RISKS POSED BY UNCERTAINTIES IN THE SUPPLY CHAIN

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ABSTRACT

Competition today is so savage that it creates uncertainties a real threat to an organization's survival. Creating and managing supply chains is a method for controlling these uncertainties. This paper examines empirical research from postgraduate students and scholarly papers published in the journal of an international university in Thailand, on supply chain techniques.

Major uncertainties are found in: matching supply to demand, production and information problems, and lack of co-ordination with chain partners. Several methods which firms use to improve their supply chains are examined: these include inventory control, systematic forecasting, selection of quality suppliers, distribution, and partnership collaboration.

Valuable through these efforts are, they cannot be perfect and have to be frequently reviewed and updated. Some methods of evaluating supply chains are explored. But some uncertainties will always be present, mainly in the human software because supply chain partnerships are vulnerable to a lack of trust and commitment. In addition to disaster planning, eternal vigilance is also greatly needed.

The methodology in this paper is a literature review of research papers from a Thai international university, and the extraction of meta-themes. Limitations include generalizability, as the research was restricted to firms in Thailand, and there are inevitable limitations within each of the research projects mentioned in this paper.

***Keywords**: risks, uncertainties, collaboration, trust, commitment*

บทคัดย่อ

การแข่งขันอย่างรุนแรงในทุกวันนี้สร้างความไม่แน่นอนเปรียบเสมือนภัยคุกคามความอยู่รอดขององค์กร การสร้างและบริหารโซ่อุปทานเป็นวิธีที่ใช้เพื่อควบคุมความไม่แน่นอนเหล่านี้ งานวิจัยนี้เป็นการวิจัยเชิงประจักษ์ทางด้านเทคนิคโซ่อุปทาน จากผลงานของมหาบัณฑิตและผลงานวิชาการที่ตีพิมพ์ในวารสารของมหาวิทยาลัยนานาชาติในประเทศไทย

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ความไม่แน่นอนที่พบส่วนใหญ่ คือ การทำให้อุปทานสอดคล้องกับอุปสงค์ ปัญหาการผลิตและข้อมูล การขาดความร่วมมือกันระหว่างคู่ค้า ซึ่งทำให้บริษัทพยายามหาวิถีทางต่าง ๆ เพื่อปรับปรุงโซ่อุปทาน เช่น การควบคุมสินค้าคงคลัง การพยากรณ์อย่างเป็นระบบ การเลือกซัพพลายเออร์ที่มีคุณภาพ การกระจายสินค้า และการร่วมมือกับคู่ค้า

สิ่งสำคัญที่ได้จากความพยายามนี้ คือ ไม่มีวิธีใดที่สมบูรณ์แบบ จึงต้องมีการทบทวนและปรับปรุงอยู่เสมอ ผู้วิจัยพบว่ามีการใช้วิธีการประเมินโซ่อุปทานอยู่หลายวิธี แต่ความไม่แน่นอนก็ยังพบเห็นได้อยู่ หลัก ๆ เกิดจากมนุษย์ที่ทำให้ความสัมพันธ์เปราะบางจากการไม่ไว้วางใจกันและขาดข้อผูกพันระหว่างกัน นอกเหนือจากการวางแผนฉุกเฉิน การระมัดระวังรอบคอบเป็นสิ่งจำเป็นยิ่ง วิธีการวิจัยที่ใช้ คือ การทบทวนวรรณกรรมจากผลงานวิชาการในมหาวิทยาลัยนานาชาติในประเทศไทย และการแยกหัวข้อประเด็นต่าง ๆ ข้อจำกัดในงานวิจัยนี้รวมถึงการนำความรู้ที่ได้ไปใช้กับงานวิจัยอื่น ๆ เนื่องจากงานวิจัยนี้จำกัดแค่บริษัทในประเทศไทย และข้อจำกัดอื่น ๆ ที่ได้ระบุในผลงานแต่ละเรื่องที่ได้ไปทบทวนวรรณกรรมมา

INTRODUCTION

The justification for the current dominant economic philosophy of capitalism is that its central reliance on market forces rather than command economics produces what people want and forces firms to compete. Competition become ever more ferocious, driving firms to secure a competitive edge. Increasing globalization leads to greater competition between firms engaged in international trade, and has a contagion effect on their local markets. Firms search for new ways of finding that elusive magical trick to becoming ever more effective and efficient. ‘Quality’ became the focus, with ISOs and Quality Assurance, but they no longer are sufficient in proving provide a competitive edge, being relatively static and are now virtually universal basics for firms.

