RESILIENCE**report**

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Designing the Factory Footprint for Competitive Advantage

For further information:
Michael Pfitzmann, Chicago: michael.pfitzmann@booz.com
Curt Mueller, Chicago: curt.mueller@booz.com
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Designing the Factory Footprint for Competitive Advantage

Assessing supply chain design can be the key to profitability and even survival.

by Dermot Shorten, Michael Pfitzmann, and Curt Mueller

The chief operating officer (COO) at a consumer products manufacturer was preparing for the quarterly management team update and was not expecting an easy time. In the previous few years, the company had opened plants around the globe, closer to its markets, to be more responsive to local demand. But the medium-sized factories in Europe were not operating efficiently compared with their larger-scale sister plants in the U.S., and the recently opened, supposedly low-cost plant in Vietnam was demonstrating very poor labor productivity and quality results. At the same time, currency fluctuations had begun to make it difficult to predict profitability in any region. Relentless coverage of the pros and cons of offshoring in "low-cost" geographies in the press had led the COO to worry that his company might be missing out on the opportunity to dramatically improve its cost structure — but his experience in Vietnam had convinced him that he did not have a well-thought-out strategy or a full understanding of the total supply costs from changing his manufacturing network.

The COO was starting to conclude that the number and location of the company's manufacturing facilities were creating a drain on profitability. It was becoming clear that to stay competitive, he would have to rethink the design of his "manufacturing footprint."

Similar reevaluations are occurring at more and more companies, as manufacturing network design has become an economic and strategic imperative. Companies in virtually every industry are trying to determine the best way to use their manufacturing footprints, realizing that if they want to stay competitive, they can't wait until their manufacturing costs are out of line to take action. In many industries, target costs are set for product launches and their associated manufacturing programs, which are scheduled for years in the future. Use of these forward-looking cost positions to identify a supply chain that can help the organization come in at or under budget is critical to executing profitable product launch programs.

Companies that have adjusted their manufacturing networks have realized impressive success: A defense electronics manufacturer consolidated plants to reduce costs by 24 percent annually; a pharmaceutical company combined plant consolidation and outsourcing to boost the bottom line by $20 million; and an automotive supplier generated yearly savings of $320 million, which put the company on the road to 15 percent profit growth, from restructuring its manufacturing footprint and supply base.

As is clear from these and other examples, proactive companies can reduce unit costs by as much as 40 percent of total acquisition cost (that is, raw material, manufacturing, inventory, and freight to end-customer markets) by asking: How many plants should we have? Where should they be? What should their focus and mission be?

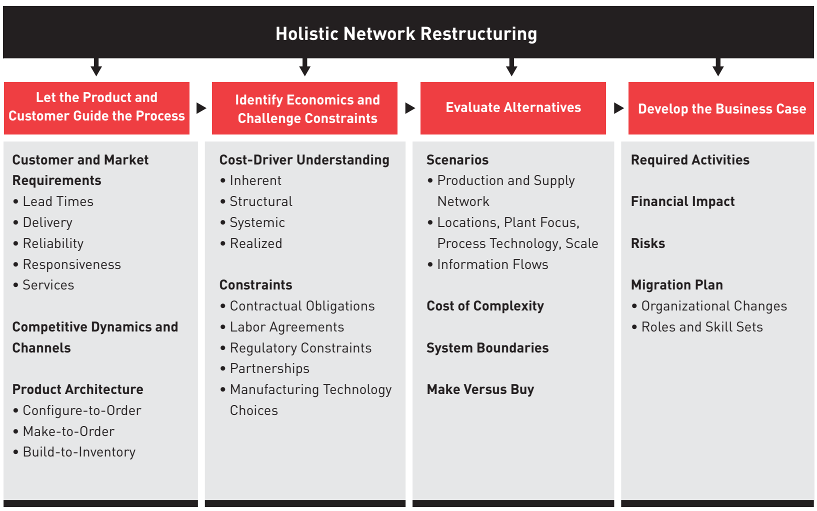
Finding the Benefits

New product-line or business-line launches provide the best opportunities to rethink the design and strategy of the entire network of manufacturing footprint and supply base structure, because there are no sunk costs or existing resource commitments and fewer vested interests. In the relatively clear air surrounding a launch, it is possible to design a manufacturing footprint from scratch. But even for existing business lines, assessing network design is critical, so important that it can be the key to profitability and even survival. Unless companies analyze their manufacturing footprint and adjust their existing network — proactively, not reactively — to ensure maximum financial performance, they could be out of business in a matter of years. The benefits of optimum network design include:

