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Strategy, Planning, and Operation

FIFTH EDITION

Sunil Chopra • Peter Meindl

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Table 6-2 Dimensions to Consider When Evaluating Total Cost from Offshoring

Performance Dimension	Activity Impacting Performance	Impact of Offshoring
Order communication	Order placement	More difficult communication
Supply chain visibility	Scheduling and expediting	Poorer visibility
Raw material costs	Sourcing of raw material	Could go either way depending on raw material sourcing
Unit cost	Production, quality (production and transportation)	Labor/fixed costs decrease; quality may suffer
Freight costs	Transportation modes and quantity	Higher freight costs
Taxes and tariffs	Border crossing	Could go either way
Supply lead time	Order communication, supplier production scheduling, production time, customs, transportation, receiving	Lead time increase results in poorer forecasts and higher inventories
On-time delivery/lead time uncertainty	Production, quality, customs, transportation, receiving	Poorer on-time delivery and increased uncertainty resulting in higher inventory and lower product availability
Minimum order quantity	Production, transportation	Larger minimum quantities increase inventory
Product returns	Quality	Increased returns likely
Inventories	Lead times, inventory in transit and production	Increase
Working capital	Inventories and financial reconciliation	Increase
Hidden costs	Order communication, invoicing errors, managing exchange rate risk	Higher hidden costs
Stock-outs	Ordering, production, transportation with poorer visibility	Increase

It is important to quantify these factors carefully when making the offshoring decision and to track them over time. As Table 6-2 indicates, unit cost reduction from low labor and fixed costs along with possible tax advantages are likely to be the major benefit from offshoring, with almost every other factor getting worse. In some instances, the substitution of labor for capital can provide a benefit when offshoring. For example, auto and auto parts plants in India are designed with much greater labor content than similar manufacturing in developed countries to lower fixed costs. The benefit of lower labor cost, however, is unlikely to be significant for a manufactured product if labor cost is a small fraction of total cost. It is also the case that in several low-cost countries such as China and India, labor costs have escalated significantly. As mentioned by Goel et al. (2008), wage inflation in China averaged 19 percent in dollar terms between 2003 and 2008 compared to around 3 percent in the United States. During the same period, transportation costs increased by a significant amount (ocean freight costs increased 135 percent between 2005 and 2008) and the Chinese yuan strengthened relative to the dollar (by about 18 percent between 2005 and 2008). The net result was that offshoring manufactured products from the United States to China looked much less attractive in 2008 than in 2003.

In general, offshoring to low-cost countries is likely to be most attractive for products with high labor content, large production volumes, relatively low variety, and low transportation costs relative to product value. For example, a company producing a large variety of pumps is likely to find that offshoring the production of castings for a common part across many pumps is likely to be much more attractive than the offshoring of highly specialized engineered parts.

Given that global sourcing tends to increase transportation costs, it is important to focus on reducing transportation content for successful global sourcing. Suitably designed components can facilitate much greater density when transporting products. IKEA has designed modular products that are assembled by the customer. This allows the modules to be shipped flat in high density, lowering transportation costs. Similarly, Nissan redesigned its globally sourced components so that they can be packed tighter when shipping. The use of supplier hubs can be effective if several components are being sourced globally from different locations. Many manufacturers have created supplier hubs in Asia that are fed by each of their Asian suppliers. This allows for a consolidated shipment to be sent from the hub rather than several smaller shipments from each supplier. More sophisticated flexible policies that allow for direct shipping from the supplier when volumes are high, coupled with consolidated shipping through a hub when volumes are low, can be effective in lowering transportation content.

It is also important to perform a careful review of the production process to decide which parts are to be offshored. For example, a small American jewelry manufacturer wanted to offshore manufacturing for a piece of jewelry to Hong Kong. Raw material in the form of gold sheet was sourced in the United States. The first step in the manufacturing process was the stamping of the gold sheet into a suitable-sized blank. This process generated about 40 percent waste, which could be recycled to produce more gold sheet. The manufacturer faced the choice of stamping in the United States or Hong Kong. Stamping in Hong Kong would incur lower labor cost but higher transportation cost and would require more working capital because of the delay before the waste gold could be recycled. A careful analysis indicated that it was cheaper for the stamping tools to be installed at the gold sheet supplier in the United States. Stamping at the gold sheet supplier reduced transportation cost because only usable material was shipped to Hong Kong. More importantly, this decision reduced working capital requirement because the waste gold during stamping was recycled within two days.