A major current competitive technique is ‘supply chain management’ (SCM). This seeks to tackle a major factor in business success, of removing a major uncertainty by matching supply to demand, to avoid expensive inventory and stockouts. It is difficult to do this alone, in isolation from one’s suppliers and customers, hence the relationships between supply chain partners become extremely important, each in itself but especially in conjunction with the chain partners. Many companies realize that a supply chain system for co-ordinating activities and knowledge between suppliers, manufacturers and customers is essential if they are to remain in business and thrive (Lawrence, 2011). The basic problem is uncertainty of information: about demand for a product, when and how much; and about supply, of raw materials, production schedules, and delivery (Rafi-Ul-Shan et al., 2014).

Supply Chain Management can enable firms to manage a new complexity involving the creation, connection and management of physical and information flows. This ability is also required to interact with technological and Business Intelligence instruments, that allow a close coordination between the several actors of a Supply Chain (Savino, 2008). Various entities (e.g., suppliers, manufacturers, distributors, retailers and commercial customers) work together to acquire raw materials, convert these into final products, and deliver these to retailers or end-customers. The benefits

of SCM are lower costs, higher service level, close links between those in the chain, higher productivity, and higher profit).

Managing supply chains is a substantial challenge because of uncertainties. Demand uncertainty is caused by inaccurate or insufficient forecasting. Supply uncertainty can be due to the supplier's operational malfunctions, or late delivery. Variations in manufacturing lead time are a major source of manufacturing uncertainty. To minimize cost and maximize service, firms must find ways to control these uncertainties.

These are mainly external causes of uncertainty. Internal causes, within the supply chain itself, can have similar causation but there is also the moral-human element of honesty and straightforwardness which creates trust, and the exercise of care by each management and its employees. In risk management terms these risks called physical hazard, moral hazard (trustworthiness) and morale hazard (carelessness).

Many uncertainties abound, and cannot be accurately quantified or evaluated. But they can be watched with attention, and multi-scenarios developed, with crisis management structures set in place. As in ordinary planning, the benefit is not only in producing an actual plan but in the familiarity and expanded vision which comes from the planning process itself. Better to think ahead and be mentally prepared than have to do it fresh under the stress of crisis.

UNCERTAINTIES

Risk is everywhere in human life, producing uncertainty. Uncertainties in internal and external environments can be managed by implementing a strategy of supply chain management, in order to maintain or enhance the firm's performance. Many supply chains consist of complex interactions and relationships, involving suppliers and customers. The uncertainties are also complex: they produce difficult challenges for management, as the information essential to decision-making has a degree of imprecision and unpredictability Supply chain uncertainty refers to decisions in the supply chain in which the decision maker "does not know definitely what to decide as he is indistinct about the objectives; lacks information about the supply chain or its environment; lacks information processing capacities; is unable to accurately predict the impact of possible control action on supply chain behavior; or lacks effective control actions" (van der Vorst & Beulens, 2002, p. 413). The uncertainties can be found in a firm's management abilities and information systems, and in the abilities and information of other firms in the supply chain.

The business environment is replete with uncertainty. Without clear insight into imminent economic, political, and security developments, firms rightly fear for their survival in the maelstrom of global disruption and market change. As a response some firms have outsourced key business processes such as distribution, but outsourcing adds more complexity and risk due to the several firms involved. Information flows and material flows are not linear chains, but complex networks with multiple paths, producing delays in operations and deliveries. Thus, firms are unable to react to the expectations and the changing conditions of the market. Firms try to avoid stock-outs,

excess inventory and delivery delays, by improving their forecasting methods. However, because of economic and political uncertainty, buying behavior is often unpredictable. Indeed in a dynamic market, many changes are unpredictable and confusing, making it problematic to manage a supply chain (Sashikala & Gupta, 2009).

There are many links in the chain, involving material suppliers, production facilities, distribution services, warehouses, service centers and customers. Supply chain partners try to co-ordinate their decisions and activities, but as the efficiency of a supply chain increases, so does the risk of disruption or breakdown. Reliability is crucial in dealing with disruption risks. Failure of a supplier can result in loss of supplies or even total disruption (Lakshminarasimhan, Vijayakumar, & Milton, 2009).

