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The Different Elements of Risk in the Supply Chain

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Integrating Market Intelligence with Risk Assessment

In today's regulatory and complex supply chain environment, no decision is exclusive of the risk associated in its environment. In fact, assessing risk is a major deliverable for any supply chain team. Moreover, assessing risk is a way of determining how to tie together the different types of data that can be identified in the supply chain. As shown in Figure 1.1, a formal process is required to develop a formalized assessment of risks, identify the potential impacts, and develop a set of contingency plans to mitigate risks.

The types of risk present in the supply market can impact many areas of the company. Market intelligence and risk assessments are consumed by various functional and business units in the organization, not just strategic sourcing. Some of the major elements of market and business intelligence that impact risk include the following:

1. Customer demand (or *demand*) for the supply input
2. Price (including international exchange rates)
3. Competitor (identification and competitive ranking)

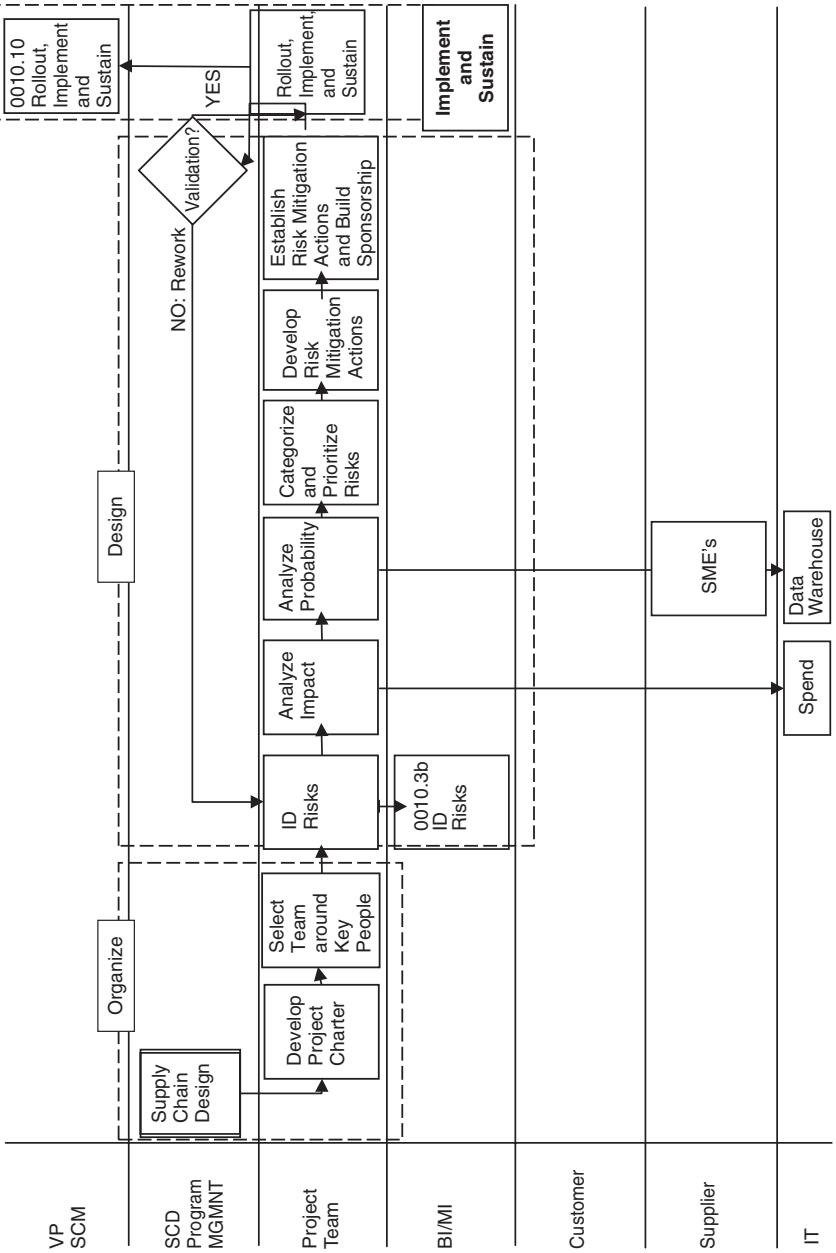

Figure 1.1 Risk management.

4. Capacity (resources including technology advancements)
5. Technology forecasts
6. Supply resources
7. Regulatory
8. Logistics risk

This chapter provides a high-level overview of the different forms of supply risk that can exist in different environments, as a precedent to detailed discussions found later in the book.

Price Forecasts

Price forecasts predict short- and long-term prices for component materials and services that the company needs for making its product and getting it to customers. The extent of variability and rapid escalation and de-escalation in price in today's supply market environments can be significant. Prices are often driven by supply and demand as well as strategic inputs, such as technology capabilities, information sharing, and operational streamlining. Price forecasts assist a company in laying out its buying strategies. For commodities that are expected to have rising prices, the purchasing department may stockpile the commodity (buy it in larger-than-normal quantities and store the commodity excess in inventory for future use) to save money. Common stockpiling strategies are *forward buying* and *hedging*, which involves buying more than required for the next month, and perhaps for the next year. Conversely, if prices are falling, buyers could utilize the *hand-to-mouth buying* strategy, buying fewer quantities than usual until the prices go down. The Purchasing Manager's Index (Table 1.1) can be a helpful tool.

All over the world, high commodity prices have more companies digging for iron ore, paper, copper, and coal.* As the increase in commodity prices ripples through the world economy, many companies — from heavy-equipment makers, energy companies, to steel mills to chemical plants — are finding that they can raise prices more than at any time since the 1970s. Contract labor rates are also on the rise, especially for software development and programming. Behind the surge: rebounding industrial growth, especially the voracious demand for commodities from burgeoning China and India. For the companies benefiting from the commodities boom, there is also a downside: Manufacturers, like everyone else, have to pay more for many supplies. For example, Caterpillar, which almost never adjusts prices more than once a year, imposed an extra increase in July that averaged 3 percent and has announced another 3 percent boost for this month. Jim Owens, CEO, noted that "[n]obody at Caterpillar anticipated the ferocity of the commodities surge that began about a year ago." Based on this assessment, companies are finding there is a need to create a process for identifying the key early indicators for pricing and market capacity moves, based on a variety of quantitative and qualitative data collected from primary and secondary

Table 1.1 Purchasing Manager's Index

The PMI is a leading index for tracking fluctuations in U.S. total purchasing expenditures. Published by the National Association of Purchasing Managers (NAPM), it documents month-by-month purchasing spend. NAPM polls U.S. purchasing managers on a monthly basis, querying the managers as to their total purchasing expenditures for the month. The numbers are entered into the PMI tracking database. NAPM analysts then compare the current month's numbers with the previous month's numbers for each respondent company. The numbers are totaled, and the status for the overall purchasing spend is ascertained as a percentage change: increased, decreased, or same. The data is then rated and published on a scale from 1 to 100. Basically, anything under 50 is indicative of decreased total purchasing spend; anything over 50 shows increased total purchasing spend.
The total purchasing spend is important, because it is a strong indicator of the overall health of the economy. The PMI, therefore, is a critical tool for forecasting projects, particularly for short- and mid-range forecasts.
NAPM publishes their results in book and web formats, which are available on a subscription basis. They also publish other indices and periodicals that are helpful, like *Purchasing Today*, a monthly magazine. Learn more by visiting them online at www.napm.org.

sources. A preliminary process associated with collecting this data involves the following steps has been identified based on best practice information and interviews.