- Lower product unit and total acquisition costs
- Alignment with major customers as they move to low-cost geographies
- Improved margins — the company whose network costs are lowest can capture the difference between its own internal costs and the next best competitive supply option
- Flexibility to adjust to market or technology changes and other business disruptions

Historically, companies rarely adjusted manufacturing footprints. The headaches associated with moving a plant greatly outweighed the operational benefits, and a high degree of vertical integration ensured that any change in plant sites could have a massive impact on the supply chain. In addition, because of a lack of necessary infrastructure in many locales, it was often costly to locate factories at a distance from sources of supply, end markets, and customers. But today's business conditions — improved logistics, better computer systems and telecommunications infrastructure, less vertical integration, streamlined supply chains, the emergence of low-cost, high-productivity nations as quali-

Exhibit 1: **Key Principles for Designing a Manufacturing Footprint**



Source: Booz Allen Hamilton

Dermot Shorten
(shorten_dermot@bah.com) is a vice president with Booz Allen Hamilton in Boston. Mr. Shorten focuses on value stream restructuring, with specific expertise in supply chain management, supply base configuration, and manufacturing strategy.

Michael Pfitzmann
(pfitzmann_michael@bah.com) is a principal with Booz Allen Hamilton in Chicago. He serves automotive, energy, and other industrial clients and specializes in manufacturing strategy, competitive cost analysis, sourcing, and operations management.

Curt Mueller
(mueller_curt@bah.com) is an associate with Booz Allen Hamilton in Chicago. He focuses on operating and manufacturing efficiency across industries and functional groups to drive value creation and improve supply chain performance.

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fied manufacturing locations, and competition that is stronger than ever before — have made it absolutely necessary to address network design issues.

Designing an appropriate manufacturing footprint is not an easy process, but the complexity is manageable when a few essential principles are followed (see Exhibit 1):

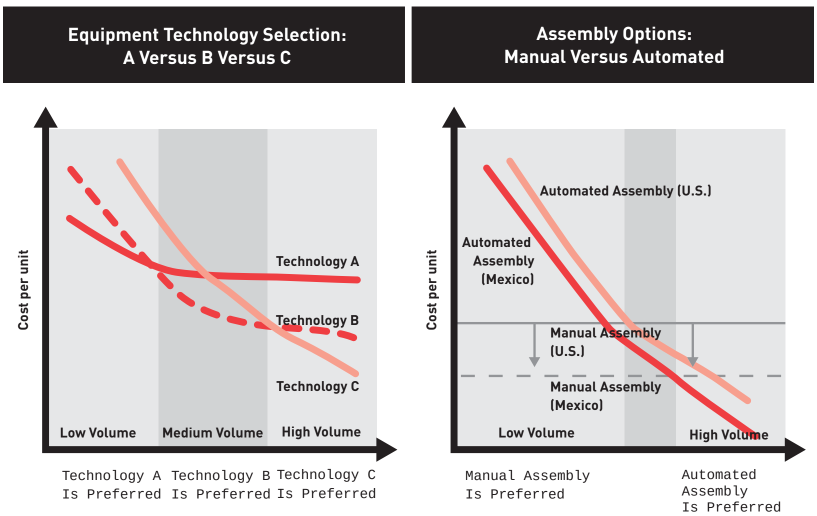
• **Let the product and customer guide the process from the market back.** Customer and market requirements need to be well understood so that the footprint is designed to meet those needs. Networks that are not configured with the customer in mind will invariably lead to low customer satisfaction and lost revenue, and, eventually, can drive the company out of business. Target customers may value short lead times; whole-order delivery; reliability; responsiveness; or low-cost, value-added services such as kitting; or some combination of these variables, and what is valued may vary by subsegment. Each of these customer differentiators, however, could have a different implication for footprint design (see "Types of Networks").

Customers that require short lead times may force companies to rule out having key manufacturing operations in distant low-cost countries and instead locate final assembly and test operations in nearby markets or regions, while components could be supplied by low-cost locations. On the other hand, customers that demand low-cost products above all else might drive the supply chain to the inexpensive cost structures that can be found in such countries as China, Thailand, Russia, and Brazil. Similarly, flexibility, customization, and design or manufacturing responsiveness might dictate the number of plants required or the technologies and processes used in each plant.

The key to establishing the requirements that the supply chain and manufacturing network must serve is to look ahead and not fixate on current conditions. Areas of potential change that should be monitored are: 1) shifts in channel strategies among direct sales force models, indirect channels, and e-business channels; 2) shifts in required lead times for crucial customer segments; 3) shifts in product makeup (for example, more software or software-enabled components and less hardware); and 4) shifts in volume growth in geographic markets served. All of these can have significant implications for optimal supply chain design.