There is also a shortage in most countries of talent in logistics and supply chain management (Handfield et al., 2013). In such an increasingly complex and challenging field, intellect and creativity are essential, to identify, analyze, and address critical issues and situations.

From the many supply chain factors and problems, internal and external, a sample had to be selected for this paper. The central focus will be on inventory: manufacturers' inventory levels of finished goods available to be dispatched to customers, and inventories of raw materials delivered from suppliers. This will involve an examination of forecasting techniques, systematic selection of able suppliers, distribution systems, and third-party logistics providers. The ideal of collaborative integration between partner firms is considered. Finally there is an examination of some methods for assessing the reliability of a chain, even though in an uncertain world some residual uncertainties will forever remain, and therefore there will be unprepared managers.

FORECASTING DEMAND

Most SCM research makes some mention of the inventory problem. Inventory consists of raw materials, work-in-progress and finished goods. It is tied-up capital. The problem can be over-stock (to be sure of meeting customer demand), which is expensive, or under-stock, which is risky as it might make customers wait for their order to be fulfilled. Achieving a balance is the desired aim, but that depends on predicting customer demand (how much and when), for which accurate forecasting is needed. Forecasting is also essential for scheduling production operations and the supply demand (how much, when, and from whom) of raw materials. Therefore, we now begin with empirical research to identify appropriate forecasting methods.

Pleesiri (2010) investigated a ceramic tile manufacturer in Thailand which needed to reduce its costs to stay competitive. The focus was on reducing the finished goods inventory. The average weekly sales was twice the average weekly inventory on hand, causing wasteful tied-up capital worth about US$ 130,000 per week.

Inaccurate unsystematic forecasting was the root cause: the company relied on intuition and experience. Forecasts of the demand for the upcoming week had an accuracy of

72%. Despite the high average inventory level, demand shortages still occurred. Production had to be disrupted for three days to produce a rush order.

Demand and inventory data was collected, followed by product classification analysis to determine the pilot item that had the highest impact on the company. Moving Average and Decomposition forecasting methods were applied, but both gave unsatisfactory results because of their limitations. The Moving Average method fails to recognize the rapid changes in the demand when there is a seasonal effect or marketing promotions. The Decomposition method uses a seasonal index but in this firm seasonality only occurs at Year End and start of New Year. Therefore, the forecasting method which fitted this product demand was Mixed Decomposition. Each product demand has its own idiosyncratic pattern.

A research requirement was that the 100% service level must be maintained. In the Mixed Decomposition forecast, the service level reduced, making necessary a safety inventory. The cost of the 100% service level multiplied three times, but compared with the cost of the old unsystematic method, the inventory cost had greatly reduced, by about 85%. There were other benefits: improvement in warehouse operations and space, improved lead times, and more effective sourcing of raw materials.

The research by Leabchantra (2011) focused on developing an appropriate systematic forecasting method for a Thai Nutrition Company which wanted to increase warehouse utilization and storage space. The highest sale volume product was selected as a pilot case. The theoretical forecasting methods applied were Moving Averages, Exponential smoothing, and Holt's model. The results were unsatisfactory because the demand changed rapidly in promotion campaigns. Thus, a mixed model for forecasting was developed, which blends moving average periods with an adjusted rule-based moving average to eliminate data variation, and proved to be satisfactory. Compared with the previous methodology the firm gains financially by reducing total opportunity loss and inventory costs. Warehouse utilization improvement and less inventory handling were achieved.

The aim of the next research (Boonyapisomparn, 2010) was to identify an accurate quantitative forecasting technique for materials needed by a construction retailer in Thailand selling materials for residential and commercial buildings, including cement, steel, and tiles. The construction industry is highly competitive, with high risk and low profit margin. Reduction in purchasing costs through inventory management is thus most important (Wisner et al., 2005). The company's problem was that inventory was either too high or too low in relation to customer demand, with consequent shortages or excess inventory. The top-selling 22 items were the study focus, generating 70% of total sales. Quantitative methodology was applied to supply and demand data for three years, and demand patterns identified. The result found that the Exponential Smoothing model was suitable for some materials and Moving Average for others. Finally, MAPE (Mean Absolute Deviation Error) and MAD (Mean Absolute Deviation) techniques were used to determine the best forecasting accuracy for each group of construction materials. These could reduce inventory and shortage costs by 26.6%.