An interesting approach is to look at the Producer Price Index (PPI) and consider the different forces shaping supply and demand. For example, consider the PPI for plastic in the following.

Scenario: A buyer is looking for pricing irrationalities within a family of plastic shields. Any unusual pricing might require further analysis and negotiation with suppliers. The buyer is performing this analysis by reviewing pricing data between 1999 and 2003. Volumes for each of the part numbers have been similar, so any price differences are not the result of material volume discounts.

Design changes occurred for parts 4 and 5 during 1999 and 2000. The number below the per-unit price in 1999 and 2000 (for parts 4 and 5) is the total amount of plastic in the components (Table 1.2).

The buyer has also collected other data to help with the analysis. He has tracked the PPI for plastic between 1994 and 2003, and has developed the labor index based on PPI data for 1999 to 2003. Finally, he has developed an estimate of the cost breakdown (Table 1.3) for the component, based on discussions with an engineer who "reverse-engineered" the component.

At this point, he compared increases in PPI to increases in pricing attributed to the higher costs of plastic and labor put forward by the suppliers. Several pricing irrationalities requiring further analysis and negotiation with the supplier were identified.

Table 1.2 PPI Example

Plastic Shield	Price Analysis				
Part Number	**1**	**2**	**3**	**4**	**5**
2003	$4.95	$5.02	$4.89	$5.99	$6.50
2002	$2.75	$3.45	$2.75	$3.55	$3.65
2001	$2.85	$3.75	$3.02	$3.88	$4.02
2000	$2.99	$3.98	$3.01	$3.87	$3.99
				1.60lb.	1.63lb.
1999	$2.25	$2.47	$2.23	$2.89	$3.09
	1.95 lb.	1.85 lb.	1.90lb.	1.85lb.	1.95lb.

As shown in Table 1.4, there were clear surcharges in pricing during 1999–2000, as well as in 2002–2003, that would require additional investigation.

Example of Effective Supply Planning: Suncor Energy

A good example of price hedging strategies, using supply market intelligence that was effective at one company, involved steel. One of the key success stories at Suncor Energy, a bitumen mining operation in northern Alberta, has been in steel, a typical leverage item (with lots of suppliers available to provide the material). In developing a sourcing strategy, Suncor Energy did a global search and ended up selecting a local supplier, Wayward Steel, based on alignment of culture. They were excited about a long-term contract approach — and were willing to work overtime during emergencies despite a strong Ironworkers' Union on site. The union realized that it had to meet this major customer's needs. Although Wayward had many other customers, their preferred relationship with Suncor allowed them to meet the demand on short notice in order to grow their business and profit. Further, although several union re-negotiation contracts occurred, no increase in steel prices took place due to productivity improvements. On the last project, there was not a single engineering change overrun. The key here is that the group worked as a team.

A win/win point is that the major cost of steel is not in price but, rather, in the total cost of ownership of erection, measured in man-hours per ton. At Suncor's major project construction sites, the cost per ton was about 50 hours per ton prior to the relationship with Wayward — with the industry average of about 48 hours per ton. Using the new relationship approach, Suncor achieved 21 hours per ton. They are paying the same price as before — but erecting it at half the cost. This translates to a savings of $2500 per ton on erection over their project.

Table 1.3 Cost Breakdown

Series Id: PCU325211325211			
Industry: Plastics material and resins manufacturing			
Product: Plastics material and resins manufacturing			
Base Date: 8012			
Year	**Jan**	**Dec**	**Annual**
1994	130.8	152.6	137.7
1995	156.9	147.8	159
1996	146.1	154.2	149.6
1997	154.1	150.3	153.9
1998	150.4	129.2	139.2
1999	130.1	159.1	142.8
2000	158.3	162.9	164.3
2001	165.6	146.3	159.9
2002	142.7	153.9	148.9
2003	157.8	164.8	167.7
2004	168.6(P)	(P)	(P)
P : Preliminary			
Laminated Plastic Price Index Cost Element by percentage		**at Year Ending**	
Direct Materials	45%	2003	159.3(P)
Direct Labor	15%	2002	159.1
Manufacturing Burden	25%	2001	158.1
G&A	8%	2000	151.7
Profit	7%	1999	150.4
Selling Price	100%	Base Year 1989 = 100	
Labor Monthly Statistics Hourly Earnings Index			
2003		162.3	
2002		157.8	
2001		153.4	
2000		147.9	
1999		142.5	
Base year 1989 = 100			
Source: Data Extracted April 8, 2004.			

Table 1.4 Surcharges

Material % Price Increases (45%)						
	1	**2**	**3**	**4**	**5**	**% PPI Material Change**
1999–2000	14.80%	27.51%	15.74%	15.26%	13.11%	15.06%
2000–2001	–2.11%	–2.60%	0.15%	0.12%	0.34%	–2.68%
2001–2002	–1.58%	–3.60%	–4.02%	–3.83%	–4.14%	–6.88%
2002–2003	36.00%	20.48%	35.02%	30.93%	35.14%	12.63%
Material % Volume Changes						
Labor % Increases (15%)						
	1	**2**	**3**	**4**	**5**	**% PPI Labor Change**
1999–2000	4.93%	9.17%	5.25%	5.09%	4.37%	3.79%
2000–2001	–0.70%	–0.87%	0.05%	0.04%	0.11%	3.72%
2001–2002	–0.53%	–1.20%	–1.34%	–1.28%	–1.38%	2.87%
2002–2003	12.00%	6.83%	11.67%	10.31%	11.71%	2.85%
Material Volume % Changes						
				4	**5**	
1999–2000				–12.70%	–16.41%	
"Should Be" Price (based on 1999 pricing, PPI changes and design changes)						
	1	**2**	**3**	**4**	**5**	
1999	$2.25	$2.47	$2.23	$2.89	$3.09	
2000	$2.42	$2.65	$2.39	$2.94	$3.09	
2001	$2.40	$2.63	$2.38	$2.92	$3.07	
2002	$2.34	$2.56	$2.31	$2.84	$2.99	
2003	$2.48	$2.72	$2.46	$3.01	$3.17	

How did Suncor achieve these savings? One of the biggest drivers behind man-hours per ton is having the steel available and delivered to the site when required. Late deliveries occur due to capacity problems at the steel mill. Companies such as Wayward are experts in market intelligence who can inform customers when to order steel to best capture the lowest cost of ownership. Wayward can book the steel mill run capacity ahead of time and have the materials even when competitors cannot (and who then must get

it on allocation.) To do so does not require a detailed specification. Suncor, when notified by Wayward that steel prices may be rising, can take a rough quantity off the project plan, and then develop and share a forecast with these suppliers. Suncor can allocate work based on quality and price, and the business will grow based on improved performance. On Millenium, there were savings of $350,000 on a single order, when chrome pipe pricing varied from $700 per foot with 23 weeks lead time to $1600 per foot with 16 weeks lead time — and ordering early drove the savings.

