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Securing the upstream supply chain: a risk management approach

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Abstract *Supply managers must manage many risks in their increasingly competitive environments. Traditionally this meant buffering against uncertainties, which sub-optimized operational performance. Risk management can be a more effective approach to deal with these uncertainties by identifying potential losses. This conceptual study proposes that situational factors- degree of product technology, security needs, the relative importance of the supplier, and the purchasers' prior experience with the situation should be taken into consideration when determining the level of risk management in the supply chain. Doing so can avoid unforeseen losses and lead to better anticipation of risks.*

Introduction

> A lot of firms have taken a good lesson from the 9/11 attack. They are re-examining their own corporate security programs to determine whether they have avoided problems because their programs are that good or because they've just been fortunate. Obviously, if you're lucky, it's only a matter of time before your luck may run out. So the bottom line is that . . . your security controls need to be meaningful, strategically designed, and diligently maintained. And if you're not doing that, then you are unnecessarily exposing your company to internal and external loss (Staff, 2003).

The above statement was made by Barry Brandman, president of Danbee Investigations in Midland Park, New Jersey, in his interview with the *Supply Chain Management Review* staff. It reflects that firms are confronted today with new risks. Traditionally, businesses have been always faced with various risks that emanate from the environment in which they operate. Risk is part of every business environment. Today worldwide changes have created newer sources of risks. Protection against threats of terrorism is now a cornerstone of the Department of Homeland Security's strategy. The movement of manufacturing to offshore facilities, particularly in China, increases risks. For example, the effect of SARS virus on business has been widely publicized and has had an effect on supply chains. Firms need to understand the value of prevention and not merely the reaction to security risks. It makes far more sense in terms of time, money, resources, and aggravation for firms to adapt their businesses in order to dedicate their efforts to preventing problems from happening (Kendall, 2003).

Other more traditional risks that face firms include cost pressures that require firms to constantly balance cost reduction targets with their objectives. For example, a sluggish economy has left firms such as automotive companies with excess

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inventory. They have responded by offering consumers rebates and attractive financing rates, in some cases as low as zero percent. Competition in most businesses is intense and has forced firms to accept low profit margins. Increased reliance on outsourcing creates a loss of control and a risk of losing proprietary information shared between parties.

Traditionally, companies used to adopt strategies, which buffer against risks present in their environment by using multiple sources for strategic items and holding safety stock. These buffers restrict operational performances and can negatively impact competitive advantage. New approaches involve risk management, which is a formal process that involves identifying potential losses, understanding the likelihood of potential losses, and assigning significance to these losses. Supply chain management seeks to reduce these risks and enhance competitive performance by closely integrating internal functions within a company and effectively linking them with the external operations of suppliers, channel members and final customers.

Previous research has focused on:

- the risk assessment process (Zsidisin *et al.*, 2000);
- proactive risk management practices (Smeltzer and Siferd, 1998); and
- factors that influence management's perceptions of supply risk (Zsidisin, 2003).

However, a research gap still exists in the supply management literature on providing guidelines for managers on the situational factors that may influence the level of investment in risk management systems. Therefore the purpose of this conceptual research is to provide a categorization of these situational factors.

Most previous research in this area addressed the "sources of risk" in the supply chain rather than the influential forces on the "level of investment in risk management". These two are not mutually exclusive. However, we argue that the situational factors affect the level of investment in risk management. We explore four of these factors. These include:

(1) degree of product technology;

(2) need for security;

(3) importance of the supplier; and

(4) the purchasers' prior experience.

Prior to discussing these four factors we first present the sources of supply management risks identified in literature. Second, we compare risk buffering activities to risk management strategies. Third, we discuss a situational approach to risk management. From this, we develop a set of research propositions for four situational factors and managerial implications of these factors. Figure 1 highlights the approach taken in this research.

The changing world events have had an impact on the supply chain environment. Traditional risk buffering approaches are no longer sufficient to deal with this new environment. Risk management becomes necessary as purchasers move to adopt more strategic supply management practices. The level of risk management depends on situational factors. This research posits four important ones based on previous research.