Another research project, by Xiao Xia Liu (2008) in a frozen food company, involved excess inventory due to insufficient inventory control and monthly demand volatility. A reliable forecast of demand is not easy because of the difficulty of estimating the right quantity of demand for each product during a specific period. Consequently, this research focused solely on the company's internal inventory control in proposing a feasible managerial solution. The research conclusion was that the choice between continuous review and periodic review of inventory is not a simple decision. Which one is better depends on the relative importance of its advantages in various situations. Management must weigh each alternative in selecting the best system.

SUPPLIES AND SUPPLIERS

If demand can be systematically forecast, the supply needed has to fit that demand. Therefore, we now examine the supplier angle. The research focus of Patipanpanya (2009) was on supply: it sought to identify which forecasting method would be appropriate for a pineapple canning factory in Thailand. Its existing method was an inaccurate qualitative approach which resulted in supply shortages (an insufficient inventory of harvested pineapples).

The supply shortages occurred in February and June, when actual pineapples supplied to the factory were lower than sales orders. An order placed in April for June shipment had to be delayed. In addition to unhappy customers, the service punctuality service level was only 78%: delayed shipments incurred an annual penalty of US$ 1.5 million. However, in January to May the supply was greater than actual sales, so that there would be a surplus of pineapples, to be kept as inventory for an uncertain period waiting for a spot order or kept for shipping later. The effects were lost annual sales opportunities of US$ 4.5 million, and an inventory carrying cost of US$ 1million.

Historical pineapple supply data was used to investigate the sales/supplies pattern. The Coefficient of Variance and Autocorrelation Functions were examined to select suitable forecasting techniques. The analysis showed a stationary pattern, and so the Moving Average and Simple Exponential Smoothing forecasting approaches were selected. These approaches were measured for accuracy by calculating the Mean Absolute Percentage Error (MAPE). The result was that MAPE indicated that the Simple Exponential Smoothing approach was more accurate.

Fashion accessories, which frequently change style, have short-lived sales periods which can be seasonal, or even months or weeks, as customer demand changes with fashion trends. Research by Tortienchai (2008) into a women's handbag manufacturer revealed that the company did not have not the capacity for the short lead times necessary for on-time production and delivery to stores, nor an adequate relationship with the main supplier for sharing information such as production schedule, delivery schedule, and new product development. Fashion companies tend to source their supplies from offshore low labour cost countries, which needs significantly longer lead times in exchange for a substantial cost advantage. Also, delay and variability caused by internal processes at both ends of the chain, as well as the import and export procedures in between, can lead to inventory problems and consequent lost sales.

The research examined the impact of some factors on supply sourcing performance. The results indicated that forecast accuracy, and supplier relationship positively affect supply sourcing performance, but price negotiation power had no significant impact. The main activities of a buyer in the future had to be found in forming a closer coordination of schedules, cooperation on process and product improvement and development, and joint action for cost reduction. This would help reduce inventory investment, improve product quality, reduce cost, and improve profitability for both parties.

Lo et al. (2007) undertook research into a Taiwanese SME retailer in Vietnam which imported cars from and parts from Taiwan, Germany, Hong Kong and Malaysia, to be sold to customers in several cities in Vietnam. The problem was that in this global supply chain the suppliers had different ordering processes, there was no forecasting of demand, and records were paper-based not digital (Lo et al., 2007). The root problem was that since the company was founded in 1999, it had not kept pace with managerial and technological improvements, and considered itself too small to be able to afford to achieve this. The two universities involved were committed to helping the firm, but the research does spotlight the idea that a global company has to be of a certain size to be capable of sophisticated supply chain techniques. In a savagely competitive world, where customers can usually easily find other retailers, an effective supply chain is essential.

Despite the importance of the suppliers on the success and progress of the automotive industry in Thailand, very little empirical research has examined supplier aspects. Research by Panjakajornsak & Wararatchai (2008) therefore investigate the relative importance of factors in supplier selection decisions. The results show that these factors, ranked in order of importance, are product quality, price, after-sales service, delivery time, and product information. In addition, the most influential departments in supplier selection were purchasing, top management, production, and finance. Finally, implications for researchers and practitioners were suggested for further research.