Working with suppliers can identify the good, bad, and ugly in terms of long lead items and dollars, and minimize engineering surprises. Early timelines and relatively clean Materials Requisitions can allow suppliers to book fabrication windows saving huge dollars. Early involvement by fabricators can minimize construction surprises. And avoidance of bid processes for every job saves time and money for everyone. In effect, Fabrication and Construction drive the process, with Materials Supply and Engineering reporting to them. Block flow diagrams and process flow diagrams can provide early warning to suppliers — and chosen supply chain partners become an integrated part of this process.

Competitor Forecasts

Any forecast should also consider competitor's actions, and attempt to identify what their needs for products or services will be. This can be challenging but can be achieved with good market intelligence. Many of the principles of supply market intelligence apply here as well — speaking with key subject matter experts, going to trade conferences and speaking to other people in the network, and speaking to customers about their planned requirements. Of course, one of the biggest challenges can be separating the true from the fictional forecasts. Consider the case of Cisco Corporation in Table 1.5.

Capacity Forecasts

Capacity refers to key resource capabilities, broken down by all of the various types of relevant issues: human resources, warehouse space, transportation, machine time, or inventory. The objective of a capacity forecast is to quantify capacity requirements, as broken down by differing hypothetical demand levels. Companies use the capacity forecast data in developing their operating budgets. They also refer to it to assess whether more human resources will be needed and, if so, whether to address the need by offering overtime incentives to current employees, or to hire new employees instead. These forecasts are also important for gauging whether more equipment or warehouse space will need to be purchased.

These forecasts are usually done in conjunction with demand forecasts, and use the demand forecast's projected demand as their point of reference.

Table 1.5 Cisco Vignette

In the summer of 2000, with its order book overflowing but its assembly lines sputtering from lack of parts, Cisco Systems decided to crank up its supply line. Cisco committed to buying components months before they were needed, and it lent the manufacturers who build most of its Internet switching gear $600 million interest-free to buy parts on Cisco's behalf. As it turned out, Cisco made a bad bet.
On Monday April 16, 2001, with both its sales and the value of its surplus components shrinking, Cisco said it would write off $2.5 billion of its bloated inventory. People were in shock. Cisco was the darling of Wall Street and had enjoyed unprecedented growth and an associated rise in its stock value. CEO John Chambers said his company was the victim of a sudden, unanticipated economic chill. As recently as November 2000, Cisco's orders were growing at a 70 percent annual clip. However, some claim that Mr. Chambers and other Cisco executives ignored or misread crucial warning signs that their sales forecasts were too ambitious. They overestimated Cisco's backlog because of misleading information supplied by Cisco's internal order network and continued to expand aggressively even after business slowed at some Cisco divisions. In April 2001, Cisco laid off more than 8500 people after hiring more than 5000 between November 2000 and March 2001. Alex Mendez, an ex-Cisco executive who left in November to become a venture capitalist, claims that "Cisco always had a bit of trouble finding the brakes."
Like other high-tech companies, Cisco was caught unaware by the one–two punch of the broader slowdown and the retrenchment in the telecommunications sector. When Cisco's 600 top executives met for their annual retreat in May 2000, they planned on increasing revenue by 60 percent. One cloud loomed on the horizon: components for some products, particularly switches used in corporate computer networks, were in critically short supply and customers had to wait as long as 15 weeks for delivery, compared to the normal 1 to 3 weeks. To help the situation, Chambers and top aides devised a two-fold strategy to revitalize Cisco's supply chains: help contract manufacturers accumulate parts and commit to buying specific quantities of components from key suppliers.
Contract manufacturers worried that this strategy involved setting overly aggressive expansion plans. For example, Solectron had warned Cisco that they appeared to be ordering more parts than needed. In October 2000, sales in the telecommunications industry grew less than 10 percent from the previous quarter. At this time, at least two Cisco suppliers began warning Cisco that shipments were slowing, or not meeting forecasts. By November, Mr. Chambers said that orders were "comfortably" more than 70 percent ahead. Further, he emphasized that the latest downturn was an opportunity for Cisco to break away from rivals such as Nortel and Lucent Technologies. By December, however, he had changed his tune. On December 15, Mr. Chambers gathered his top executives and asked "What happens if we're off by a billion or a billion and a half in quarterly sales?"

continued

Table 1.5 (continued) Cisco Vignette

Things got worse; sales to telecommunications carriers fell 40 percent in the January quarter. The speed of the sales decline was surprising. The root cause was then determined: facing two and three month waits for popular Cisco products, some customers had been double- and triple-ordering, once from Cisco and then again from Cisco distributors. Once the product was shipped, customers canceled the duplicate orders. All of a sudden, their backlog vanished into thin air. Mr. Volpi, a Cisco executive, claims that without the misleading information, "we might have seen better and made better decisions."
Chambers noted that "We will always err on the side of meeting customer expectations. The day we stop taking risks as a company is the day I would sell the stock." An expensive gamble indeed: even after its write-off, Cisco reported inventories of $1.6 billion, up 33 percent from July 2000.
Adapted from The Wall Street Journal, "Behind Cisco's Woes Are Some Wounds of Its Own Making," by Scott Thurm, p. A1, April 18, 2001.

Supply Forecasts

Supply forecasts collect data on all factors that can potentially influence the supply chain. This includes data on the suppliers in the market — on a global scale, now — that can supply the components needed for making the product. It includes the competitors that supply customers with a competing product. It also includes data on competing technologies, and the ability of competitors to seize market share. A big consideration is global competitiveness, particularly if the company is currently or planning soon to be buying commodities and selling their finished products globally, which has become an instrumental competitive strategy.

Supply market capacity is a difficult element to conduct intelligence on — but understanding the subject is instrumental to making sound sourcing decisions. Once again, establishing a network of subject matter experts is critical, especially suppliers that can provide information on changing market conditions. Consider the example of the market environment for electronic components.

Traditionally, original equipment manufacturers (OEMs) such as IBM, Nortel Networks, and Cisco work directly with component manufacturers and new product development (NPD) people to develop a bill of materials (BOM) for a new product. The BOM is sent to contract manufacturers such as Solectron, Jabil, SCI, and Flextronics for quotes. The contract manufacturers then partition the BOM into direct components such as memory and chips, and request quotes from component manufacturers such as TI, Motorola, Intel, and AMD. The contract manufacturer may also receive quotes from franchised distributors such as Arrow and Avnet. The quote package will then be rolled back to the OEM, who will review it and award the business.