Future product architecture and product technology are additional critical areas of influence on supply chain design. Increasingly, companies are proactively adjusting product architecture to enable highly efficient supply chain design. Product architecture can drive the ability to do late-stage customization by allowing, for example, high-velocity flows of standard product modules and adding complexity to the product later in the manufacturing cycle, closer to the end market. Similarly, product architecture will strongly determine decisions on how to control the supply chain: Different supply chain networks are required for configure-to-order, make-to-order, and build-to-inventory architectures. The level of component proliferation — for example, the number of power supplies or cable types — can drive significant complexity in the supply chain and can easily degrade manufacturing and distribution performance or raise the cost of meeting customer requirements.

Exhibit 2: **Impact of Technology on Footprint Design**



Source: Booz Allen Hamilton

Types of Networks: Eight Benchmarks in Building an Advantaged Supply Network

Manufacturing footprints are typically structured according to one of five geographic alternatives. Each alternative signifies a different trade-off between production scale and logistics cost and time.

1. Integrated. Production and/or assembly occur within a prime product facility. An integrated model is often advantageous when components are specific to the prime product, or when component production processes are not scale intensive or not compatible across prime products. Similarly, when high logistics costs outweigh potential scale benefits from sharing prime product demand, an integrated model is apt to be the most economical option.

2. Regional/Feeder Plant. Production and/or assembly are located near a prime product facility. Feeder plants are often used because of space constraints or high labor cost in the product facility. In these cases, the benefits from lower wages and minimizing capital spending outweigh the higher logistics, transaction, and overhead costs.

3. Hub and Spoke. The demand from all prime product facilities within the regions is steered to one facility for production and assembly. The rationale for choosing this option may be to take advantage of improved scale economies and lower sensitivity to demand fluctuation, particularly when component production is capital intensive. Alternatively, wages may be a large portion of production costs, driving component production to low-wage locations.

4. Integrated Hub and Spoke. Similar to hub and spoke, in this alternative, manufacturers leverage scale across components by producing multiple components in a facility within the region. When component production processes are scale sensitive and similar processes can be shared across components, an integrated hub-and-spoke model may be economically advantageous because of the improved scale and utilization of the combined production processes. When logistics costs are high, the economic benefits of combined component production can sometimes even drive horizontal integration of prime production.

5. Global. A single component or a group of components is produced in one facility or region and shipped to fulfill global demand. The global network/distribution model has received much media and public attention in recent years. It is generally advantageous when production is very scale sensitive or wage sensitive and when logistics costs are relatively low. Semiconductor and chip production, which are scale sensitive and involve relatively low transportation cost, use the global model. Another example is the apparel industry: Current forecasts predict that 67 percent of the clothing sold by the U.S. garment industry will be manufactured in the world's lowest-wage nations, with the majority of growth expected in China and India.

In many industries, increased importance is being placed on software to enable product features. Software-enabled changes can greatly simplify both the supply chain and late-stage customization. In addition, a growing number of companies sell software exclusively, or sometimes unbundled from hardware, to customers. These types of sales require manufacturers to build new capabilities to manage their "software supply chains." For example, they may have to create online sales channels, offer the ability to unlock the product through password keys, provide customers with ways to configure the software, and proactively push software patches and updates.

• **Identify economics and challenge constraints.** All costs associated with designing a network need to be fully understood so that the trade-offs can be analyzed. Costs can be categorized into four "buckets":

1. Inherent Costs: a function of product design and process technology. Addressing inherent costs means revisiting *what* the supply chain is being designed to do: the customer response requirements being promised by market segment, the underlying product architecture or design, and which manufacturing processes and technology it uses. These usually offer the greatest potential for improvement.

2. Structural Costs: a function of make versus buy, production scale, process complexity, sourcing

strategy, location, etc. Addressing structural costs means changing *where* and *how* the company makes the product.

3. Systemic Costs: a function of operating practices, overhead, capabilities, and supply chain control philosophy, such as "pulling" to true end-market demand rather than "pushing" inventory to forecast. A critical lever in this category is "tailored business streams," that is, supply chain processes (and their associated overhead) that have been redesigned to match the requirements of the demand streams (for instance, low-overhead, simple product flows for high-volume "runners" versus more complex support for custom products, or "strangers"). Addressing systemic costs means changing *organization and operating policies*.

4. Realized Costs: a function of efficiency and performance in execution (e.g., operating asset effectiveness, labor productivity, negotiated wage rates, material price variances, rush freight charges, etc.). Addressing realized costs means changing actual *work practices* to make them more efficient.