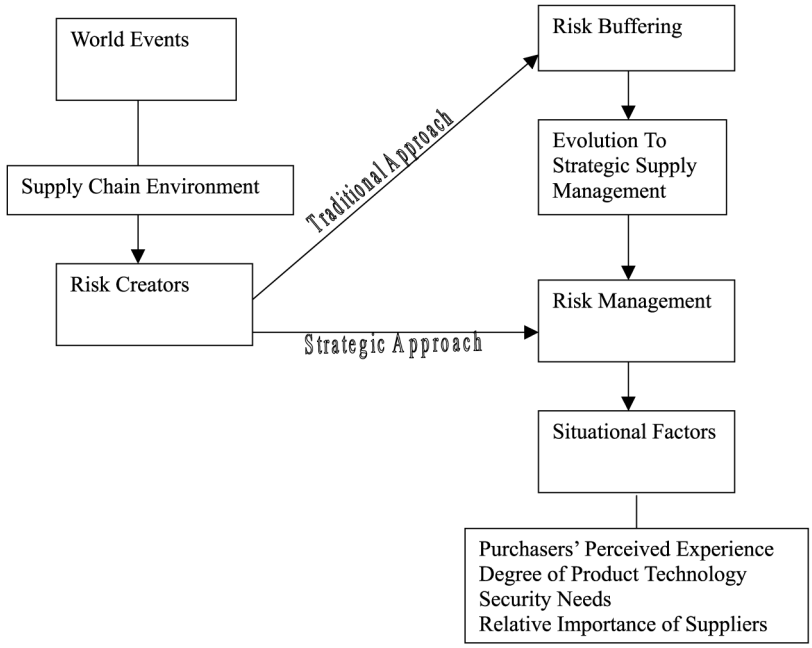

Figure 1.
The framework for risk management

Sources of supply management risks

Supply risk involves the potential occurrence of events associated with inbound supply that can have significant detrimental effects on purchasing firms (Zsidisin *et al.*, 2000). As previously mentioned, there are numerous factors present in the world environment that affect supply management professionals perception of risk. One of the potential consequences of the war in Iraq is higher oil prices and its effect on logistics costs. Another is the instability of the relations between Pakistan and India. Also, threats from North Korea could affect purchases of items in South Korea and China. To safeguard themselves from such risks, companies will have to develop supply managers who understand these issues and prepare strategies to mitigate their consequences. Supply managers must understand the business context in which their company's corporate strategy was developed (Arminas, 2003).

In addition to world political events, there are several conditions that create risks in a supply chain. These include product availability (Singh, 1998), distance from source (MacKinnon, 2002), industry capacity (Lee *et al.*, 1997), demand fluctuations (Singh, 1998), changes in technology (Iyer, 1996), and labor markets (Wiseman and Gomez-Mejia, 1998), financial instability (Larson and Kulchitsky, 1998) and management turnover (Wiseman and Gomez-Mejia, 1998).

Increased distance adds uncertainty to supply continuity through longer lead times and potential transportation disruptions. Supplier capacity constraints result in the inability to supply the quantities demanded by purchasers. Fluctuations in demand may tax a supplier beyond its abilities through insufficient utilization of equipments and employees (Lee *et al.*, 1997). Other capacity risks include volume/product mix requirement fluctuations that result from the increased customers' sophistication and

the unpredictability of demand and process technological changes. Also, if a supplier cannot implement technological changes in the long term, that supplier may not be able to produce items to necessary demand level and at a competitive price.

Additionally, supply chain professionals are faced with business risks associated with the financial instability of a supplier. With the increased reliance on outsourcing financial stability of suppliers, who influence a major portion of firms' costs, becomes more critical (Larson and Kulchitsky, 1998). If suppliers are unprofitable, they become a greater risk. Particularly when there are no alternative sources and new sources must be found and developed. This risk is especially critical within industries that are consolidating, utilizing partnerships and alliances. Finally, management tenures are shrinking with all the downsizing actions taken by corporations. This results in increased uncertainty of labor skills and a reduction of management talent in many organizations. In such an environment, there is a need to manage these uncertainties in the supply chain.