DISTRIBUTION AND LOGISTICS PROVIDERS

The research of Pattanavekin (2011) examines the impact of changing a distribution system from a direct system (to each store) to a Distribution Centre (DC) system, for a multi-location electronic retail company in Thailand. The DC system is an inventory centralization system which puts inventory in one place for distribution to other locations. Each store keeps a safety stock. The research statistically compared a three-month period of implementing a DC distribution with the same period of the previous year in order to eliminate the seasonal nature of the product sales volume. The total distribution cost consists of the average aggregated stock level, transportation cost, and inventory management and administration cost, and the researcher expected a reduction after the company implemented a DC system. Indeed the results did show that a DC system can reduce the total distribution cost. However, the results of the impact on transportation cost are surprising, as the weighted sales volume transportation cost is reduced by a DC distribution system which is the opposite to what was expected.

The routing and scheduling of delivery vehicles is an important factor affecting the cost of a product, and is the topic of the next research by Charoenkittirak (2010). The company distributes dairy products, using four delivery vans. The customers were major supermarket chains and other retailers in Bangkok. The research aim was to achieve maximum capability of the vans by discovering how to reduce the fuel cost, total distance and driving time.

Before this research, the company used unsystematic transport planning, and there were many complaints from customers about delays. Other major problems were: Sometimes too many vans were used without good scheduling, resulting in overtime payments to drivers. Sometimes the routing and scheduling for each driver was not fair, and led to driver dissatisfaction. Some problems affecting delivery times were difficult to control, such as traffic, rain, and accidents.

Because of all these problems, the company needed: better routing and scheduling of product delivery for all their customers; good scheduling plan, which would be easy to use; reduction in the company's transportation cost.

Three heuristic devices were used in the research. Heuristic A could save a total distance of 7.11% per week. It also reduced the fuel for each van by 7.33%. Drivers' daily wage costs reduced by 1.89%. This heuristic could save driving time for the whole week: a decrease of 0.89%. Heuristic B could save a total distance of 8.04% per week. The new fuel cost decreased by 8.26%. Drivers' wage costs would decrease by 2.13%. Total driving time for the whole week would decrease by 4.05%. Heuristic C could save a total distance 9.08% per week; fuel cost reduced by 9.3%, total transportation costs reduced by 2.4%, total driving time could be reduced by 5.92%. Which heuristic is best? All three show less fuel cost and less distance. Heuristic C seems to be the best alternative as it can save greater total distance and fuel costs, although it cannot save as much total time consumed as A and B. This would be a distinct improvement on the old system.

Transportation cost is one of the key success factors in a competitive market Some firms search for efficient transport routing by redesigning their transport network to include a consolidation hub model to achieve total cost saving. The purpose of the research by Leelawirojrith (2011) was to improve knowledge and awareness of applying a consolidation model, by studying the technique to reduce cost in a charcoal trading company in Thailand. The research showed a massive 60% cost saving in the company's inland transportation cost.

Suvansombut (2009) compared the service performance of two trucking service providers, to develop a framework for selecting the better of the two. The following five dimensions emerged: Management, Availability of transportation, Value added service, Quality service, and Service characteristics. Based on the scores, provider A was chosen.

With increase in trade across national frontiers, some firms have decided to outsource the distribution process, to third party logistics provider (3PLP). Salam (2009)

investigated the future use of 3PLPs in China, Korea, Thailand, and Vietnam. He used three factors: extent of use, decision making process for choosing 3PLP firms, and impact of the use of these contract logistics services on the hiring organization's operational efficiency and effectiveness. His detailed findings revealed differences depending on the size of the hiring organization and the specific country. Small firms with less than 200 employees tend not to use 3PLPs. The most frequently used service was shipment consolidation. 80% of those surveyed used these contract services because of cost savings, flexibility, customer satisfaction and accessing up-to-date techniques and expertise. Over 90% reported productivity improvements through using 3PLPs, with the consequent opportunity for the firm to focus on its core business. There was a high level of enthusiasm for the capabilities and service of 3PLPs, even if it meant some loss of direct control by the hiring organization. It was not all good. Some firms reported difficulties of coordination and integration, incompatibility of information systems, and poor understanding by the 3PLP of the organization's operations.