For purposes of this example, let us assume that Solectron is the selected contract manufacturer. Solectron can assign 14 buyers to manage the product,

with each buyer responsible for certain component commodity families. Note that global contracts for these commodity families may have been negotiated through Solectron's global commodity management teams, but the buyers manage releases and inventory levels. The buyer can place the order with the component manufacturer or a franchised distributor.

The relationship between component manufacturers, franchised distributors, and third parties (often called independents, non-franchised, or brokers), such as Converge, is complex. Buyers will often go first to the component manufacturers to purchase part of the requirements, and then they might go to franchised distributors. Franchised distributors work closely with the component manufacturer to stock parts as buffers; they account for the additional 12 to 18 percent inventory carrying charge through markups to the contract manufacturer. They also bear the risk of obsolescence costs in the event of an economic downturn. In a sense, they are an extension of the component manufacturer's sales force, and many distributors have hired engineers to work with the sales force at OEMs to get direct components designed into new OEM products. They are, in turn, compensated via a debit program.

For example, if Texas Instruments sells a component for $2.00 to an OEM, the franchised distributor will sell the same part for $2.50. However, if the franchised distributor was responsible for a "design win" (i.e., through engineering working with sales in the OEM's NPD process) that gets the component designed into the product, the franchised distributor will receive a $0.50 debit from the direct manufacturer for every component it sells.

Going back to the example, the Solectron buyer who wants 10,000 components might get a partial order of 5000 from a component manufacturer and 3000 from a franchised distributor, and still require 2000 units. In such cases, an independent such as Converge will act as a "market maker" to complete this requirement. At its headquarters in Peabody, Massachusetts, Converge has a triangular trading floor with 350 dedicated customer sales representatives. They also have a "pit" of commodity managers who monitor global commodity conditions and pricing. Prices are presented via a trading board over the pit throughout the day. The Solectron buyer contacts the Converge sales representative, who then e-mails the sales floor requesting 2000 components. Each salesperson will contact his or her databases of customer components to check for available inventory, or even inventory in the pipeline that is not destined for a particular location. At this point, the negotiations begin. Through interactions with customer representatives, franchised distributors, and component manufacturers, Converge will leverage its core relationships worldwide to create markets. They will negotiate to obtain the best pricing as well as help dispose of inventory for customers when needed. Although companies such as Partminor do this via a Web site only, Converge relies on its core relationships to obtain required parts.

With the recent economic downturn, this type of function has become even more critical. Converge works with key customers to help them manage excess inventories. As shown in Figure 1.2 below, supply exceeded demand

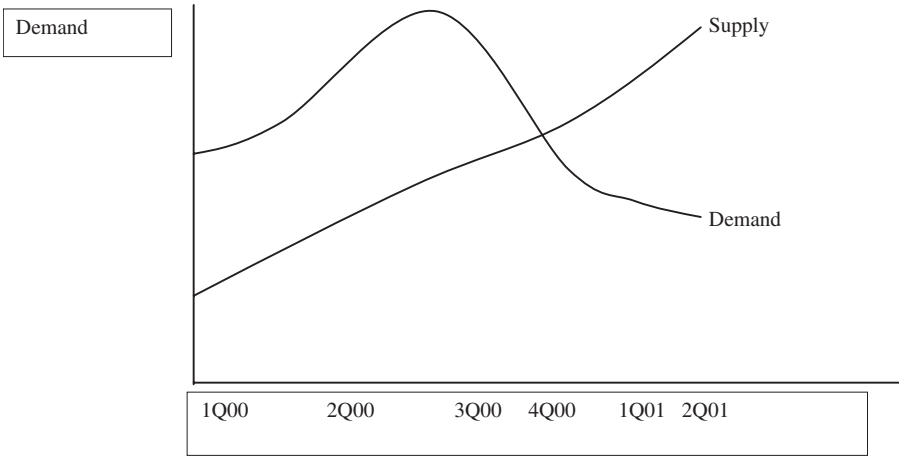

Figure 1.2 Supply and demand in the high-tech component industry.

in 2001 where only a few months earlier supply shortages were common. Herein lies one of the real challenges of creating value systems: organizations must be able to go from accelerating their operations to putting on the brakes in an instant — without accelerating excessive expediting charges, obsolescence charges, or inventory carrying costs.

Technology Forecasts

Many firms we have visited with indicate that the costs associated with retooling, engineering changes, and process re-design resulting from major design changes were often crippling. The uncertainties of market demands make the benefits of early supplier involvement in developing new technologies even more questionable. There is a risk associated with committing to an outsourcing decision too early in the new product development process. Interviews with managers revealed that a major risk associated with early supplier involvement in design was the potential for choosing the "wrong" supplier. One firm mentioned that on a previous project it had chosen a supplier that was unable to meet the new product deadline, although they assured the buying company that doing so was feasible. Consequently, the firm missed its window of opportunity, and the company was shut out of the market. In these environments, the need for supply market intelligence on competing technology solutions is more critical than ever.

Even when a known, clearly identified market for the innovation exists, the design of the product itself is sometimes in such flux that manufacturing or suppliers cannot identify, develop, or purchase the appropriate production equipment. In this situation, an unknown product form negatively affects the viability of the parallel approach. Predevelopment activities such as preliminary market study and technical assessment are important

to successfully bring new products to market quickly. This involves a close integration of marketing, design, and manufacturing to carry out customer tests of the prototype or sample. But while close and frequent interaction between marketing and manufacturing is critical to this approach, high levels of uncertainty often compromise benefits in environments of discontinuous innovation. Because marketing's knowledge about the market is often poorer under these conditions than in products associated with more incremental innovations, and the customer may not yet perceive a need for the product, such interactions may be less useful.

Before embarking on the new product development process and committing to a particular design platform, project managers are well advised to thoroughly investigate technology options both inside and outside the firm by working closely with supply management. A common argument against involving supply management personnel in this process is that they are typically averse to anything new and different. Traditionally, this is because purchasing's goals and performance metrics focus on low costs, which are generally at odds with any type of new process. Managers in radical development projects confirm this problem. For example, the lead designer involved in one project said about his interactions with manufacturing when he proposed design changes, "The manufacturing manager will give me a list of things that I absolutely do not want to do in an order like this (1) You are offending God, (2) You are offending the Saints, (3) You are offending the Pope. And in this kind of decreasing order of magnitude, you figure out what you might be able to do."

