

Possible Research Directions in Manufacturing Logistics and Supply Chain Management for Thailand¹

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Abstract

Thailand is beginning to emerge from a severe economic crisis that has inflicted the country since 1997. The results of the “bullwhip effect” caused immense adjustments to take place in business strategies throughout the country. At around the same time, supply chain management has intensified its presence in Thailand. This paper provides some historical perspectives about interests in supply chain management as a competitive strategy for industrial business, offers a brief literature review of some international journals, identifies some research issues for Thailand based on an adaptation of six research directions in literature, and suggests some research and implementation priorities for Thailand.

Keywords: Research Directions, Supply Chain Management, Logistics, Thailand

1. Introduction

Thailand is beginning to emerge from a severe economic crisis that has inflicted the country since 1997. The results of the *bullwhip effect* caused immense adjustments to take place in business strategies throughout the country. No industries were unaffected by the shock. Only through a huge devaluation in currency and heavy borrowing from the International Monetary Fund, did the nation slowly restore its economic confidence. Surviving businesses made adjustments to the new exchange rate. The devaluation helped boost exports and, in recent years, the proportion of exports to Gross Domestic Products (GDP) rose from less than 60% in 1997 to more than 90% in 2000. Thailand has become much more reliant on exports for its economic well-being, and the Thai government has made it clear that every effort will be made to ensure that the flow of exports will not be interrupted. It is clear then, that international supply chains currently play a significant role in our economy.

However, the problems of the *bullwhip effect* still remain. More recently, in early 2001, Thailand felt the effects from the demise of the dot-com companies. The shock rippled through internet equipment manufacturers such as Cisco Systems and large

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contract manufacturers such as Solectron, and finally reached Thailand, where it sent chills throughout the country, especially to electronics subcontractors. Once again, businesses in Thailand had to make big adjustments.

In both cases, there were warning signs that the bullwhip was ready to strike. The most significant sign was perhaps the euphoric nature of business *somewhere* along the supply chain, indicating that the business was, in fact, simply too good to be true (Schwartz 2001). When the true demand does not precipitate, the effects can be devastating for some businesses upstream in the supply chain. Needless to say, the non-performing loans of these businesses have caused severe economic problems in our finance and banking system. With the results of recent research, we now have a better understanding of the dynamics of supply chains in various industries (Fine 1998). Yet it is still very difficult to control supply chain behavior in general, especially when politics or non-tariff trade barriers are at play.

A case in point is the recent ban on Thailand's Tiger Shrimp (due to some chemical residuals) by the European Union (EU) in late 2002. Thailand's competitiveness in the shrimp industry has catapulted it into the number one spot in world shrimp export. Although the amount of export to the EU is much smaller than to that of the United States and Japan (who use different chemical screening standards), severe damages to shrimp farmers in the south have already occurred. In less than 2 months after the ban, more than 50% of the shrimp farmers have gone out of business in one Surat-thani Province (ITV 2002). Indeed, the entire shrimp supply chain in Thailand has felt the impact of the ban. It is estimated to have affected over one million people, from shrimp food producers, breeding farmers, shrimp food distributors, shrimp raising farmers, related equipment manufacturers, to frozen food factories, and exporters.

From the examples I have raised so far, it is important for researchers to recognize the big picture and what we might expect when observing supply chain dynamics. Since the study of supply chain management is about improving supply chain efficiency and competitiveness in terms of time and cost, we should focus our efforts towards studying and devising methods to improve and control our business processes. However, since our research resources are very much limited, I believe it would be wise to select research topics that will result in the highest impact for Thai industries.

I have a mixed view about where to concentrate our research efforts. On one hand, I think we need to use research to help our large corporations expand outward, and become more efficient, stronger, and more competitive in the world market, especially those corporations whose upstream members in their supply chains are mainly in Thailand and downstream members are outside Thailand. On the other hand, Thai small and medium enterprises (SMEs) need to learn and apply SCM principles too. Any SCM research that would help Thai SMEs become more competitive is likely to be more valuable to Thai society at large since more than 99% of the businesses in Thailand are SMEs. Together with our export focus, I believe that industrial supply chain management problems should be the main focus of our research efforts because it should result in the most benefit.

With that in mind, the rest of the paper is organized as follows. Section 2 provides a brief literature review of some of the academic research directions that I have come across. Section 3 provides a list of suggested research directions/topics that I feel are relevant to Thailand. Section 4 gives an assessment of the state of SCM practices in some industries and suggests some development priority. Section 5 gives some final remarks.

