## Globalization and supply chain

Globalization has offered tremendous opportunity, as well as increased risk, in the development of supply chains. High-performance supply chains such as Samsung and Zara have taken full advantage of globalization. In contrast, several supply chains have found themselves unprepared for the increased risk that has accompanied globalization. As a result, managers must account for both opportunities and uncertainties over the long term when designing a global supply chain network.

## The Impact of Globalization on Supply Chain Networks

Globalization offers companies opportunities to simultaneously increase revenues and decrease costs. Most of Samsung's sales were outside its home country of Korea. Apparel and consumer electronics are two industries for which globalization has offered significant cost reduction opportunities. Consumer electronics focuses on small, lightweight, high-value items that are relatively easy and inexpensive to ship. Companies have exploited large economies of scale by consolidating production of standardized electronics components in a single location for use in multiple products across the globe. Contract manufacturers such as Foxconn and Flextronics have become giants with facilities in low-cost countries. Apparel manufacture has high labor content, and the product is relatively lightweight and cost effective to transport. Companies have exploited globalization by shifting much apparel manufacturing to low-labor-cost countries, especially China. In the first half of 2009, about 33 percent of U.S. apparel imports were from China. The net result is that both industries have benefited tremendously from cost reduction as a result of globalization.

One must keep in mind, however, that the opportunities from globalization are often accompanied by significant additional risk. In a survey conducted by the consulting company Accenture in 2006, more than 50 percent of the executives surveyed believed that supply chain risk had increased as a result of their global operations strategy. For example, in 2005, hurricane damage to 40,000 acres of plantations decreased Dole's global banana production by about 25 percent. Crude oil spot price and exchange rate fluctuations in 2008 illustrate the extreme volatility that global supply chains must deal with. Crude started 2008 at about $90 per barrel, peaked in July at more than $140 per barrel, and plummeted to below $40 per barrel in December. The euro started 2008 at about $1.47, peaked in July at almost $1.60, dropped to about $1.25 at the end of October, and then rose back to $1.46 toward the end of December.

The only constant in global supply chain management seems to be uncertainty. Uncertainty of demand and price drives the value of building flexible production capacity at a plant. If price and demand do vary over time in a global network, flexible production capacity can be reconfigured to maximize profits in the new environment. Over the life of a supply chain network, a company experiences fluctuation in demand, prices, exchange rates, and the competitive environment. A decision that looks good under the current environment may be quite poor if the

situation changes. Thus, supply, demand, and financial uncertainty must be considered when making global network design decisions. Table 1 shows Results of Accenture Survey on Sources of Risk That Affect Global Supply Chain Performance.

Table 1

| **Risk Factors** | **Percentage of Supply Chains Affected** |
|---|---|
| Natural disasters | 35 |
| Shortage of skilled resources | 24 |
| Geopolitical uncertainty | 20 |
| Terrorist infiltration of cargo | 13 |
| Volatility of fuel prices | 37 |
| Currency fluctuation | 29 |
| Port operations/custom delays | 23 |
| Customer/consumer preference shifts | 23 |
| Performance of supply chain partners | 38 |
| Logistics capacity/complexity | 33 |
| Forecasting/planning accuracy | 30 |
| Supplier planning/communication issues | 27 |
| Inflexible supply chain technology | 21 |

**The Offshoring Decision: Total Cost**

many companies have taken advantage of cost reduction through offshoring, others have found the benefits of offshoring to low-cost countries to be far less than anticipated. The increases in transportation costs between 2000 and 2011 have had a significant negative impact on the perceived benefits of offshoring. Companies have failed to gain from offshoring for two primary reasons: (1) focusing exclusively on unit cost rather than total cost when making the offshoring decision and (2) ignoring critical risk factors.

The significant dimensions of total cost can be identified by focusing on the complete sourcing process when offshoring. It is important to keep in mind that a global supply chain with offshoring increases the length and duration of information, product, and cash flows. As a result, the complexity and cost of managing the supply chain can be significantly higher than anticipated. Table 2 identifies dimensions along which each of the three flows should be analyzed for the impact on cost and product availability.

Table 2

| **Performance Dimension** | **Activity Affecting 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, and 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 |
| Stockouts | Ordering, production, transportation with poorer visibility | Increase |

Ferreira and Prokopets (2009) suggest that companies should evaluate the impact of offshoring on the following key elements of total cost:

1. Supplier price: should link to costs from direct materials, direct labor, indirect labor, management, overhead, capital amortization, local taxes, manufacturing costs, and local regulatory compliance costs.

2. Terms: costs are affected by net payment terms and any volume discounts.

3. Delivery costs: include in-country transportation, ocean/air freight, destination transport, and packaging.

4. Inventory and warehousing: include in-plant inventories, in-plant handling, plant warehouse costs, supply chain inventories, and supply chain warehousing costs.

5. Cost of quality: includes cost of validation, cost of performance drops due to poorer quality, and cost of incremental remedies to combat quality drop.

6. Customer duties, value-added taxes, local tax incentives.

7. Cost of risk, procurement staff, broker fees, infrastructure (IT and facilities), and tooling and mold costs.

8. Exchange rate trends and their impact on cost.

It is important to both quantify these factors carefully when making the offshoring decision and track them over time. As Table 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 being negative. 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. 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.

One of the biggest challenges with offshoring is the increased risk and its potential impact on cost. This challenge is 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 designed specifically to handle most of the fluctuation. Companies using only 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 freight and significantly reducing the amount of inventory carried in the supply chain.

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

Table 3

| Category | Risk Drivers |
|---|---|
| Disruptions Natural | disaster, war, terrorism Labor disputes and 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 |
| Forecast risk | Inaccurate forecasts due to long lead times, seasonality, product variety, short life cycles, small customer base |
| 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, Industrywide 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 |

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. Similarly, having flexible capacity mitigates the risks of global demand, price, and exchange rate fluctuations. Every mitigation strategy comes at a price, however, 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 4.

| **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. |

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, however, 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 effective in each set of macroeconomic conditions. The ability of such a flexible design to react to fluctuations decreases the need for financial hedges. 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.

**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 many distinct models using as few unique platforms as possible. The consumer electronics 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.

*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 in which 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 for 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.

*Volume flexibility* refers to a firm's ability to operate profitably at different levels of output. 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.

Jordan and Graves show that a chained network mitigates the risk of demand fluctuation almost as effectively as a fully flexible network. Given the higher cost of full flexibility, the results of Jordan and Graves indicate that *chaining* is an excellent strategy to lower cost while gaining most of the benefits of flexibility.

flexibility and chaining are effective when dealing with demand fluctuation but less effective when dealing with supply disruption. Designing smaller chains called *containment* that contain or limit the impact of a disruption can be more effective than designing a network with one long chain. four plants with the flexibility to produce the four products in the form of two short chains. In this design, any disruption in one of the chains does not affect the other chain.