Risk buffering practices in supply chain

Purchasing/supply management is expected to mitigate risk and, at the same time, control costs and assure continuity of supply. Previous research findings lead to the conclusion that relationships exist between risk, strong pursuit of objectives, early supplier involvement, and careful development, evaluation and management of suppliers (e.g. Zsidisin and Hendrick, 1998; Laios and Moschuris, 1999). However, traditional strategies that were used to buffer risk implied that the purchasers' main role was to react to internal customer needs. Under this philosophy a purchase requisition is received from another department and an order is placed with a supplier. Purchasing is largely transaction-oriented and risk averse. Evaluations are based on two major criteria (see Table I):

(1) administrative costs involved; and

(2) cost savings on material expenditures.

Historically, most purchasing professionals adopted policies that hedged against risks after the events had already unfolded. They buffered against supply risks by developing multiple sources of supply and carrying safety stock. Risk stimulated the creation of safety buffers by increasing order quantities and subsequent inventories to prevent poor supply chain performance. However, buffers often limited performance and reduced competitive advantage, since these extra costs made the firm less efficient. Supply professionals must realize that companies which cope best with uncertainty posed by risks in their environments are most likely to produce competitive bottom-line performances.

Today, supply chains are perceived as a source of competitive advantage. Competitive advantage cannot be attained through the inefficiencies associated with traditional buffering strategies. Buffering practices used in traditional purchasing often meant having the wrong items. This leads to increased transaction costs, long purchase order cycle times, poor productivity and an environment characterized by rush orders. We propose that various strategies that deal with risks require a more proactive risk management approach.

Risk creators	Traditional risk buffering		Risk management	
	Practices	Potential problems	Practices	Potential problems
Material availability	Extra inventory	High transaction costs	Industry consolidations/ partnerships/alliances	Lower control over supply-related risk
Long distances	Multiple suppliers	Long purchasing ordering cycle times	E-procurement	Magnification of problems throughout the supply chain
Insufficient capacity	Expediting		Just in time deliveries	Paying higher prices
Demand fluctuations	Manual purchase orders	Low purchasing productivity	Small flexible supply base	Higher switching costs
Technological changes	Frequent supplier changes	Rush orders	Increased coordination	Skill gaps in current employees
Financial instability			Early supplier involvement	Security of transactions
Labor instability			Frequent commitment	
Management turnover			Highly-trained supply management professionals	
			Measuring total costs	

Table I.
Risk buffering vs risk management strategies in the supply chain

Risk management practices in the supply chain

As stated above, the buffering approach worked when purchasing was more tactical. As we move to more strategic approaches risk management becomes a desired option. These purchasing practices include industry consolidations, e-procurement, just in time deliveries, smaller supply bases, and a focus on total costs (Table I).

Risk management is a continual process that involves long-term dedication of supply chain members. Ongoing risk assessment involves gathering, communication, and evaluation of information that helps in developing appropriate risk management strategies (Zsidisin *et al.*, 2000). It is important to realize that there are risks with these new supply chain strategies. For example, fewer suppliers and lower inventories mean that a problem at one supplier can be magnified throughout the supply chain. Similarly, a disruption in transportation services could quickly cripple the entire supply chain since inventories are very low throughout the chain. Transportation risk management contingency plans would provide for alternative modes of transportation. Thus, if a trucking company failed, alternative modes such as air or rail backups would be in place to guard against supply disruption.

In order to manage risk effectively, purchasers are moving to adopt closer relationships with key suppliers. These suppliers are expected to provide solutions and compliment or enhance the buying firm's core competencies. Dell Computer is often cited as an example of a firm that has implemented this close working arrangement with its suppliers (Antonette *et al.*, 2002; McWilliams and White, 1999). Suppliers are treated as extensions of Dell's operations and its purchasing personnel are extensively involved in understanding their suppliers operations, products, and commodities. Such long-term business relationships are expected deliver added value for buyers and suppliers.