Such considerations as labor contracts, planned divestitures, willingness and ability to partner with suppliers or customers, government regulations, tax and duty implications, and other factors will shape decisions about how to restructure a manufacturing network. In Europe, for example, severance costs are often so high that closing plants to relocate production may be uneconomical. But even within the constraints, improvements are often possible: for example, rebalancing which products are assigned to which locations.

Manufacturing technology choices may also affect, or even drive, the decision of where and how to manufacture (see Exhibit 2). A major Japanese automaker's worldwide production scheme relies on manufacturing process decisions and technology to build flexibility into the overall network and to be able to move volume around on the basis of changes in demand. Standardization of tooling and manufacturing processes is an important element in the firm's strategy. Such standardization not only improves delivery performance and cuts development time, but also reduces production costs and total network investment requirements.

• **Evaluate alternatives.** Once the supply chain economics and the constraints are clear, it is possible to define the "ideal" network for the entire value chain and test it in several realistic but varied scenarios. For one of our clients, an analysis of the value chain revealed that supply base location was a more important factor than either logistics or labor. Even much lower internal production costs in a low-wage location can sometimes be outweighed by higher inbound logistics and quality costs if a capable local supply base does not exist.

In addition, companies that move abroad naively may cut themselves off from information, efficiencies, and the relationships available only to industry participants clustered closely in a region. Well-known examples of such industry clusters include the automobile industry in Detroit for most of the last century, Silicon Valley in the 1990s, and the pharmaceutical industry in New Jersey today. India's Bangalore or China's Shenzhen are examples of low-cost areas that have a critical mass of commercial and industrialized activity and offer an increasingly capable supply base — as well as qualified people to do the work.

The cost of complexity is yet another important consideration. Some companies mistakenly decide to always manufacture low-volume, high-complexity products in high-wage locations, but send high-volume, low-complexity products offshore. Although this may be optimal in some situations, typically the low-volume, high-complexity parts are the most labor-intensive and therefore could benefit most from a move to a low-cost location, as long as that location has the necessary technical and manufacturing support expertise (see Exhibit 3).

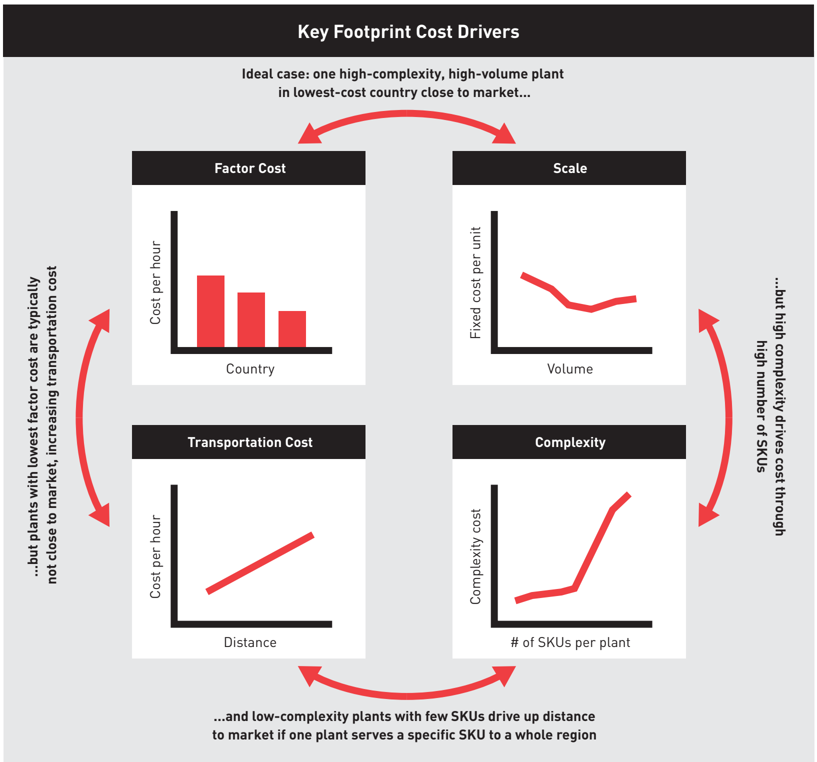
In evaluating different network scenarios, the total production and supply network, which is generally much broader than a company's manufacturing footprint, needs to be considered and optimized. Especially in cases where much of the manufacturing activity that creates the product's value is performed externally rather than in-house, it is necessary to consider and potentially restructure the supply base. To do this, a company takes a clean-sheet view of what capabilities are necessary from its suppliers and what target cost structure is imperative to design a more effective, typically much smaller, more capable supply base.