2. Literature Review

The evolution of SCM has its roots in the knowledge of materials management, physical distribution, functional logistics, and integrated logistics. Internal control of supply functions as well as external coordination with upstream and downstream entities, are necessary to create an integrated logistics system. Houlihan (1985) has been credited with coining the term “Supply Chain Management.” Because SCM includes management of day-to-day operations, which tend to be activities for less senior people, Houlihan suggests that there should be some differentiating elements that distinguish SCM from past research that belongs to the domain of integrated logistics. That differentiation is the strategic decision making of supply chain management (See Ganeshan, Jack, Magazine, and Stephens 1999). This is the reason why SCM has been elevated to upper level management where those decisions and policies affecting the corporation are made. SCM is now seen as an important corporate strategy and an effective way of creating value for customers.

Cohen and Mallik (1997) discuss analytical modeling of global supply chain issues facing multinational companies that are trying to derive competitive advantages from production and distribution facilities that are geographically dispersed throughout the world. Competitive advantages can be derived if the value-adding activities of those facilities are *effectively coordinated and flexibly adjusted* to meeting changing market conditions. They focus on two types of strategic planning approaches: network flow models and option valuation models.

A network flow model is a model of a firm’s production-distribution network, where nodes along the diagram represent facilities that are component, semi-finished and finished goods plants, distribution centers, warehouses, and market areas. The arcs between the nodes represent the supply-demand flows of raw materials, subassemblies, or finished products between the facilities. Typical supply chain planning problems are 1) network design problems that deal with choosing the location of facilities, and 2) supply chain coordination problems dealing with effective management of activities that will result in lower production and distribution costs. While these problems are applicable to domestic supply chain planning as well, additional issues of complexity arise when dealing with international supply chains, including the needs for 1) tax minimization due to transfer pricing between entities operating in different tax jurisdictions, 2) financial arbitrage via international cash flow management, and 3) the reduction of currency exchange risks via a combination of financial and operational hedging.

In contrast, option valuation models provide global firms with decision-making options to respond to uncertain events, such as exchange rate fluctuations, changes in government policy, competitors’ decisions, or the arrival of new technologies. How the firm should deploy its excess capacity in different plants and/or switch production among these plants and in which time period is referred to as *operational hedging*. Option valuation models are usually formulated as *mathematical programs* that seek to minimize (or maximize) finite or infinite horizon discounted expected costs (or profits) for a global firm.

Cohen and Mallik (1997) cite a number of applications where network flow models or option valuation models have been used, including:

- 1) Breitman and Lucas’ (1987) decision support system, PLANETS, which is used by General Motors,

- 2) Cohen and Lee's (1989) model to analyze Apple Computer's global manufacturing and distribution network,
- 3) Lee and Billington's (1993, 1995) implementation of a series of supply chain management models at Hewlett-Packard and HP's worldwide inventory network optimizer (WINO), which has been used to model the Vancouver supply chain of HP Deskjet printers.
- 4) Arntzen et al.'s (1995) description of the Global Supply Chain Model at Digital Equipment Corporation.

Despite the use of all these models, Cohen and Mallik (1997, p.56) pointed out their limitations, saying, "a general criticism of the majority of the reported models is that they lack practicality and would be difficult to implement."

Nonetheless, we continue to see publications describing the real applications of supply chain network design models. Some more recent examples include: 1) Camm et al. (1997)'s restructuring of P&G's North American Supply Chain, 2) Cheung, Leung, and Wong (2001)'s strategic service network design for DHL Hong Kong, 3) Lyon et al. (2001)'s IBM Microelectronics SCM effort, and 4) books by Simchi-Levi et al. (2000) and Shapiro (2001) describing successful and practical applications. It will require even further research to see which of these models may be relevant to Thailand.

2.1. Supply Chain Management Research Taxonomy

Following Stevens' (1989) method, Ganeshan et al. (1999) categorized SCM research up to that point in time into three main categories: 1) Competitive Strategy, 2) Firm-Focused Tactics, and 3) Operational Efficiencies. This is also similar to problem classification by Simchi-Levi et al. (2000). This categorization is simple and easy to understand. Although there are subcategories in each main category, we will not go into the details.