Mergers and alliances are ways that companies expand their power and manage the risk of uncertainty. Total mergers and acquisitions across all sectors worldwide totaled more than $1.8 trillion through the first nine months of 1998 (Cavinato and Kauffman, 2000). By 1999 mergers taking place around the world were worth $3.43 trillion (Caulk, 2000). Industry consolidation, partnerships and alliances lead to greater overall procurement efficiencies as newly formed companies leveraged their size and influence to push suppliers for more services and lower costs. The demands of these larger firms often create situations that lead to consolidation in the supply base to meet the increasing demands of these large buyers.

Another form of investments in risk management is the use of e-procurement to integrate supply chains. The emergence of e-procurement reduced transaction costs from $40 to $400 (via a sales representative) to $2 to $5 (telephone) to $0.10 to $0.40 (Internet). While these firms are more efficient, there are concerns about security of the information placed on the Internet. As a result, many larger firms have developed their own buy side portals. Suppliers are required to enter theses private portals when doing business with a large company. For its investment the buying firm is safe in knowing its information is secure (Antonette *et al.*, 2002).

Another area where e-procurement is being used is bid solicitation. However, electronic reverse auctions technology that is being widely used by many buyers must be carefully implemented. Electronic reverse auction involves having the buyer offer its package of goods to many sellers who compete in a real time online auction format (Antonette *et al.*, 2002). It streamlines the traditional bidding process and provides an

extremely competitive environment in which sellers must aggressively bid to receive the business. While savings can be enormous there are risks in using this approach. Suppliers feel that it awards business on a price basis and overlook other important aspects of the relationship such as service, quality, and delivery issues.

Joint buyer-supplier efforts may reduce risks in the supply processes. Williams and Stemper (2002) reported that collaborative supply management efforts increase product reliability and reduces risks in product introduction. The key to successfully managing risks in this process is to provide allowances for these risk variables. For example, after the final reverse auction results are tabulated a percentage allowance is given to a certified supplier and another percentage allowance is given to a supplier with outstanding delivery performance. Quality-related risks can cause significant detrimental effects on supply chain, with a cascading effect through the supply chain to final consumers. Each link within a supply chain is dependent on the other links to meet product or service requirements. Organizations using net markets to purchase goods from distant sellers expose themselves to greater risk, as it is hard to assess quality levels and specification requirements before shipment (MacKinnon, 2002). Data quality problems such as wrong or out-of-date part numbers can mean the success or failure of a supply chain. Quality failures can stem from failure of suppliers to maintain capital equipment, lack of supplier training in quality principles and techniques, and damage that occurs in transit.

Problems with risk management

Conversely, certain risk management purchasing practices can create new problems and risks. Single sourcing, just-in-time deliveries, and reduced supply bases all have the potential for disrupting supply chain processes. Reliance on e-procurement tools also involves additional risks.

For example, security of transactions in an electronic environment is a potential risk management problem (Kendall, 2003; MacKinnon, 2002). Information in the hands of a "competitor" or a "hacker" could create major confusion for the supplier. Also, shipments of material that can be used to make illegal items, such as pipe bombs and biological, could wind up in the wrong hands. Recently, extensive publicity has been given to the lack of security over the contents in shipping containers unloaded daily from ships at major port cities in the USA. Finally, risk management skills, including awareness of risk signals and developing risk management plans, are essential requirements for supply management success today (Giunipero and Pearcy, 2000).

The above discussion indicates supply chain participants are using newer more efficient strategies. These new strategies could increase firms' susceptibility to supply disruptions, which require a risk management approach.

Situational risk management

Risk is present to some extent in every supply chain. Each commodity, product, or service purchased exhibits a different risk profile. With today's uncertain conditions and heightened awareness of supply threats it is particularly important for supply managers to assess the degree of risk across their purchase categories. The distinguishing characteristics of each purchasing situation are expected to have a differential impact on the need for risk management. Further, the extent to which

management invests in any risk handling strategy depends largely on the buying situation.