The scenario testing should be both quantitative and qualitative, and might use tools as simple as spreadsheets or as sophisticated as dedicated supply chain modeling software. Scenario analysis is important in order to avoid “incrementalism” — small changes to the status quo that typically create only minor improvement — and to generate innovative solutions. Any redesign of the manufacturing footprint should consider scale, capacity utilization, technology, and level of automation. Analyzing and potentially redefining existing system boundaries, which involves logically grouping material components of a product, is often beneficial, because this results in component clusters that better match supply base capabilities or enable streamlined flows to reduce cycle time, improve quality, and reduce such non-value-added tasks as duplicate material handling. The extent of a company’s vertical integration should also be included in the evaluation.

Make-versus-buy decisions need to answer the following questions:

- What critical core capabilities do we want to keep in-house because they drive real differentiation in the product or the service level offered to our customers?
- Which alternative, make or buy, produces the lowest total cost?
- Which has the lowest supply risk?
- How attractive is this business to us? How much capital do we have to invest in it to maintain these processes in-house?

Exhibit 3: **Examination of Economic Trade-Offs**



Source: Booz Allen Hamilton

• **Develop the business case.** The final step is to lay out required activities and financial impact over time in a detailed business case and migration plan. This plan should highlight organizational changes and define roles and skill sets of team members and key stakeholders. It should explicitly address such risks as supply interruption, political change, transportation delays, currency movements, etc. If, for example, Chinese authorities decide to float the yuan, the effect on the economics of Chinese manufacturing will be profound.

Finally, it is important to periodically monitor the manufacturing footprint, reevaluate network scenarios, coordinate research to identify changes and updates to relevant information, and develop business cases for adjustments to the global network.

Minimizing Risk

Manufacturing network design can improve a company’s cost structure even more than best manufacturing practices, but there are associated risks. There are ample opportunities to make costly mistakes when managing a network transition and putting in place global production and capacity planning. One of the most common mistakes is to ignore the broader strategic context. Supply networks have a lot of moving parts. Labor rates, productivity, product design, process technology, and raw material costs are only a few of them. Companies with cost-reduction tunnel vision have put at risk intellectual property and proprietary information worth many times the savings possible from reduction of production costs.

Any network redesign must take into account the stability of demand and the speed of technological change. Production economies that come only at the cost of long lead times are not worth the cost in fast-moving technology markets. Some telecommunications companies learned this lesson the hard way. Their long supply chains could not respond efficiently to a market slowdown. As a result, inventory swelled. Meanwhile, R&D moved technology ahead. When the market recovered, their inventory was obsolete.

Developing a manufacturing organization with a network in an emerging country is a challenge. Risks include local currency exposure, political issues, and variations in local taxes and penalties. Moreover, countries are developing so fast that some networks that made excellent economic sense just a few years ago are now on the road to becoming a competitive disadvantage. Labor costs in Hungary rose 17 percent from 2001 to 2003; in the Czech Republic, they jumped by 11 percent. Wage increases in South Korea outpaced productivity growth by almost 4.7 percent, on average, from 1986 to 1996, and in 2002 alone, hourly labor costs there increased by 17.3 percent. Beyond labor costs, companies also need to examine potential differences in productivity in low-labor-cost locations. However, bringing in sufficient management talent and the right infrastructure support can often minimize these differences.

Labor plays a role in another risk. The development of suppliers may be required when shifting a manufacturing footprint. That could lead to initial quality problems or delays in bringing a plant up to capacity. Intellectual property risks are also present, particularly when companies outsource important processes in countries where patents and intellectual property laws are not as strictly enforced as in the United States. Finally, change management difficulties can come with the transition, in terms of handling communication both internally and externally, as well as managing the move to minimize business disruption.

Manufacturing footprint decisions and network designs have always been important. But in recent years, a rapidly changing competitive environment has made the choice of the right network design even more critical. As networks become more complex, identifying and implementing the right solution becomes increasingly difficult. Manufacturing footprint design capability is indispensable in the contemporary competitive and economic environment, and requires a thorough understanding of underlying economics and relevant trade-offs. Currency and political risks, safety and supply risks of sourcing critical components from third parties, intellectual property risks, and regulatory and tax risks all enter the cost-benefit equation.

Manufacturing footprint design is more complicated than it used to be; however, it is a challenge no company can afford to ignore. Balancing brand considerations against labor and logistical costs takes analytical acumen and may demand skills and expertise that many companies lack. But there is no acceptable alternative to meeting the challenge and developing the skills. The days when a company could build a manufacturing network and leave it alone have slipped into history. Manufacturing footprint design is the next capability for winning. +

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