One of the biggest challenges with offshoring is the increased risk and its potential impact on cost. This challenge gets exacerbated if a company uses an offshore location that is primarily targeting low costs to absorb all the uncertainties in its supply chain. In such a context, it is often much more effective to use a combination of an offshore facility that is given predictable, high-volume work along with an onshore or near-shore facility that is specifically designed to handle most of the fluctuation. Companies solely using an offshore facility often find themselves carrying extra inventory and resorting to air freight because of the long and variable lead times. The presence of a flexible onshore facility that absorbs all the variation can often lower total landed cost by eliminating expensive outbound freight and significantly reducing the amount of inventory carried in the supply chain.

Key Point

It is critical that offshoring decisions be made accounting for total cost. Offshoring typically lowers labor and fixed costs but increases risk, freight costs, and working capital. Before offshoring, product design and process design should be carefully evaluated to identify steps that may lower freight content and the need for working capital. Including an onshore option can lower the cost associated with covering risk from an offshore facility.

6.3 RISK MANAGEMENT IN GLOBAL SUPPLY CHAINS

Global supply chains today are subject to more risk factors than localized supply chains of the past. These risks include supply disruption, supply delays, demand fluctuations, price fluctuations, and exchange-rate fluctuations. As was evident in the financial crisis of 2008, underestimating risks in global supply chains and not having suitable mitigation strategies in place can result in painful outcomes. For example, contamination at one of the two suppliers of flu vaccine to the United States led to a severe shortage at the beginning of the 2004 flu season. This shortage led to rationing in most states and severe price gouging in some cases. Similarly, the significant strengthening of the euro in 2008 hurt firms that had most of their supply sources located in Western Europe. In another instance, failure to buffer supply uncertainty with sufficient inventory resulted in high costs rather than savings. An automotive component manufacturer had hoped to save $4 to $5 million a year by sourcing from Asia instead of Mexico. As a result of port congestion in Los Angeles–Long Beach, the company had to charter aircraft to fly the parts in from Asia because it did not have sufficient inventory to cover the delays. A charter that would have cost $20,000 per aircraft from Mexico ended up costing the company $750,000. The anticipated savings turned into a $20 million loss.

It is thus critical for global supply chains to be aware of the relevant risk factors and build in suitable mitigation strategies. Table 6-3 contains a categorization of supply chain risks and their drivers that must be considered during network design.

Table 6-3 Supply Chain Risks to Be Considered During Network Design

Category	Risk Drivers
Disruptions	Natural disaster, war, terrorism Labor disputes Supplier bankruptcy
Delays	High capacity utilization at supply source Inflexibility of supply source Poor quality or yield at supply source
Systems risk	Information infrastructure breakdown System integration or extent of systems being networked
Forecast risk	Inaccurate forecasts due to long lead times, seasonality, product variety, short life cycles, small customer base Information distortion
Intellectual property risk	Vertical integration of supply chain Global outsourcing and markets
Procurement risk	Exchange-rate risk Price of inputs Fraction purchased from a single source Industry-wide capacity utilization
Receivables risk	Number of customers Financial strength of customers
Inventory risk	Rate of product obsolescence Inventory holding cost Product value Demand and supply uncertainty
Capacity risk	Cost of capacity Capacity flexibility

Source: Adapted from "Managing Risk to Avoid Supply Chain Breakdown." Sunil Chopra and Manmohan S. Sodhi, *Sloan Management Review* (Fall 2004): 53–61.

Good network design can play a significant role in mitigating supply chain risk. For instance, having multiple suppliers mitigates the risk of disruption from any one supply source. An excellent example is the difference in impact on Nokia and Ericsson when a plant owned by Royal Philips Electronics, located in Albuquerque, New Mexico, caught fire in March 2000. Nokia adjusted to the disruption quickly, using several other supply plants in its network. In contrast, Ericsson had no backup source in its network and was unable to react. Ericsson estimated that it lost revenues of $400 million as a result. Similarly, having flexible capacity mitigates the risks of global demand, price, and exchange-rate fluctuations. For example, Hino Trucks uses flexible capacity at its plants to change production levels for different products by shifting workforce between lines. As a result, the company keeps a constant workforce in the plant even though the production at each line varies to best match supply and demand. As illustrated by these examples, designing mitigation strategies into the network significantly improves a supply chain's ability to deal with risk.

Every mitigation strategy, however, comes at a price and may increase other risks. For example, increasing inventory mitigates the risk of delays but increases the risk of obsolescence. Acquiring multiple suppliers mitigates the risk of disruption but increases costs because each supplier may have difficulty achieving economies of scale. Thus, it is important to develop tailored mitigation strategies during network design that achieve a good balance between the amount of risk mitigated and the increase in cost. Some tailored mitigation strategies are outlined in Table 6-4. Most of these strategies are discussed in greater detail later in the book.