The supply professional should be aware of the cues that each buying situation presents, so that they can invest in the appropriate level of risk management strategies for each buying situation and, thereby, optimize their performance and minimize their risk at the same time. As previously discussed Table I summarizes the sources of risk and the traditional practices used to address these risks as well as the newer risk management practices. The table also indicates that both risk buffering and risk management practices have the problems associated with their implementation. Therefore, companies need to strike a balance between the benefits gained through risk management and the costs incurred by using these practices. The following section addresses our main research question of: "When should management invest more resources in risk management systems?" In other words: "What situational factors determine the level of investment resources directed to risk management?"

Previous research has shown that four major parts of the supply chain are important situational factors; the buyer, the supplier, the product bought, the environment surrounding the purchase (e.g. Niraj *et al.*, 2001; Mabert and Venkataramanan, 1998).

Research propositions

Product technology

In his study, Zsidisin (2003) posited that there are numerous characteristics that affect how supply management professionals perceive risk. Risk management should always be conducted, but money and time spent on risk management should be rationalized to vary according to the need. Managing expenses at each point in the supply chain can produce greater returns. Management should be able to assess differentially risk management depending on specific situations.

In an attempt to provide a classification of supply risk sources, most studies in this area posited than "product technology" is an important determining factor of the level of risk management needs. Zsidisin (2003) posited that item characteristics are the major categories of supply risk. Also, Laios and Moschuris (1999) used the degree of differentiation, technical complexity, specialized installation, and technical after sales service, to assess the complexity of the item. In the same study, the authors posited that these variables would affect the level of commercial uncertainty. In this study we define product technology as the degree of change and complexity of product applications and the competencies required for the product application and usage.

High-technology markets are characterized by a rapid pace of technology change involves a high degree of uncertainty for buyers. An important source of uncertainty stems from buyers' lack of experience with product technology. Risks caused by the rapid pace of technology changes. In markets where technology changes at a rapid pace there are, usually, multiple discrepant product standards (Heide and Weiss, 1995). Rapid technology changes makes difficult for buyers to evaluate suppliers' performance and predict any likely problems that might arise in the production and the delivery of the product.

This study's predictions are that businesses developing high-technology product face higher risks of failure than other businesses because of greater competency demands and higher organization costs (Baker, 1995). In high-tech markets, the

occurrence of frequent major technological changes often destroys existing competencies and requires the redeployment of resources to develop capabilities suitable for the new technological regime. Further, investments in risk management activities, such as alliances and coordinating supplier relationships, moderate failure risks. Its central prediction is that businesses developing high-tech products involve a higher risk of failure – of ceasing operations and exiting their industry – than businesses developing less technologically complex products. In considering alternate explanations for the impact of technological complexity (Baker, 1995).

In such situations, buyers have to be involved in extensive risk management activities. Buyers have to engage in an ongoing process of information gathering about and assessment of suppliers' production processes, costs and lead times, because information gathered at a particular point in time may not be relevant for long. Also, proper selection of suppliers can be an important key to managing risks in such scenarios. As the relative pace of technology changes increases as well as the novelty of the situation, the carefulness with which suppliers are selected should increase. That is:

P1. High-tech markets require more extensive risk management than other low-tech markets with slower pace of technological changes.

Security needs

A second situational factor that is likely to affect the level of risk management is the "need for security". On the one hand, there a general increased need for security. On the other hand, there are some supply chains purchased items that require greater security precautions. This is true in a long supply chain, where there are three or more supplier tiers and/or when the products are globally bought, processed, and/or transported. In such situations, nearly every container load represents a point of vulnerability in the pursuit of security. In the USA, each day 17,000 cargo containers enter 361 US seaports (Adam and Woolever, 2003). Multiply this number by the hundreds of pairs of human hands through which that cargo passes and you can begin to see the magnitude of the port security problem.