- 1) Research on Competitive Strategy in SCM. This category includes research that is strategic in nature and tends to cover a longer planning horizon. It can focus on helping us understand the supply chain dynamics of various industries, or help us determine suitable supplier and customer integration strategies of firms, as well as the appropriate degree of integration and synchronization. It can focus on supply chain design and configuration to enhance competitive advantage, or provide insights into the historical perspective of SCM, etc.
- 2) Research on Firm-Focused Tactics in SCM. This category includes tactical planning decisions for shorter planning horizons, such as days, weeks, or months that focus on the implementation of the strategic decisions of a firm. They tend to deal with relationship development, integrated operations, transportation and distribution, and development of information systems and the use of enabling technologies, such as MRP, JIT, DRP, ERP, etc. that are necessary to do the job.
- 3) Research on Operational Efficiency in SCM. This category reflects operational decisions on a day-to-day basis or up to two weeks. This type of research is concerned with operational controls and performance measurements such as service level, throughput, supplier performance and cost, and inventory investment. Related problem areas can be categorized as inventory management and control, production planning and scheduling, collaboration and information

sharing, coordination, monitoring or tracking and tracing, and other operational tools

Wu et al. (2002) suggest an informal but quite comprehensive manufacturing logistics research taxonomy that classifies research problems similar to Kendall's classification of queuing models, but only with three dimensions in the nomenclature to identify research problems as follows:

System / Decision Scope / Business Environment

The *System* dimension represents different levels of physical manufacturing units, which can be a production line, a plant, a company, or a supply chain. *Decision Scope* can be of operations and control type, or planning, or organization design, or decision structure (e.g., hierarchical, centralized, decentralized, collaborative, etc.). The *Business Environment* dimension specifies elements of the problem in terms of Uncertainty, Global issues such as currency and tax, Information Technology and Electronic Commerce, different Industry Convention such as automotive versus electronics, Human Factors, and Environmental Considerations.

They suggested six major research directions as follows:

- 1) Managing Uncertainties
- 2) Information Technology and Data Management
- 3) Supply Chain Design and Coordination
- 4) Planning and Control Systems
- 5) People Issues in Manufacturing Logistics Systems
- 6) Logistics Implications in Product Development and Design

3. Possible Research Directions for Thailand

Section 2 is written to give the reader a flavor of academic research in the area of supply chain management as perceived by university researchers abroad. Most of the literature I have cited so far has leaned toward the OR/MS and POM areas where I found most of them. Since the level of research abstraction means different things to different researchers and since research in SCM is ever expanding, I will limit my comments here to the more practical research problems that I feel would yield faster benefits to Thailand

Under the six suggested research directions of Wu et al. (2002), I will list some possible SCM research areas which fall under the three SCM categorizations suggested by Ganeshan et al. (1999), i.e., strategic, tactical, and operational issues. Although Wu et al. have limited their suggestions to manufacturing logistics, I will assume a broader scope of manufacturing logistics and supply chain management. Later on, I will also comment on the state of SCM competency in our industries, and suggest some areas that may have a higher priority in research for Thailand.

3.1. Managing Uncertainties

At the strategic level, research into the risks associated with globalization for Thai industries is badly needed. How each Thai industry can be protected from vulnerability to the forces of supply chain dynamics is a fruitful and significant research area that warrants high priority. The study of *industry clockspeeds* within the Thai economy is one particular

research area that should uncover the leading indicators of vulnerability. This will allow the government to design proper warning mechanisms to protect the constituencies of each industry. In today's highly competitive environment, *the ability to innovatively manage uncertainty and to respond accurately and reliably to changing market conditions is crucial to our survival and prosperity*. Research into this area is likely to involve economists and the government should take an active role to make this happen. Since significant portions of our industries are in automotive, textile, electronics, and agricultural, the ability to predict the behaviors of portions of the supply chains that belong to Thailand and related economic regions will guide the design of proper protective mechanisms. Since product life cycles are getting shorter, constant renewal of product and service innovations will be required as we venture outward to offer more products to the world markets. As such, research into the capacity management of basic communication and transport infrastructures affecting SCM should also be fruitful.

At the tactical and operational levels, detailed plans that can assist businesses up and down their supply chains should be designed in the same way as if a particular area of a country is affected by a natural disaster or an epidemic. Moreover, for Thai companies having operations outside Thailand, protection from risks arising from politics, unrest, currencies, local and global economies will go a long way in helping us expand our supply chains and products into the world. Existing government agencies can be used to coordinate and integrate these functional requirements.