ADVANCED SUPPLY CHAINS: COLLABORATION

With increased competition and complexity, many firms now seek a stronger relationship with their chain partners, so that integrated processes and information can further reduce uncertainties. The transformation of an SCM partnership from open-market negotiation, then cooperation and coordination, and now to sophisticated collaboration is described by Puttibarnchareonsri (2010). The simple deadline-coordinating phase, to minimize inventory and stock-out, which involved information linkages and EDI exchange, was no longer sufficient. Relationships of sharing, based on trust between partners, providing win-win situations, became an advanced form of collaborative strategy. Collaboration takes a leap by involving integration of the supply chain, joint planning, and technology sharing. The synergy of such collaboration is significant, promising improvements in efficiency, effectiveness and profitability, and leading to a win-win-win situation for all participating partners (although not necessarily equal wins).

There are different degrees of collaboration, which produce different results. For such activities as information sharing, joint planning, and problem solving, a low level means little information exchange, and no joint planning or problem solving. A medium level means shared promotion plans and payment data, but limited to sales promotions. A high level means shared promotions, inventory, sales information, and top management meetings to ensure sharing of information, and includes joint planning and forecasting, as well as forming teams to work on special supply chain projects (Sheu et al., 2006). Research reports have consistently shown that information sharing, joint planning/joint decision making, incentive alignment, and relationship-specific investment, are the main attributes of a good collaborative supply chain (Puttibarnchareonsri, 2010).

Many firms want to be part of a strongly integrated business network. It seems to offer more stability and permanency in addition to the integrated compatible processes and information. Some 3PLPs aim for a collaborative relationship, tying-in a customer

(especially big customers). This is demonstrated in a paper from Graham (2008), which makes a strong case for joint planning and investment, access to information systems, available warehouse space, trucking space and trucking schedules. This is seen as a trend towards outsourcing: manufacturing, replenishment, plus data and financial management, and the need for closer economic and strategic ties. Going even deeper, this paper sees many companies becoming 'pure brand' companies, having outsourced the arms and legs of physical operations to chain partners in a strategic partnership from sourcing to end delivery. This would allow the brand-company to focus purely on development and R&D.

However, this enthusiasm should be tempered with caution. A collaborative strategy is complex, and not always successful. Collaborative efforts might reduce product innovativeness, perhaps due to a failure to see the potential of a dramatically innovative product. Firms which become dependent on a single partner may find themselves locked into capabilities which become obsolete following sudden substantial changes in technology or market segmentation (Puttibarnchareonsri, 2010).

RELIABILITY

The configuration of a supply chain and the correct choice of methods and tools is a key step in supply chain management. A wrong choice can lead the firm into make wrong decisions and investments in human resources, software and strategic objectives. Also long-term results can be affected by not meeting specific market requirements, such as the level of service and certain product requirements (Savino, 2008).

Performances evaluation plays a central role in SCM, because the complexity of the existing relationships has to be analysed by management, and measurement tools must be able to give useful information to indicate whether the strategic choices have generated an effective advantage for the firm. Management methods remain a weak point in supply chain analysis because these are often not included in the definition of techniques for performance evaluation or strategic control.

Savino (2008) explores the problem of the choice of tools and methods for performance measurement in Supply Chain Management. He proposes an integrated approach based on the SCOR model which deters the user from selecting a wrong method or wrong parameters, because it guides the user in the configuration of its supply chain in along with existing approaches and also along with modified ones. The proposed integrated system incorporates some of the most widely used systems of performance management, such as SCOR, BSC, ABC, and CSF, which allow firms to estimate the different aspects of the supply chain and to characterize them with a set of synthetic and meaningful indicators.