Also, this is especially important for products like computer chips, Anthrax vaccines, biodegradable packaging, biological agents, items for national security, etc. The ramifications of unforeseen events on customers in such situations are great. Customers need to know for certain whether or not the product has been tampered with when it hits the market because this can radically damage the product, constitute health hazards (Staff, 2003). With increasing public demand for environmentally safe products and potential overall reductions in cost, adoption of environmentally sound purchasing policies and practices may provide firms with a competitive advantage in the marketplace (Zsidisin and Hendrick, 1998). Additionally, there is also the issue of brand integrity. Customers are going to look at company name on the label and hold that company responsible both ethically and legally (Staff, 2003). Thus, risks of failures in the case of products that require high security can be detrimental to the long-run credibility of companies.

Meeting the need for security challenge requires an end-to-end technology solution is necessary to thwart any attempts to damage the product. Investments in security using disparate and disconnected technology solutions are not sufficient. What is needed is a system of systems where all pieces of the security puzzle can be connected and monitored simultaneously (Adam and Woolever, 2003). Extensive risk

management systems investment are needed in the supply chain in order to develop a holistic approach would enable all interested parties to track the whereabouts of a single toy, for example, and determine whether the container it is shipped in has been tampered with, and where along the supply chain the tampering has occurred (Adam and Woolever, 2003).

Purchasers in this case should invest more to move to adopting closer relationships with key suppliers that will enable them to scrutinize their suppliers' production and deliveries processes and, thereby, avoid the long-lasting negative impact of supplier failure. That is:

P2. Those suppliers who provide items that have high security requirements require more extensive risk management than those providing items with relatively less security needs.

Relative importance of suppliers

Antonette *et al.* (2002) posited that suppliers that are vital to the success of the firm, in terms of their reliability in both items availability and on the competitive edge of the final product, impact the level of risk. They deliver the key elements that exist in a business to deliver to its own core customers. The impact of the purchase on the profitability is another supplier factor that was found to influence the supply risk (Zsidisin, 2003). Should the risks to the bottom line be significant, then, with the approval of management, critical resources of knowledge, information, and technology should be obtained, and organizational processes put in place to facilitate optimum use of these resources to meet this purchasing challenge.

The relative importance of suppliers is an important determinant of how much time and effort should be dedicated to risk management. As dependence of the buyer on a certain supplier increases, relative importance of that supplier compared to other suppliers that the buyer deals with increases. Dependence on a supplier may arise as a result of the large quantity of items provided by that supplier and/or from criticality of these items. For example, if the buyer is building a computer and a critical component is available on time in stock, the buyer would not be able to complete the assembly of the finished product (Staff, 2003). Obviously, that is a huge productivity risk, especially with many firms going to just-in-time (JIT) inventory systems. Such risks are present when procurement may involve investments made by the firm specifically for the supply relation, or when items crucial to the firm's operations and processes are being contracted (Iyer, 1996).

Another reason for the increased relative importance of a supplier is prior commitments to a technology (Heide and Weiss, 1995). For products like computer products and customized machinery, buyers usually invest in technologies incompatible with other products and suppliers. Thus, the risk of any production problems that might occur on the part of suppliers involves high switching costs because of the high investments that need to be changed if a new relationship with a new supplier is to be established. Hence, in dealing with major suppliers that provide critical items supply management is expected to take the necessary precautions since risks of their performance failure can be prohibitive. Strategies such as supplier certification, quality management programs and quality audits can help mangers in selecting the most reliable suppliers. Companies that have strong supplier certification programs are able to reduce their supplier base, which is a risky endeavor, to assure

they met standards (Smeltzer and Siferd, 1998). These activities essentially reduced the risks of poor judgments in supplier selection. Hence:

P3. Major suppliers of high volume, value and/or critical items require more extensive risk management than those who supply fewer or less critical items.

Purchasers' prior experience

Previous research addressed "purchasers' experience" as an important determinant factor of the investment in information gathering and alternative assessment (e.g. Robinson *et al.*, 1967; Johnston and Lewin, 1994; Iyer, 1996). The buy class framework that was presented by Robinson *et al.* (1967) predicted that these three criteria increased in value as the buying situation changed from straight rebuy to modified rebuy to new task buying. Johnston and Lewin (1994) concluded that the "levels of risk associated with a given purchase situation" account for much of the variation in organizational buying behavior. Further, this risk "is a function of the importance of a particular purchase and/or uncertainty of the purchase outcome" (Iyer, 1996). Purchase importance and outcome uncertainty reflect strategic concerns for the buying firm and provide the crucial links between the procurement decision and organizational strategy.