In an effort to more accurately monitor supply chain activities, research into the possibility of creating a national legislation to require all items of goods sold locally and abroad to have a "Global Trade Item Number (GTIN)" and all manufacturing locations to have a "Global Location Number (GLN)" is an interesting one, in my opinion. Having such information will go a long way in helping to track movements of Thai goods anywhere in the country and in the world (Chantjiraporn 2002). The implication of creating, maintaining, and deriving useful information from such a database is immense but can be made routine. The appropriate level of information that should be surrendered by businesses to the government, as well as the timing, are sensitive issues.

3.2. *Information and Communication Technology*

The rapid pace of information and communication technology (ICT) is both a threat as well as an opportunity for business to compete. Because much of the impetus for efficient supply chain management lies with ICT, most Thai industries are handicapped because we have not fully taken advantages of the available technology. However, the need for quicker response and just-in-time delivery is bigger than ever. *The rise in e-commerce and e-business practices and models is inevitable and this is a fertile ground for research*. Several journals, e.g., Decision Sciences and POM, will be publishing special issues on E-business and Supply Chain Management.

One other information source where practitioners and academics meet and share ideas about the impact of technology on supply chain management is the ASCET Project, *Achieving Supply Chain Excellence through Technology*, published by Montgomery Research and sponsored by Accenture. Trends and ideas and new business models are being generated through thought leaders in SCM. See for example Mulani and Lee (2002) and <http://www.ascet.com>. Technologies and issues related to procurement, product design and manufacturing, fulfillment, and collaboration are discussed.

At the strategic level, research into the viability and the appropriate forms of local marketplaces and trading exchanges suitable for industries in Thailand should be welcome.

This is because clearer directions and guidelines are needed for companies who are contemplating using the services of these new exchanges, private or public. Some current B2B exchanges for on-line auctions, e-procurement, and e-marketplaces are www.foodmarketexchange.com, www.pantavani.com, www.thailandexport.com. More are expected to appear in the future and their effectiveness in improving SCM should be assessed. It is likely that innovative services offered by these exchanges will improve supply chain performance in the future because they can serve as effective communication hubs. Research into the types of services should be interesting and fruitful.

At the tactical level, research into linking local exchanges with international exchanges, evaluating international exchanges as well as local exchanges in foreign countries such as China, should be useful to Thai industries in forming supply chain alliances. In addition, the challenges of integrating new business processes, such as automatic supply contracts, with other internal processes, provide opportunities for useful research.

At the operational level, technical as well as behavioral issues related to the use of bar coding, ebXML, and other forms of supply chain execution technology should be evaluated and benchmarked. This needs to be done in order to ensure the widest usage of the most appropriate technology for SCM purposes, especially among SMEs. Research on *how to spread the use of automatic data capturing, storing, transmitting, and interpreting for business processes*, is a challenge and should have a higher profile in research since this is so fundamental to SCM. See also Gates (1999).

3.3. Supply Chain Design and Coordination

At the strategic level, supply chain design has received much attention from the OR/MS community (Camm et al. 1997, Cheung et al. 2001, Cohen and Lee 1989, Fine 1998, Shapiro 2001, Simchi-Levi et al. 2000). Commercial software for designing supply chain networks and routine production-distribution planning using optimization is quite common but expensive. How best to quickly evaluate and redesign a supply chain network, such as when new logistics partnership is incorporated into a supply chain structure, is an interesting research topic. Use of computer simulation and/or optimization techniques are practical for research right now and more should be encouraged to assist in decision-making. Other useful research issues could include the optimum of placement of safety stocks in supply chain networks, and replenishment coordination decisions.

Geographic information data, and freight rates & structures for various modes of transportation (air, ground, water) will be required for analysis, as well as accurate transportation leadtime estimates. Research into the logistics costs for Thailand as a percentage of our GDP would give us a sense of urgency about efficiency improvement (Bowersox et al. 2002, p.34). National databases available to industries to assist in decision making may need to be built and maintained using Thailand as the logistics center. This is a challenging task but may be unavoidable because of the need to make rapid analyses of logistics and supply chain options or to perform optimization.