RESIDUAL UNCERTAINTIES

The list of research projects described here, to make improvement in supply chains, is impressive in its wide scope of companies, trades, aspects, and methods: which

demonstrates the wide impact of SCM, its complexity, and its dynamism. However, several themes can be discerned which show that all is not ideal. 'One size fits all' is denied in several projects, indicating that situational factors are important such as size of company, the specific trade, product specifics, and national differences. There are also limitations. Follow-up evaluation reviews and revisions are not mentioned. All research has limitations, and any research which does not admit this is not credible. Researchers often use models developed by others. Models are maps, not the territory, and are simplifications to convert complexity into understandability. Even statistical tests have deficiencies and limits. There is also the systems viewpoint that change in one part of a system affects others, often in unexpected ways which can be good or bad. Supply chains, especially collaborative ones, are susceptible to this. Another theme that emerges is 'balance'; balance between cost and service, between short-term and long-term, and between interdependence and independence. Deciding where the balance lies depends on fallible human judgement. Complex, collaborative integrated chains contain uncertainties and threats arising from the nature of such a hybrid creation which verges on the unnatural. Even good marriages are prone to disagreements, estrangement or divorce. Residual uncertainties remain.

Many differentiation aspects have not been included in the above research reports, but there are many more, adding to the confusing choice for supply chain managers, uncertain which to believe and act upon. For example, for demand uncertainty it is suggested by some researchers that different product types ('functional' and 'innovative') require different strategies ('efficient' and 'responsive'). For supply uncertainty, efficient supply chains fit grocery, basic apparel, food, oil and gas firms; while responsive supply chains fit fashion apparel, computers, and pop music firms. Also, risk-hedging supply chains and agile supply chains fit different types of firm (Puttibarncharoensri, 2010).

Supply Chain models treat the world as if certain knowledge existed about everything. However, even if all the details of the Supply chain could be known with certainty, the system would still encounter occasional disruptions, perhaps through weather, strikes, or sabotage. Thus, although we live in a relatively unstable world, yet we have increasingly sensitive supply chains. Many firms have suffered from the surprising frequency and severity of recent disasters, which revealed a lack of contingency planning. The traditionally designed supply chain is unable to deal with disruptions due to unanticipated events. Traditional models mechanically focus on cost-efficiency. Just-in-time supply chains are prevalent in many industries, and supply chains facilitate this. However these models are based on the assumption that every element in the supply chain will always perform as planned (Lakshminarasimhan et al., 2009).

It is the human software problems which have the most potential uncertainty. This is the realm of human behaviour, not of economics but of sociology and psychology. We therefore turn now to examine the issues of trust and commitment, the foundations for sophisticated supply chains.

TRUST AND COMMITMENT

Trust between partners in a supply chain is important. It is part of the software, the human-ware of business, harder to produce and maintain than the hardware of technical components such as the financial, marketing, production, and technological aspects of supply chains. Wang and Liu (2007) investigated the trust between manufacturers and suppliers, from sociological and psychological perspectives. Supply chain trust (SCT) is a construct derived from the idea of social capital; it is a definite hypothesis of the uncertain attitude and behaviour of counterparts in a co-operational relationship, which presupposes that the other party is honest, credible, predictable, and benevolent. It is also a control system with three subsystems of trust history, trust behaviour, and trust increment. The interaction of these three was explored to find elements that are controllable. The result was an SCT management system comprising nine factors: objectives, values, dependence relationships, satisfaction, perceived devotion, supplier's independence, communication, share, and producing collaboration. The research paper proposed an empirical methodology for the interaction of these factors, diversified according to the different cultures existing among supply chain members.

In Fukayama's substantial analysis of Trust (1995), he found that it varied according to the culture of a nation. Thus, Japan and Germany are high-trust nations, whereas China and Thailand are low-trust. This has important implications for economic structures within a nation but also for international cooperation across global supply chains.

It might appear simple for a company to copy the model from this research, but it is not, for it involves an understanding of the context of trust, its antecedents, its foundations, and its sheer complexity (as we would expect from anything to do with human behaviour). As with much in our new complex world, very little is linear and mechanical anymore, but rather iterative and organic. Trust determines observable behaviour but is itself rooted in unobservable (often subconscious) values. Where trust is based only on economic calculation it is deficient and unstable by not being firmly rooted in values. When the going gets tough, trust weakness will be exposed.

Salam (2007) also studied behavioural factors in the supply chain, especially the level of commitment to partners in the promise or agreement to maintain and strengthen a relationship. This includes willingness to make short-term sacrifices to maintain a long-term stable relationship. Dr. Salam lists three types of commitment: affective (feeling), normative (obligation), and continuance (perceived cost of leaving, or no alternative). Trust is one of the factors. Once commitment is established between partners, it normally ensures cooperation. An example is honouring a previously agreed price despite market fluctuation. The research results implied that behavioural determinants play a pivotal role in achieving supply chain commitment and the integration of business processes. Behavioural dimensions proved to be critical in linking external market requirements with internal considerations. Therefore, managers must learn to understand and apply this.

