday issues must be identified and resolved before they develop into problems. Timely decisions must be made so that the project can move forward as scheduled. Placing an activity on hold because approval drawings have not been returned or because the person who needs to make a decision is on vacation can disrupt the flow of a project and prove to be costly to the owner.

The secret to a successful project is effective project management. The individual who has the responsibility to represent the owner has more at stake than meets the eye. He must coordinate, facilitate and take responsibility for the successful completion of the project. No matter which method of project delivery has been chosen, the owner will have ongoing responsibilities, and must assume an active role throughout the building process. The owner must:

- Be represented at all planning and progress meetings
- Develop and maintain a master project milestone schedule
- Provide timely information to the A&E, contractor, or suppliers
- Develop and implement procedures for budget tracking and cost control
- Review payment requests and make recommendation for disposition
- Coordinate and expedite delivery and installation of owner-furnished materials and equipment
- Review drawings, submittals, and product samples as required
- Maintain documents, records, and logs as required to protect the owners interest
- Prepare and submit progress reports and schedule updates to top management
- Review and approve all change order requests

Completing a major project on time and within budget requires an extraordinary amount of time and effort on the part of the owner. Those with limited resources, who do not have experienced construction professionals on staff who can be assigned to the project, should consider securing the services of an outside consultant to act as their agent. An experienced consultant who is familiar with the strategic master plan and understands the role of the facility as a production tool rather than a structural box can be invaluable to the owner. Working as the owner's designated representative, he can move the project along smoothly from one phase to the next without interruption or delay while protecting the integrity of the functional design at each step. This ensures that contractors, suppliers, or other project participants do not make changes to the structure that will affect the process that the building has been designed to house.

For example, the placement of light fixtures, conduits, ductwork, or fire-protection lines below the designated clear height of the building can dramatically affect the designed manufacturing or warehousing process by restricting the travel of material handling equipment. Relocating utilities or other obstructions after the fact can be costly to the owner. Having a qualified representative on site during critical construction phases is a case of spending a penny to save a dollar.

The planning, design, site selection, construction, and start-up of a new or expanded distribution center or manufacturing facility is a linear process that follows logical steps from concept to completion. It is easy to understand the steps; it is not easy to manage the process effectively.

Do not underestimate the difficulties that will arise between concept and completion. Typically, millions of dollars of construction money are at stake, as well as the potential loss of revenues should the facility not be operational as scheduled, not perform as anticipated, or prove to be in the wrong location.

4.5. Summary Points for Construction

Let's review the steps to project success:

- *Establish realistic criteria for site selection:* When we say "realistic," we mean according to the needs identified in a strategic master plan (SMP). The SMP will identify and prioritize facility requirements for a given planning horizon, based on historical data and objective analytical projections. Establish needs and stick to the plan.
- *Select the contracting or project-delivery method that best fits your needs:* The generalized definitions of the four methods described in this monograph are intended only to introduce the reader to the process. Before committing to any method, the owner should have a clear understanding of the rules of the game and the roles and responsibilities of each player. Knowledge is power. Do research. Have unbiased consultants or third parties help you.
- *Select the best construction team for your project:* Your project is only as great as the skills and dedication of its team members. Do not get involved with unnecessary conflict and politics. Be careful; use quantitative and qualitative evaluations. Weight each criterion based on its unique importance to you. Your cautious diligence will pay off.
- *Vigorously manage the project:* You've done a lot of work up to this point; Do not let success slip away by neglecting the bricks-and-mortar phase. Allocate qualified staff to oversee the process, or select third-party agents or consultants to represent your interest during this critical stage. Wiping your hands of the construction process now is guaranteed to create difficulties down the road.

5. CONCLUSION

Developing a comprehensive plan that encompasses site selection and construction ensures that the organizational mission and goals will be addressed in the concept to reality process. Through a combination of awareness, research, reflection, and leadership, organizations can be assured that the property they choose and facility they ultimately build will increase return on assets, enhance competitive advantage, and provide the supply chain with the resources, processes, and methodologies that provide a true competitive advantage.

ADDITIONAL READING

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