At the tactical level, Thai logistics researchers should pay more attention to the impact of the new airport and air-logistics issues. Research into the efficiency and service costs of the new airport operations benchmarked with competing airports would be beneficial to Thailand. A case in point is the recent discussion at the July 2002 Conference on Asia Pacific Express carrier on "Increased Customs Overtime Charges Levied by Thailand Customs," which, if implemented, could reduce Thailand's competitiveness. Another area of research that may be important to many exporters is the improvement of

customer service with different combinations of ground, sea, and air transport speeds, i.e., offering the right delivery leadtime. Typically, higher costs are associated with faster speeds. *Selecting the right speed at the right price to service members in the supply chain is a recurring problem that warrants the attention of researchers and practitioners.*

At the operational level, vehicle routing research issues and software development specific to Thailand and neighboring countries should be interesting since geographic data is readily available. The effectiveness of system designs should be evaluated. Research into the recent implementation of i2 Technologies' vehicle routing and scheduling systems by Cement Thai Logistics should be an interesting case study.

3.4. *Planning and Control Systems*

The most common planning and control system is the ERP system. Enterprise Resource Planning systems have been implemented in Thailand for the past 15 years or more. *At the strategic level,* research into the implementation successes, cost trends by industry, and the satisfaction of Thai industries should be helpful. Empirical research similar to McAfee (2002) could be performed for real cases in Thailand. See also Mabert, Soni, and Venkataramanan (2001). In addition, study into the applicability of other production control systems besides Kanban system in Thailand could be undertaken, e.g., CONWIP (Hopp and Spearman 1996).

Since supply-chain planning software is just entering Thailand, there will be plenty of learning and research to do in the coming years to exploit and develop the technology further for local consumption. Because technology is changing rapidly, it is possible for Thailand to be a player in the software market as well. See Hensen (2001).

At the tactical and operational level, research in scheduling over the past 40 years has been somewhat disappointing with respect to implementation applicability (Portougal and Robb 2000). McKay, Pinedo, and Weber (2000) have suggested more practical research approaches. From my own experience, commercial planning and control software such as Advanced Planning and Scheduling (APS) system and Finite Capacity Scheduling (FCS) software has entered Thailand since 1994. As the need for more precise order promising increases, businesses look for tools that would give them visibility into the shop floor. Customer orders can be inserted in a real-time manner and their due dates estimated and promised based on the real information about the amount of jobs already scheduled. Impacts of emergency orders or contingencies can be assessed more precisely. *Research into developing better and cheaper systems exists and should be pursued.* In addition, proper implementation as well as strategies in using the system for tactical and operational planning should be interesting research topics. Wu et al. (2002) refer to this area of research as demand management.

At the operational level, Wu et al. (2002) also suggest doing research on *when and what decision* should be made with respect to real-time systems. As an example, Dell Computers' planning period is every two hours for orders that have been received from its web site. Analysis of other real-time systems should be interesting as well.

In addition, the widespread use of real-time global-positioning information in logistics in addition to mobile devices is increasing and common. Research on its impact on improving supply chain processes should not be overlooked.

3.5. *People Issues*

While enabling technology is important to create truly efficient and integrated supply chains, it is people and their willingness to change and align themselves with new

processes and incentives, which ultimately make or break a supply chain. New technological processes normally will eliminate non-value added activities and, in essence, create a leaner and more agile organization. This will, however, affect people and their power positions. Womack and Jones (2000, p.242) state “*Companies must pursue every option for preserving jobs as they create lean enterprises.*” This same philosophy is at the corner stone of government policy regarding jobs. Hence, innovation will be needed to find alternative jobs when more efficient processes replace inefficient ones. This is indeed a challenge and a fruitful area for research and case study development. Since SCM cannot be achieved without leadership from the top, research into issues regarding leadership, change management, organizational design and behavior when facing supply chain process thinking, should be very fruitful. In addition, research issues concerning SME entrepreneurs in supply chain matters is a top priority for Thailand (Shinawatra 2001).

I believe there is a great deal of human resource research issues whether they are of strategic, tactical, or operational issues. At issue is how companies can collectively exploit their competitive advantage as teams of people from different links in the supply chain who work together as one to streamline supply chain processes. Collaboration and trust as well as supply chain performance metrics are important research issues.