Other interviews with managers revealed how discontinuous innovations similarly affect sourcing decisions. The result of the increased risk associated with uncertain technologies in the insourcing/outsourcing decision frequently requires that managers patiently wait for the technology to "stabilize." By putting such technologies "on the bookshelf," the potential for making the right technological decision increases. The need for careful, serial market analysis was made evident in discussions with a large Japanese computer components manufacturer. Once a year, the company goes to an industry consortium with other leading companies to identify future technology roadmaps, standardized configurations, and forecasted technology trends. The company also has face-to-face meetings with its major customers to identify their future software requirements. By delaying product development decisions until after these meetings take place, the product development manager is able to identify critical future technological requirements that will enable the firm to develop a breakthrough product that fills a market need. This is particularly important in an industry such as computers, where hardware requirements are often unable to keep up with changes in software requirements.

The project manager in another firm struggled to develop a project at the more discontinuous end of the spectrum. In summarizing this process, he noted that in the early stages of their project, "All we could prove to a typical manufacturing engineer is that we don't know enough to be wasting

his time." There was little point in speeding up the project's development because the product requirements were unknown.

Much that has been written about this parallel approach has to do with activities at specific development "stages." However, at early stages of these more discontinuous innovations, much less can be pinned down with regard to specifics of the product and process attributes. Further, even if one could make an educated guess, the penalties associated with committing manufacturing too early are often significant.

A perfect example of this situation arose in discussions with an engineer at a U.S. electronics manufacturer that was attempting to develop a new programmable automation system requiring specialized components at different stages in the system. In mapping out the technology, the engineer identified "green dots" (well-known technologies), "amber dots" (unstable technologies), and "red dots" (emerging technologies with many defects). Although the planned system contained many red dots, salespeople were overzealously promoting it to their customers prior to its development! The engineer immediately contacted the salespeople and admonished them for announcing the innovation before the technology became available.

In the next project stage, he consulted with several university research centers on the best methods for developing the "red dot" technologies, including the possibility of outsourcing. The researchers convinced him that the technology could be developed but that it should be developed internally to maximize the probability of success. The firm purchased the equipment for developing the products later that year. It took another year of careful process design experiments to stabilize the technology; during this time, the engineer emphasized that to perfect the technology, a certain "peace of mind" was required to complete the design of experiments. To create this environment, an actual "cage" was built around the equipment, to avoid it being integrated into existing production processes. The engineer described this process as follows:

> "In order to bring in the product, the process technology has to be developed in a closed environment. Concurrent engineering doesn't work for such breakthrough technology — you simply can't rush it! This approach really worked for us. By the time the actual product design was developed according to the technology road map, we were able to 'wheel in' the process technology in time to meet the market window."

A large Japanese computer manufacturer noted that in the case of basic research at the lab stage, informal meetings with key suppliers are very common (with no formal contract in place). Information sharing occurs in the form of joint meetings with suppliers, beginning with their top management, in an effort to gain commitment. The firm approaches a supplier's top managers and

asks them if they are willing to work on development for a future product. This is a trust-based approach with a noticeable lack of formal contracts. For such basic technologies, the R&D group is primarily involved in approaching and evaluating suppliers. Suppliers are asked to share ideas on the technology in the hopes of integrating an external core level of expertise with an internal level of expertise. The firm hopes that the synergies achieved will result in a radical new product. In such meetings, R&D leads the discussion; purchasing personnel may not even be involved.

At this stage, nondisclosure agreements are not used for technology sharing. One manager noted that "we do not want to get locked into letting a supplier develop a promising technology, particularly if we are working on a technology internally." Discussions are primarily of a technical nature, and often focus primarily on the supplier's technological capabilities and expertise. Once R&D determines that the supplier is capable, purchasing and legal personnel can then help develop a nondisclosure agreement.

Political and Economic Country Forecasts

Political and economic assessments of supply chain risk are critical, especially of instabilities in regions to which and from which that the company sells. An example of the more general political landscape can be seen from the second war in Iraq. On the one hand, a number of oil mines became inoperable, affecting international supply. Any company that buys oil to use in its product or to resell will be affected. America's embargo restrictions on Iraq were lifted but political turmoil in Venezuela, Russia, Nigeria, and other key oil-producing regions continues to make the supply of oil a major variable in many supply planning processes.

There is a need for a dedicated market intelligence group that can provide a level of risk assessment for major suppliers located in different parts of the globe. In one of the companies we interviewed, executives were evaluating the addition of manufacturing capacity in their footwear supply chain, as they were expecting to increase sales in global markets (Asia, Eastern Europe, and Latin America) significantly in the next six months. The challenge was to understand strategies around developing a portfolio of suppliers to maximize the company's financial situation and own set of capabilities. Specifically, executives were developing a methodology to consider the balance of risks and rewards (government, political climate, exchange rates, industry-specific issues regarding labor, etc.) that may exist in maintaining a global portfolio of suppliers in low-cost country sourcing. What things might be considered relative to location that could help the organization from a supply chain perspective? For example, are there benefits to sourcing locally given the size of the growing Chinese market for their products? As part of this process, a more rigorous risk evaluation approach was considered to assist executives with developing strategic decisions in this important area of competition. Although the company does not produce more than 3 percent of products

without a customer order, there is an expectation that as demand grows, responsiveness is a critical element of this strategy.

The company developed a risk profile of each country or region for its current supply locations, added additional locations to be considered and used a risk portfolio approach to find the optimal network risk profile. In addition, validation of theoretical and true capacity at different locations was established, with estimates of potential for capacity expansion at each site determined. The key inputs for developing a capacity risk strategy included collecting information on each country's:

- Existing supplier locations — theoretical, proven, and potential capacity, as well as quality and cost
- Potential supplier locations — availability of qualified sources for manufacturing footwear
- Tax environment related to goods located in or moving through the country
- Labor cost trends of existing locations relative to the considered locations
- Infrastructure:
  - Road, with some effort on air and ocean
- Number of national holidays
- Cost of land
- Price of fuel
- Unemployment
- Labor stability
- Propensity for work stoppages
- Holiday conventions
- Manufacturing and distribution costs:
  - Per pallet
  - Per square meter
- Population
- Healthcare spend
- Political stability
- Other (major) distribution centers in the country
- Natural disaster propensity
- Technology infrastructure assessment
- Crime/theft assessment
- Employment legislation
- Strictness of consultation rules
- Other issues, as appropriate

Data on each of these elements was captured by analysts using a variety of data input sources available on the Web and in other locations, including:

- U.S. State Department
- Asian, Latin American, and East European trade associations

- World Bank
- Supply Chain Resource Consortium data sources
- Corporate Asian Distribution Reports
- Standard & Poor's country profiles
- Logistics contacts: Menlo, Ryder, Schenker, Eagle, Exel
- CIA intelligence reports
- Department of Commerce reports
- Local news agencies
- Multiple other entities

The analysts developed risk profiles for the specific supply chain configurations under consideration. This was achieved by creating a "risk algorithm" that incorporated all the data into an overall risk score by weighting individual measures based on probability of outcome and severity of the impact. The outcome was a maturity grid with definitions associated with different levels of maturity. The grid had five levels — Very unsuitable (Score: 1) to Very suitable (Score: 5). Source data for each rating was documented in each case. Based on primary research, this maturity grid was developed and populated with characteristics and definitions corresponding to each level for each parameter. An example is shown in Table 1.6.