The investment in the risk management systems involves reducing the likelihood of being exposed to supplier opportunism. Some forms of investments here can be in backward integration. Moreover, wherever supply relations involve providing critical information to suppliers, there is always a risk that the supplier may "piggy-back" on the firm's knowledge of products and processes for their own forward integration attempts. Thus, the risks of supplier opportunism and priorities in the protection of firm-specific knowledge may call for a more strategic – as opposed to cost-based – reasoning of the "make-versus-buy" decision.

When supply professionals have greater experience in a certain buying situation they are better able to employ more effective strategies for customization and adaptation to risks associated with that situation and, therefore, need to employ risk management activities to a lesser extent than if confronted with a novel situation. That is:

P4. Suppliers with whom purchasers have less experience require more extensive risk management than those with whom there is a history of purchasing.

Situational risk management continuum

The conceptual research has presented the movement from risk buffering to risk management. When a firm utilizes risk management techniques it must allocate different investment levels for each situation. Based on past research we have identified four situational factors that affect the extent of risk management.

Figure 2 highlights the four dimensions that will affect the extent of risk management activities in the supply chain. Using these as a guide can help direct supply manager to the appropriate risk management strategies.

These four dimensions that determine the extent of risk management needs are the:

(1) degree of product technology involved in the item purchased (high-tech vs low-tech products);

(2) need for security in handling, packaging and transporting the product (high vs low);

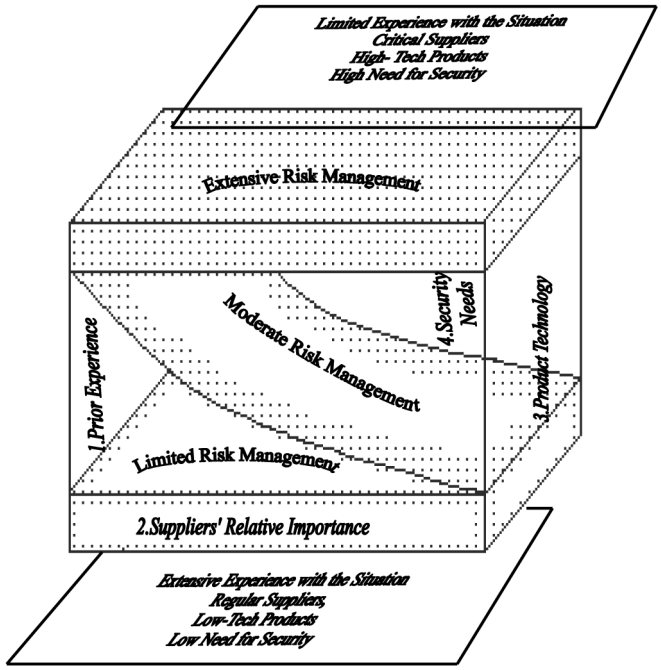

Figure 2.
Determinants of the degree of risk management

(3) importance of the supplier (regular vs critical suppliers); and

(4) purchasers' prior experience with the situation whether it is a new item, new supplier, or both (limited vs significant experience).

Thus, the higher the technical sophistication of the product; the greater the need for security in the process of producing and transporting the product; the more critical the supplier's item; and the less the previous experience with the situation, the greater the need for performing risk management. When all of these factors are combined, they produce a situation in which the likelihood and/or the detrimental effect of an unforeseen event can be quite costly for all firms in the supply chain.

By the same token the lower the technology of the product, the less the need for security in the process of producing and transporting the product; low importance of the suppliers' items to the buyer; and extensive previous experience with the situation (supplier or product), the less the need for risk assessment. In such cases, supply managers can limit risk management activities because the likelihood and the detrimental effect of unforeseen events are more manageable.