3.6. *Implications in Product Development and Design*

In the world where product life cycle is shrinking, there are many implications for business performance regarding product development and design. Fine (1998) suggests that today’s manufacturing business success depends not only on successful product design but also on the process design for making the product as well as the design of the supply chain for the product. He calls this strategy a *three-dimensional concurrent engineering* (3-DCE) approach. Indeed, I think we should advocate this approach for Thai industries. Thus research into the application of this strategy for our products should prove beneficial to any industry. Sopadaeng (2002) described a subtle case at a SME ceramics factory in Chiangmai whereby the design of a beautifully hand-crafted ceramic had to be changed in order to reduce logistics cost. By crafting the tail of the ceramic boat at a steeper angle, the length of the package containing the ceramic can be made shorter and more pieces can fit into an export container, thereby reducing logistics costs and making the product more competitive abroad while still maintaining its elegance. Although the example cited is only two-dimensional in nature, it illustrates the interactions that need to be carefully researched.

One other important issue regarding supply chain design has to do with the product life cycle. The total life cycle cost and life cycle support includes the concept of *cradle-to-cradle logistics* (Bowersox 2002, p.167). This concerns environmental issues along the supply chain. In fact, the concept of green supply chain management (GSCM) has received great attention from environmentalists throughout the world. The green movement in Thailand is also intensifying. *Research into green issues both forward and reverse logistics are all significant research areas whether they are of strategic, tactical, or operational nature.*

An example of the GSCM practices is Advanced Micro Devices (AMD) just-in-time delivery program for delivery chemicals for its wafer manufacturing sites. In the case of expensive specialty chemicals where large quantities are used, AMD implements JIT delivery approach to reduce internal handling in order to reduce the impact of spills and spoilage. In this case, JIT offers the advantage of both environmental and business

benefits. For certain commodity-type chemicals, AMD utilizes the traditional approach of bulk deliveries that reduce the handling cost throughout the supply chain and consequently reduce the potential for accidents or spills. However, the trade-off with bulk deliveries is that the handling of larger quantities could result in larger spills in the case of an accident. In many cases, AMD has collaborated with its suppliers to design automatic storage and handling facilities with improved environmental, health, and safety features for these chemicals (Trowbridge, 2001).

The most recent literature to date about environmental management and operations that I have seen are Issues 2 and 3, Volume 10, Fall 2001 of *Production and Operations Management*. Many of the articles in these two issues are GSCM-oriented.

4. State of SCM Competency and Development Priority

Houlihan wrote about SCM in 1985. Around 1997 when I joined TLAPS, I found that the retail trade had already begun their SCM efforts for some time and those efforts lead to the formation of ECR Thailand. In fact, the ECR movement has probably made their group most competent in SCM knowledge. It was not until 2001 that Thai academics really began to pay attention, largely through the crusade-like leadership of Krizz Chantjiraporn of EAN Thailand Institute, the Federation of Thai Industries. The APEC SME 2001 Conference on Strategic Alliances for Efficient Supply Chain Management, lead by TLAPS and EAN, marked an important milestone in our learning about SCM. *And the real journey has just begun for Thailand.*

For the ECR community, many SCM initiatives have already been made. The use of EDI in Thailand began around 1997-8 as well. For example, Thai Customs began EDI implementation in 1998 for exports and in 1999 for imports. Many retailers and consumer goods manufacturers began to use EDI around that time as well, along with the internet boom. Note, however, that EDI is a proven technology that has been used for more than 20 years elsewhere. More documentation about ECR best practices such as VMI, CPFR, 3PL, 4PL, Cross-docking, SC Benchmarking, SCOR, etc. need to be made for Thailand.

As far as I know, one large Japanese *automobile manufacturer* gave up on using EDI in favor of ordinary flat-file transfer. But to the Japanese, SCM is a mere extension of JIT, and we all know who has mastered that concept first. Still, I think there is much to learn about SCM for us. I think the automobile industry has a lot of knowledge about good SCM practices, largely through foreign manufacturers in Thailand. They should also take the responsibility and initiatives to offer their know-how's..

While the ECR movement has also improved domestic agricultural supply chains, *international supply chain research issues for this sector should carry one of the highest priorities* because we are a major food exporter to the world. Emphasis should be for exports and designing good logistics and supply chain management infrastructures.

The pressure is on for the *Thai Garment and Textile industries to adopt the Quick Response (QR) concept*. Note that the QR notion also connotes the Quick Response Manufacturing (QRM) idea of Suri (1998). The apparel export industry began to adopt EDI around 2001. This group still has a long way to go in terms of creating efficient and responsive supply chains and there are genuine risks of losing out in the world markets because of price pressures from China and cheaper labor countries. *High priority attention should be given to this group and practical research solutions in this area will be needed to raise its competitiveness.*

There are SCM movements and awareness in the health care industry, which is a good sign. The 30-baht public health program can benefit much from knowledge about the *Efficient Healthcare Consumer Response (EHCR)*. We can expect hot research and discussion in this area in the months and years ahead. See Kanet and Cannon (2000) for an EHCR implementation idea.