Specific research on each considered location enables its placement on this grid. The positioning also leads to the allotment of a score (1 to 5) on this parameter to the location. This type of evaluation would require an analysis to perform a subjective evaluation, based on multiple insights from interviews, secondary and primary research, as well as evaluation of news updates.

As Table 1.7 illustrates, the score for Poland on the parameter "Labor" is 3.25. This evaluation would be based on development of a score, derived from a number of different subjective evaluations. Although not a precise measure, it provides a guideline for establishing a baseline by which to make global sourcing decisions in Poland versus other areas of the world.

Based on this framework, a prototype implementation system for future scenario analysis was developed and scenario analysis was performed. Using input from executives, several probable scenarios for allocating capacity in the next six years were defined and assessed. Each scenario was run through the risk profile, identifying the high-risk elements associated with each strategy.

Regulatory Policy Forecasts

A globalizing firm must manage a number of regulatory bodies around the world, not just those of the home country. Firms may find themselves interacting with up to 50 or 60 worldwide. One of the most complex regulatory networks in the world is that which governs the pharmaceutical industry. The FDA is the toughest drug-regulating agency in the world. This poses some difficulties and opportunities for American firms. If a drug survives the FDA

Table 1.6 Maturity Grid

		Very unhospitable for mfg.	→	Somewhat hospitable for mfg.	→	Very hospitable for mfg.
Labor	**Labor Climate**	*Extremely difficult to lay-off employees *Very high union membership *Scarce availability of qualified employees *Large number of work stoppages in the last year		*Average amount of flexibility in hiring and firing employees *Moderate union membership *Qualified employees are available in some occupations and are unavailable in some others *Moderate number of work stoppages in the last year		*Very good amount of flexibility in hiring and firing employees *Very low union membership *High availability of skilled labor *Negligible number of work stoppages in the last year
	Unemployment	>20%	15-20%	10-15%	5-10%	0-5%

Table 1.7 Maturity Grid

		Very unhospitable for DC's	→	Somewhat hospitable for mfg.	→	Very hospitable for DC's
Labor	Labor Climate	*Extremely difficult to lay-off employees *Very high union membership *Scarce availability of qualified employees *Large number of work stoppages in the last year		*Average amount of flexibility in hiring and firing employees *Moderate union membership *Qualified employees are available in some occupations and are unavailable in some others *Moderate number of work stoppages in the last year	Poland	*Very good amount of flexibility in hiring and firing employees *Very low union membership *High availability of skilled labor *Negligible number of work stoppages in the last year
	Unemployment	>20%	15-20%	10-15%	5-10%	0-5%

approval process, firms can probably expect approval anywhere in the world. The FDA will not accept another country's approval and is continually the most scrutinizing in the world. For example, some companies will not come into the United States because the standards are too strict. However, that does not mean they cannot earn a profit in another, less stringent country. Since 1996, the FDA has approved fewer and fewer products each year. It is becoming more and more difficult to develop a product with a high market value. Put another way, the simpler diseases have been conquered.

The approval process is just the tip of the iceberg. After approval comes the issue of how to gain access to patients around the world. Such an issue carries major cost implications. Along with proving efficacy, firms must show that the product adds value to society (for example, Pfizer's portrayal of Viagra having a positive social impact). The United States market is a free market. However, most European nations are social-democratic countries with government-run healthcare systems requiring individual price negotiation. If a price cannot be agreed upon, patients will not be reimbursed by their healthcare system. Pharmaceutical companies must deal directly with governments to win approval for sales of their products.

It is also important to understand and forecast changes in other laws around the world, particularly when it comes to patents and intellectual property. As suppliers become increasingly integrated in new-product development, intellectual property agreements are becoming the norm. The U.S. Constitution provides the framework for the intellectual property legal system, including patent and copyright law, as we know it today through Article 1, Section 8, Clause 8, which says that "Congress shall have the Power … To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries." There are three kinds of intellectual property in the United States: (1) patents, (2) copyrights, and (3) trade secrets. Patent law has been established in several federal patent statutes, including the Patent Act of 1790, 35 U.S.C. Section 1, and companion laws. Copyright law is founded in the federal statutes, particularly in the Copyright Act of 1976. Federal patent and copyright laws overrule any contradictory state statutes. By contrast, trade secret law is grounded in common law and is intended to protect unique ideas that would not otherwise have legal protection under patent and copyright law. Because common law varies by state, there is some variance in actual statutes. However, most states have created laws that are very similar. In its most basic form, a patent is an agreement between the inventor and the federal government. Successful patentees in the United States are now entitled to exclusive rights (to make, use, or sell) an invention for the life of the patent 20 years from the filing date with the U.S. Patent Office.

Note that in some countries such as China and India, copyrights and patents may not be recognized at all. In recent years, because of the entry of these countries into the World Trade Organization, both China and India recognize copyrights (at least verbally), but piracy remains a constant problem.

A firm must protect itself from inadvertent patent infringement whenever it purchases a product from a supplier. This can best be done by including a patent indemnification clause in all purchasing documents. This clause should consist of three parts:

1. An indemnification, which seeks the supplier's assurances that the goods being contracted for do not infringe on any other party's patents.
2. The right to require the supplier to defend any patent infringement suit itself.
3. The right to have the purchaser's own attorneys involved in defense of any lawsuit concerning patent infringement.

Regulations Affecting Global Purchasing

Many laws — U.S., foreign, and international — affect global commerce. The following briefly summarizes some of the laws that can affect a purchaser's international business dealings.[2] A proactive supply intelligence group will investigate the relative impact and changes in these laws as they pertain to the dynamic and changing supply market environment.

Foreign Corrupt Practices Act. This law prohibits payments (such as bribes) that might benefit a foreign official personally. While usually pertaining to sellers, purchasers should understand this law's provisions so they can recognize situations addressed by the act.

Anti-Boycott Legislation. Various laws address doing business with countries that support the boycott of one nation against another. Examples include the boycott of Israel by Arab countries and the boycott of Taiwan by mainland China. These laws require reporting of any request to participate in a boycott, which purchasers often fail to do.

Export Administration Act. Various laws and regulations govern, and sometimes even restrict, the export of goods, information, and services. Purchasers may not perceive that they are engaged in exporting. However, the law views certain types of drawings, specifications, and prototypes forwarded to a foreign entity as restricted exports of technology. Purchasers are urged to seek the advice of an expert when questions arise in this area.

Customs Laws. This body of law addresses the importation of goods into the United States. Customs brokers who are familiar with customs laws can be quite valuable in understanding the rules and regulations governing importation.