Apart from uncertainties relating to specific businesses and trades, there are the huge uncertainties: sudden financial meltdowns, severe natural disasters, wars and terrorism. These cannot be predicted with accuracy, but firms can practice disaster planning, and to this we now turn.

THE NEED FOR A BUSINESS CONTINUITY PLAN

A Thai scholar, Srivantaneeyakul (2011), wrote an article on disaster management planning early in 2011. Thailand then endured its worst flooding for fifty years, and it is unlikely that there were many plans ready. His argument was based on the fact that in the present hectic world, demand and the supply must be planned in advance, and so precisely that the logistics experts will be able to plan the resources for the right time and the right capacity to handle those supplies. Each missing link in the supply chain will affect the rest of the chain, whether it is the raw material producer, the manufacturer, the warehouse, the transportation, or the retail part. If a catastrophe strikes a manufacturer, causing a halt to production, the remaining parts of the chain will also be useless. It is important that each link of the supply chain has a plan to handle these unexpected crises. This type of plan will help to mitigate the risk and continue the business as soon as possible. It is called a Business Continuity Plan (BCP).

In Wikipedia, its useful BCP definition is 'a plan which identifies the organization's exposure to internal and external threats, and synthesizes hard and soft assets, to provide effective prevention and recovery for the organization, whilst maintaining competitive advantage and value system integrity'. It is a plan that a company has developed to handle a crisis enabling it to restart the business as soon as possible. To develop this plan would take around 6-12 months; a larger organization could take longer. The team to develop this plan must involve all business units of the organization, fully supported by top management. Most organization will assign this responsibility to the IT Department, but BCP needs to involve all the critical function business units of the company. Another main failure of the plan is when top management perceive it as just a document for compliance, a waste of time and budgeted money, not as the last survival kit of the firm. When such a plan is finished, it will be unrealistic and inapplicable.

The methodology to develop BCP varies between five and eight steps, depending on the organisation, but all variations have more less similar objectives. The eight steps are:

> Project Plan – Risk Analysis – Business Impact Analysis – Recovery Strategy, and then - Develop this through Training, Testing, and Maintenance

Research shows that 90% of companies which lose their data in a disaster are out of business within two years (http://www.webhostingtalk.com/archive/index.php/t-517697.html). Imagine a company no longer having its customer names and addresses, contact persons, business transactions records, and other vital records: it would be very difficult to run a Demand Forecast, Warehouse Management, and Transportation Systems. Everything would have to be back to basics, using paper, pencil and calculator.

Although BCP is very important for the company to survive after a disaster, only a few companies in Thailand seem to have developed a plan, and those that have are in Banking, Insurance, Finance, and Large Retail. The Manufacturing Sector still pays little attention to the development of this type of plan. But every link in the whole chain is equally important, so if one of the links in the supply chain fails, the whole chain will also be meaningless. It is time to start to Plan now! (Srivantaneeyakul, 2011).

CONCLUSION

As we live in a dynamic economic environment, ever more complex, the smooth functioning of a supply chain cannot be guaranteed, even with the best of intentions by all chain partners. However well prepared a firm and its partners are, things will happen which are unforeseen either in their frequency or severity or both. This has always been so, but the increasing complexity and interdependence of the world increases the uncertainties and their impact. These can be natural hazards such as earthquakes and floods (as in Japan and Thailand in 2011), financial meltdown (as Asia in 1997 and USA/Europe in 2008), mechanical/human accidents or terrorist incidents, and many more

These research projects examined above, reveal a wide range of organizations which use SCM and develop close relationships to improve production, service and competitiveness, and reduce waste and cost. It is only the skilled continuous management of supply chains, including the behavioural aspects, which can make them effective, for mutual benefit and for customer satisfaction. Despite the complexity and dangers, it seems that collaborative supply chains are the best defence against competition and uncertainty, though imperfect. This is a reasonable conclusion, for perfection is unattainable in so many aspects of human life.

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