In my opinion, *our electronics industry is very vulnerable to global SCM* and research into the strategies to reduce costs, to adopt B2B standard such as the Rosettanet initiative, should be explored. This may help attract much needed overseas investments as well. Research studies into the idea of “mass customization” as well as supply chain product and process design should be encouraged.

In short, just about all industries in Thailand are paying attention to SCM. I believe we should create repositories of SCM knowledge for Thailand through professional associations such as TLAPS and the research consortium. Research funding should be given to build up SCM research competency and to join with international research communities. Strategies to achieve research goals for Thailand should be identified. Websites and journals that are useful to SCM research should be identified and shared among consortium members. Foundations in Thailand that can support research funding in SCM should be identified. *Key concepts about SCM can be taught in grade schools and high schools to build up knowledge about efficiency and value chain management.* That is one challenge that researchers can take on to design lessons for future generations of efficient workers. I believe, to a certain degree, SCM is a lot of common sense but the old habits must be broken first.

5. Final Remarks

In their paper, Wu et al. (2002, p.13) wrote about University-Industry Research Collaboration. It is interesting to analyze the different points of view regarding the role of Academia in Manufacturing Logistics Research. I would like to offer my personal point of view for Thai researchers and industrial people. Since most Academia in Thailand are beginning to direct their energy to supply chain management research, it is in the best interest of Thai industries themselves to collaborate with the academia. Some points of view mentioned in Wu et al. (2002) are as follows.

1. *The role of academia should be to study fundamental principles.* I believe this role clearly belongs to academia so that insights can be explained to industry. As an example, the bullwhip effect insights can be explained by the famous beer game. It is also important for academia to be careful about offering solution methods *without* sound application of manufacturing or supply chain principles.
2. *The role of academia should be to provide intuition and document best practices.* Just like elsewhere in the world, Thai faculty members often offer consulting services to industry without knowing best practices. It is important for academic groups and industry people in Thailand to combine forces to document and share best practice solutions (Chantjiraporn, 2002). Publications and presentations at professional society conferences and seminars are most effective and should be encouraged by industry executives as well as university administrators. Since it is typical for most company executives in industry to want to keep the know-how that are not even trade-secrets to themselves rather

- than sharing them with others, the research challenge is – can this behavior be changed given some incentive mechanism and what would that mechanism be?
3. *Academia should place more emphasis on empirical work.* Unlike some OR/MS journals, which tend to publish complex SCM models with high level of abstraction that may be of interest only to academics, we can avoid such practice. *Instead, we should encourage Thai researchers to publish sound empirical research works, much like the Journal of Operations Management, a bi-monthly publication of the E&R Foundation of the American Production and Inventory Control Society (APICS).* See, for example, Frohlich and Westbrook (2001). Or we can opt for more application-oriented research such as those that appear in the Interfaces journal published by INFORMS (<http://www.informs.org>.) Such an approach could prove more useful to industries in Thailand.
 4. *Academia should articulate the roles of models and research efforts in industrial settings.* The use of modeling in Thai industrial settings is still very light compared to developed countries. The current use of simulation software or mathematical modeling in industrial settings is rare and often confined to pure academic research. This state of affair should change with time because such software are reaching a larger mass. Over the last ten years, apart from ERP system implementation, which in itself is a model of how the company's business processes work, I have witnessed a substantial rise in the industry's awareness of the power of finite-capacity scheduling and advanced planning and scheduling software. The knowledge and experience industrial people gained from modeling their manufacturing activities will lead to more confidence in model building via other tools such as simulation and mathematical programming. Because technology is advancing rapidly, routine solving of large supply chain design and execution problems can be done with ease. However, research into improving implementation processes or doing mass implementation effectively will be needed, especially when dealing with SMEs.

Sirirangkamanont (2002) advocates that Thai manufacturers must attempt to improve their internal supply chains first by using appropriate supply chain knowledge. Larger corporations should take the lead and assist lower-tier members of their supply chains because this is where the capability gap will be widest. In addition, the burden of supply chain costs should not be borne by or transferred to lower-tiers alone. Hence, innovative approaches must be found to close the gap. He also suggests that we keep a watchful eye on practices from other Asian countries such as Taiwan and Korea that may have similarities in supply chain practices with Thailand. As far as international issues are concerned, he suggests that we examine issues that have surfaced during the APEC SME 2001 Conference in Bangkok.