Foreign Laws. In addition to the U.S. laws that apply to foreign transactions, the laws and regulations of other countries involved in a business transaction may also apply. These laws will likely address

contract law, export control, currency control, and criminal law. Some transactions could be illegal if structured in a certain manner.

International Laws. Other laws may apply to business transactions that are not part of any specific country's laws and regulations. Maritime laws are a good example of international laws that affect international commerce. Several international documents are also pertinent to international transactions. These include The United Nations Convention on Contracts for International Sale of Goods (CISG) and International Contracting Terms (INCOTERMS).

Country of Origin Labeling. The World Commercial Organization has only begun to identify and harmonize global regulations regarding labeling products with their country of origin. However, this is a long way from being deployed. In the interim, there is a complex and confusing set of laws pertinent to every country regarding the country of origin documentation required on shipment to another product. This needs to be carefully monitored.

Assessing Global Logistics Risk

It is particularly important for supply market intelligence groups to be aware of intelligence as it relates to doing business in different countries, as well as the impact of major disruptions on the business. With the movement toward global sourcing to China, India, and Eastern Europe, many companies are now recognizing the increased level of supply chain risk that exists in these worldwide distribution channels. Global sourcing affords many benefits in the form of lower price and expanded market access, but senior executives should recognize that an increased potential for and magnitude of product and service flow disruptions is another by-product of this strategy. A major disruption in the supply chain can "shut down" a company and have dire consequences on profitability.

This was felt most drastically in the past few years, including after 9/11, the war in Iraq, the West Coast port stoppage, and even through events such as the legislation capping hours on truck drivers. Other unexpected events can include natural disasters or poor communication of customer requirements and result in errors and backorders, part shortages, poor material quality, and a negative impact on the company brand. These disruptions can be costly, have resulted in significant supply chain delays and, in some cases, have brought distribution and production to a screeching halt. Further, the impacts of these disruptions may be amplified in "lean" or "time-sensitive" environments and may cause disturbances throughout the supply chain.

One of the major impacts of 9/11 has been on the environment for doing business in different countries, as well as the movement of materials between countries. A thorough discussion of doing business in China appears in Appendix A but a generic overview is presented here. Supply market intelli-

gence teams must keep their hands on the pulse of global trade, country-specific events, and logistics regulations that can impact their supply management environment. Some of the major risks and threats that should be identified include the following elements:

AntiTerrorism Laws. More and more companies are focusing on global regulation such as Customs-Trade Partnership Against Terrorism (C-TPAT) and Partners in Protection (PIP). These are joint government business initiatives to build cooperative relationships, with a goal of strengthening the overall supply chain and border security. Benefits provided to logistics partners include:

- Reduced inspections and faster clearances
- Prerequisite for other programs
  - Monthly duty payments/Fast/ISA
- Viewed as supporting homeland security
- Key for being ranked "Low Risk"
- Status Verification Interface (SVI)

Most of these agreements require the following:

- Conduct a comprehensive self-assessment of supply chain security (C-TPAT appear below).
- Sign and return the agreement to participate.
- Complete the supply chain security profile and return to customs (1st) in 60 days.
- Development and implementation of an enhanced security program.
- Communicate security guidelines to other companies in the supply chain and assist them in developing a security program.
- Applications will be processed in 60 days.
- Validation within three years.

The requirements for C-TPAT are shown in Table 1.8.

The reality in terms of forecasts for these elements is that they are only going to get stronger. Customs security concerns are permanent, but there are also discussions around RFID, "smart seals" and smart-box technology on containers. In addition, increased inspection of imports has begun, and security concerns will be a focal point of customers as well as trade compliance. There is also discussion of instituting industry-specific security standards, and coordinating with other agencies such as the Department of Transportation and the FDA.

The issue is this: the global and U.S. logistics infrastructure is stressed and there are no signals that significant relief will come in 2005. In fact, indicators show it will get worse before it gets better. Santa is going to pass right by companies that did not prepare this year as shelves dry up and inventory gets stuck in transit. All companies should begin preparations for the next few years now.

Table 1.8 Requirements for C-TPAT

Procedural Security	Does your company have procedures in place to protect against un-manifested material being introduced into the supply chain?
Physical Security	Are all buildings constructed in such a way that they resist unlawful entry and protect against outside intrusion?
Access Control	Is unauthorized access to facilities and conveyances prohibited?
Personnel Security	Does your company conduct employment screening, background checks, etc.?
Education and Awareness	Does your company have a security awareness program provided to employees including the recognition of internal conspiracies, maintaining cargo integrity, etc.?
Manifest Procedures	Are the manifests complete, legible, accurate, and submitted in a timely manner to Customs?
Conveyance Security	Is your company's conveyance integrity maintained to protect against the introduction of unauthorized items?

Logistics Vulnerabilities.[*] Companies are scrambling to thwart the logistics delays, skyrocketing lead times, and soaring costs resulting from the problems. Getting product to store shelves has never been more difficult. Companies are dealing with dramatically increased ocean traffic and severely congested ports; deficient U.S. capacity for rail and truckload caused by new hours of service rules, driver shortages and rising fuel prices; and heightened security regulations and trade rules that further complicate the situation. Let us face it: Santa has never had to deal with the rigor of the new cross-border declaration laws. Companies have scrambled to circumvent the problem, but not without cost.

Consider these cases:

- A consumer durables company made changes to its distribution network to more strategically locate the inventory of its fastest moving products so that it could create continuous loops with the same carrier and vehicles, thereby having more access to critical capacity. Because a few of its carriers failed to deliver on pre-agreed commitments for capacity, the company scrambled to make alternative arrangements to secure coverage — at much higher rates. It marks the first year the company would not be able to hold or lower its logistics costs. This is the kind of event that costs holiday bonuses.
- A toy manufacturer, with 60 percent of its annual sales coming in the holiday season, had to divert freight coming from Asia to Oakland and Seattle-Tacoma instead of Long Beach because of

a backup of up to ten additional days in the Long Beach harbor, with twenty to thirty ships sitting offshore waiting to be unloaded. The company then had to shift some of its truckload traffic to rail because it could not secure capacity. The result: order cancellations because the company could not deliver on time. The next Tickle Me Elmo may very well still be sitting in the Long Beach harbor come Christmas morning.

- Dell reported that it was going to build a new production facility in North Carolina to better serve its U.S. East Coast business and consumer customers. Because Dell specializes in custom orders, inexpensive but slow shipping methods often do not work. Locating a production facility closer to customers can keep shipping costs under control, allowing them to address custom demand more readily. Dudes may still be getting Dells, thanks to the planning and acknowledgment of logistical drawbacks.

Significant increases in directional trade volume are stressing the global logistics infrastructure and capacity on many levels. This imposes a conflicting force on the just-in-time supply chains built during the past decade. While companies may understand how to plan for the longer lead times (often two to three times longer), the increase in lead-time variability (25 to 75 percent greater) has a hugely unpredictable effect on perfect order performance, customer service, and required inventories.