Global supply chains should generally use a combination of mitigation strategies designed into the supply chain along with financial strategies to hedge uncovered risks. A global supply chain strategy focused on efficiency and low cost may concentrate global production in a few low-cost countries. Such a supply chain design is vulnerable to the risk of supply disruption along with fluctuations in transportation prices and exchange rates. In such a setting, it is crucial that the firm hedge fuel costs and exchange rates because the supply chain design itself has no built-in mechanisms to deal with these fluctuations. In contrast, a global supply chain designed with excess, flexible capacity allows production to be shifted to whatever location is most

Table 6-4 Tailored Risk Mitigation Strategies During Network Design

Risk Mitigation Strategy	Tailored Strategies
Increase capacity	Focus on low-cost, decentralized capacity for predictable demand. Build centralized capacity for unpredictable demand. Increase decentralization as cost of capacity drops.
Get redundant suppliers	More redundant supply for high-volume products, less redundancy for low-volume products. Centralize redundancy for low-volume products in a few flexible suppliers.
Increase responsiveness	Favor cost over responsiveness for commodity products. Favor responsiveness over cost for short–life cycle products.
Increase inventory	Decentralize inventory of predictable, lower value products. Centralize inventory of less predictable, higher value products.
Increase flexibility	Favor cost over flexibility for predictable, high-volume products. Favor flexibility for unpredictable, low-volume products. Centralize flexibility in a few locations if it is expensive.
Pool or aggregate demand	Increase aggregation as unpredictability grows.
Increase source capability	Prefer capability over cost for high-value, high-risk products. Favor cost over capability for low-value commodity products. Centralize high capability in flexible source if possible.

Source: Adapted from "Managing Risk to Avoid Supply Chain Breakdown." Sunil Chopra and Manmohan S. Sodhi, *Sloan Management Review* (Fall 2004): 53–61.

effective in a given set of macroeconomic conditions. The ability of such a flexible design to react to fluctuations decreases the need for financial hedges. Operational hedges such as flexibility are more complex to execute than financial hedges, but they have the advantage of being reactive because the supply chain can be reconfigured to best react to the macroeconomic state of the world.

It is important to keep in mind that any risk mitigation strategy is not always "in the money." For example, flexibility built into Honda plants proved effective only when demand for vehicles shifted in an unpredictable manner in 2008. If there had been no fluctuation in demand, the flexibility would have gone unutilized. Flexibility in the form of the intelligent body assembly system (IBAS) built by Nissan in the early 1990s almost bankrupted the company because the state of the automotive markets was relatively stable at that time. Similarly, the use of fuel hedges that made billions for Southwest Airlines cost it money toward the end of 2008 when crude oil prices dropped significantly.

It is thus critical that risk mitigation strategies be evaluated rigorously as real options in terms of their expected long-term value before they are implemented. In the following sections, we discuss methodologies that allow for the financial evaluation of risk mitigation strategies designed into a global supply chain.

Flexibility, Chaining, and Containment

Flexibility plays an important role in mitigating different risks and uncertainties faced by a global supply chain. Flexibility can be divided into three broad categories—new product flexibility, mix flexibility, and volume flexibility. *New product flexibility* refers to a firm's ability to introduce new products into the market at a rapid rate. New product flexibility is critical in a competitive environment wherein technology is evolving and customer demand is fickle. New product flexibility may result from the use of common architectures and product platforms with the goal of providing a large number of distinct models using as few unique platforms as possible. The PC industry has historically followed this approach to introduce a continuous stream of new products. New product flexibility may also result if a fraction of the production capacity is flexible enough to be able to produce any product. This approach has been used in the pharmaceutical industry in which a fraction of the capacity is very flexible with all new products first manufactured there. Only once the product takes off is it moved to a dedicated capacity with lower variable costs.

Mix flexibility refers to the ability to produce a variety of products within a short period of time. Mix flexibility is critical in an environment wherein demand for individual products is small or highly unpredictable, supply of raw materials is uncertain, and technology is evolving rapidly. The consumer electronics industry is a good example in which mix flexibility is essential in production environments, especially as more production has moved to contract manufacturers. Modular design and common components facilitate mix flexibility. Zara's European facilities have significant mix flexibility, allowing the company to provide trendy apparel with highly unpredictable demand.

Volume flexibility refers to a firm's ability to operate profitably at different levels of output. Volume flexibility is critical in cyclical industries. Firms in the automotive industry that lacked volume flexibility were badly hurt in 2008 when demand for automobiles in the United States shrank significantly. The steel industry is an example in which some volume flexibility and consolidation have helped performance. Prior to 2000, firms had limited volume flexibility and did not adjust production volumes when demand started to fall. The result was a buildup of inventories and a significant drop in the price of steel. In the early 2000s, a few large firms consolidated and developed some volume flexibility. As a result, they were able to cut production as demand fell. The result has been less buildup of inventory and smaller drops in price during downturns, followed by a quicker recovery for the steel industry.