These two situations are the extreme opposites of the risk management continuum. It is most likely that supply chain members will encounter situations characterized by a combination of different levels of these four dimensions, which require moderate risk management efforts. In such situations supply managers should use their judgment in identifying the extent to which risk management is necessary. Although it is beyond the scope of this paper to address all possible combinations of risk dimensions in buying situations, the following discussion addresses some situations that represent

how supply managers should handle differently possible buying situations that involve various degrees and sources of risks.

In situations where buyers have no or limited experience, supply professionals can learn through others' experiences, researching best practices, and taking necessary precautions. Additionally, organizational learning through prior exposure to similar situations and their potential losses should lead to proactive actions to prevent these future losses.

Managerial implications

One of the first reactions supply managers may have in dealing with risk is to grab for greater control. Control-oriented mangers in times of increased risk will move their organization to adopt conditions that produce short-term results, but overturn recent advances in supply chain management. Therefore, it is up to the progressive supply managers to resist these attempts to grab for greater control and, instead, focus on managing risk. Failure to do so will result in a step back for these firms and the gap between best and worst performers will grow even larger.

Even though using process improvements and various risk management activities can reduce supply risks, risk cannot be completely eliminated. Risk management policies need a clear mandate from top management. Because risk management is time consuming supply professionals can spend a large portion of their time in planning and assessing supply risk, they need to rationalize the investment that they make in each buying situation by identifying its distinguishing characteristics.

If the buying situation is novel, involves critical high-tech items, and requires high levels of security in its production and delivery to customers the risks of failure can be prohibitive. In this scenario, supply professional should rely on early supplier involvement, share and assess supplier risk management plans, implement automatic integration with supplier operations, and increase and strengthen the flow of communication with the supplier. In this case the risk management investments can be easily justified.

There conversely will also be commodities, products, and services that require very little risk management such as certain standard materials, machine parts, office supplies, and some general MRO items. In these areas little investment in risk management is necessary since the switching costs are low and market availability is high.

Supply professionals must have top management support. If a risk never materializes, it becomes very difficult to justify the time spent on risk assessments, contingency plans, and risk management (Zsidisin *et al.*, 2000). Also, the total cost of an undesirable event occurring needs to be evaluated in comparison to the benefits realized from having strategies in place that significantly reduce the chance and/or effects of detrimental events with supply.

Organizations that employed more qualified purchasing employees reduced risk because purchasing had the required competencies to manage the risk (Smeltzer and Siferd, 1998). Companies can rely on outsourcing and still avoid its associated risks when they develop quality certification programs and audit the suppliers to assure they meet required standards. These activities essentially reduce the risks of poor judgments in supplier selection. Long-term alliances make organizations dependent on fewer suppliers and, hence, increase risks (Smeltzer and Siferd, 1998). However, with

highly qualified purchasing managers working with the supplier to maintain and improve the desired technology and remain cost competitive, the risk is managed.

To mitigate supply risks and develop competitive advantage today, supply professionals need to coordinate the relationships in the supply chain and increase the flow of information and communication efforts. This is evident in the research findings that emphasize that interpersonal communication, ability to work in teams, and negotiation skills, which are all skills needed to support the integration of the supply chain, are critical to succeed and, even, to survive in today's competitive arena (Giunipero and Pearcy, 2000). Thus, hiring and developing employees is the key to managing risks in supply chain. It is equally important as well that top management allow purchasing the freedom to pursue potentially risky endeavors as long as an appropriate plan to manage risks is developed.

Conclusion

Increasing tension, risks and dangers are present in the world environment today. This coupled with supply management's movement to adopt more progressive and strategic practices will require the development of risk management to insure efficient and effective supply chain practices. We have traced the evolution from risk buffering to risk management and some of the problems inherent in taking a one-size-fits-all presumption. Taking a more situational approach we have proposed four buying factors; degree of product technology, security needs, relative importance of the supplier, and the purchasers' prior experience as being critical to the process.

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