Across the modes, ports, and travel lanes, providers are reporting staggering increases in volume. Certain economic events signal continued growth and promise to further stress the infrastructure. Here is what is happening in each area:

- *Ocean*. A Japanese container line reports revenue will grow 43 percent from 2003. A European container line reported a 14 percent increase in volume from 2003. Another carrier reported volume up 12 percent and rates up 10 percent on average from 2003. Panama Canal traffic was 6.7 percent higher than the previous year. The World Trade Organization expected container shipping to increase by another 60 percent in the next four years.
- *Air.* Lufthansa and American Airlines reported that air cargo volume increased 10 percent and 12 percent, respectively, from 2003, reinforcing claims that manufacturers have made increased use of expedited service. Frankfurt reported a 14.5 percent increase in air cargo traffic from the previous year, setting a record high.
- *Surface*. The Morgan Stanley Truckload Index (dry-van only) showed that the U.S. truckload demand versus supply ratio is now 10:1, double the ratio of 2003. The driver shortage and the new rules regarding hours of service are clearly having an impact. The

Energy Information Administration reports average diesel fuel prices of $2.13 per gallon, up 65.1 percent from the same period in the previous year. The Surface Transportation Board reported that rail speeds have decreased 20 percent in the past two years because of congestion and rail infrastructure problems.

- *Trade Policy.* The U.S. International Trade Commission reported that dramatic changes were expected beginning in 2005, when worldwide apparel and textile quotas would be completely phased out. This was expected to accelerate the shift of apparel manufacturing to low-cost and efficient producers in China and India.

The end result: With such growth, demand for capacity will continue to exceed supply in the short term, which in turn will push prices up and limit the ability to trade. See Table 1.9 for an example of a company taking risk seriously.

Table 1.9 GlaxoSmithKline Takes Supply Chain Risk Seriously

To protect GSK's supply chain from the threat of terrorism, the company voluntarily applied to become part of a United States Customs program called C-TPAT (Customs and Trade Partnership against Terrorism). This program, which was created in response to the Sept. 11, 2001 attacks in New York City, was designed to heighten the security of trade channels from acts of terrorism.
GSK was recently informed that its supply chain has been approved and validated. Four best practice examples were derived from GSK and are being used as examples for other U.S. companies of what a secure supply chain should look like.
"The world around us has and continues to change dramatically. As such we have to move to new business processes that allow us to conduct our business securely and efficiently," says GMS President David Pulman. "A great example is the way we have embraced C-TPAT, taking a leadership position and helping to shape the procedures and policy around this. Not only is this a good way to execute our business, it is also good for the company's reputation."
To become validated, GSK had to prepare a comprehensive security profile, which covered many areas of the business including physical security, personnel security, access controls, and data security. This profile was presented to the U.S. Customs and Border Protection validation team, which did walk-throughs of many of the security processes.
As a result of the C-TPAT validation, GSK is subject to fewer inspections of imports, which equates to fewer delays and less money lost. The C-TPAT ways of working are being embedded into the GSK Corporate ways of working, guaranteeing that the company will always be up to standard when it comes to supply chain security.
Becoming C-TPAT validated was a joint effort between Global Logistics in GMS and Consumer Healthcare. The project leads were Mike Melia, Director of Cross-Border Compliance, GMS; Rob Montague, Director, Global Distribution, GMS, and Bill Ramos, Director, International Supply and Brand Protection in Consumer Healthcare.
Source: C-TPAT in *eNetworker*, the GMS online magazine, September 9, 2004.

The laws governing supply management are complex and varied. Other laws address environmental and labor issues. This overview simply points out that today's purchaser must be aware of the laws and regulations governing domestic and international purchasing. A purchaser is urged to discuss with legal counsel any questions that arise during the performance of job responsibilities. Ignorance of the law is not a valid defense.

Tying Together the Elements of Risk

Based on recent research that involved detailed interviews with senior supply chain executives, a research team* from the Supply Chain Resource Consortium developed a list of 18 different best practices that companies can explore to enhance supply chain operational resiliency and risk management. These options were classified by matching them with the organizational functions that would typically implement or own the specific supply chain risk management capability. Figure 1.3 shows the four key organizational areas that already have some supply chain risk management capabilities and responsibilities. Note that the risk management matrix in Figure 1.3 divides risk management responsibility by internal operations or external supply base interface on the horizontal axis, and current or future business on the vertical axis.

While these groups often already have risk management processes in place, supply chain risk management is a core competency for these four groups. There must be regular cross-functional, multidirectional information sharing

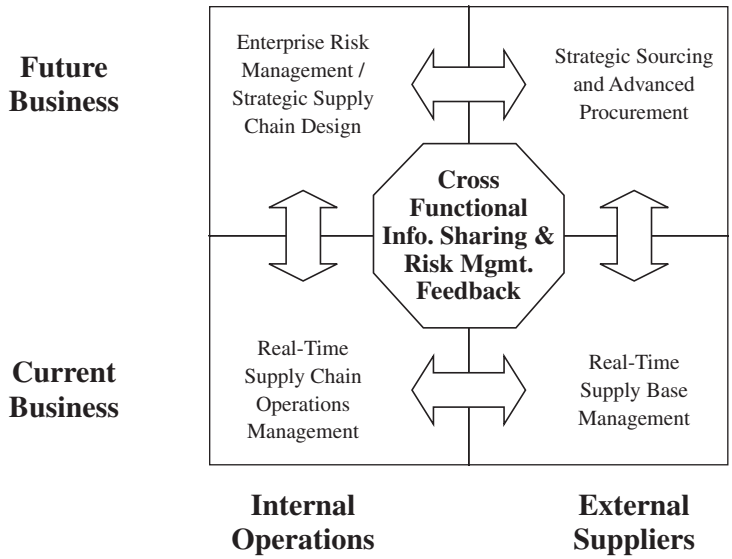

Figure 1.3 Organizational functions with supply chain risk management capabilities and responsibilities.

Table 1.10 Best Practices Survey

Subjective Rating	Points Assigned
We do not perform this activity	0
We perform this activity, yet significantly below the needed level	1
We perform this activity, yet below the needed level	2
We perform this activity, yet slightly below the needed level	3
We perform this activity at the needed level	4

and feedback into the interdependent risk management responsibilities. For example, if the real-time supply base management group is observing a type of risk event repeatedly disrupting material flow at suppliers located in a particular country, they can feed the information back to the strategic sourcing group to make sure that the risk event is explicitly considered in future business sourcing decisions. Similarly, the Enterprise Risk Management/Strategic Supply Chain Design Group can pass down information to the Real-Time Supply Chain Operations Group on things such as material flow hedging strategies or contingency plans evaluated for most effective response to key port disruptions. In addition, the two strategic future business groups, and the two current business operations groups, must interact to coordinate decisions and actions made for more effective risk management, with the strategic level handling proactive risk management and the operational level handling reactive risk management responsibilities.

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