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the symposium. Any view expressed in this paper is solely the author's and does not reflect the views of any organization that the author is affiliated with.

References

- Arntzen, B.C., G.G. Brown, T.P. Harrison, and L.L. Trafton (1995), "Global Supply Chain Management at Digital Equipment Corporation," *Interfaces*, 25, 69-93.
- Bowersox, D.J., D.J. Closs, and M.B. Cooper, M.B. (2002), *Supply Chain Logistical Management*, McGraw-Hill/Irwin., Singapore.
- Breitman, R.L., and J.M. Lucas (1987), "PLANETS: A Modeling System for Business Planning," *Interfaces*, 17, 94-106.
- Camm, J.D., T.E. Chorman, F.A. Dill, J.R. Evans, D.J. Sweeney, and G.W. Wegryn (1997), "Blending OR/MS, Judgment, and GIS: Restructuring P&G's Supply Chain," *Interfaces*, 27:1 (Jan-Feb), 128-142.
- Chantjiraporn, K. (2002), Executive Certificate Program in Supply Chain Management Course Notes, SCM Consultant Ltd., Bangkok.
- Cheung, W., L.C. Leung, and Y.M. Wong (2001), "Strategic Service Network Design for DHL Hong Kong," *Interfaces*, 31:4, 1-21.
- Cohen, M.A., and H.L. Lee (1989), "Resource Deployment Analysis of Global Manufacturing and Distribution Networks," *Journal of Manufacturing and Operations Management*, 2, 81-104.
- Cohen, M.A., and S. Mallik (1997), "Global Supply Chain: Research and Applications," *Production and Operations Management*, 6:3, 193-210.
- Fisher, M.L. (1997), "What Is the Right Supply Chain for Your Product?," *Harvard Business Review*, (March-April), 105-116.
- Fine, C. (1998), *Clockspeed – Winning Industry Control in the Age of Temporary Advantage*, Perseus Books, Reading, MA.
- Frohlich, M.T., and R. Westbrook (2001), "Arcs of Integration: An International Study of Supply Chain Strategies," *Journal of Operations Management*, 19:2, (Feb), 185-200.
- Ganeshan, R., E. Jack, M.J. Magazine, and P. Stephens (1999), "A Taxonomic Review of Supply Chain Management Research," in *Quantitative Models for Supply Chain Management*, S. Tayur, R. Ganeshan, and M. Magazine (eds), Kluwer Academic Publishers, 839-879.
- Gates, W.H., III (1999), *Business @ the Speed of Thought - using a Digital Network System*, Warner Books, Inc.
- Hensen, W., "The Impact of Microsoft.NET on the ERP Market," Intuitive Manufacturing Systems, Inc., 2001.
- Hopp, W.J., and M.L. Spearman (1996), *Factory Physics – Foundations of Manufacturing Management*, Irwin/McGraw-Hill.
- Houlihan, J.B. (1985), "International Supply Chain Management," *International Journal of Physical Distribution & Materials Management*, 15, 22-38.
- ITV Nightly News Report, October 15, 2002.
- Kanet, J.J., and A.R. Cannon (2000), "Implementing Supply Chain Management," *Production and Inventory Management Journal*, 42 (2nd Qtr), 33-40.
- Lee, H.L., C. Billington, and B. Carter (1993), "Hewlett-Packard Gains Control of Inventory and Service through Design for Localization," *Interfaces*, 23:4, 1-11.
- Lee, H.L., and C. Billington (1995), "The Evolution of Supply-Chain-Management Models and Practice at Hewlett-Packard," *Interfaces*, 25:5, 42-63.
- Lyon, P., R.J. Milne, R. Orzell, and R. Rice (2001), "Matching Assets with Demand in Supply Chain Management at IBM Microelectronics," *Interfaces*, 31:1, 108-133.

- Mabert, V.A., A. Soni, and M.A. Venkataramanan (2001), "Enterprise Resource Planning: Measuring Value," *Production and Inventory Management Journal*, 42 (3rd/4th Qtr), 46-51.
- McAfee, A. (2002), "The Impact of Enterprise Information Technology Adoption on Operational Performance: An Empirical Investigation," *Production and Operations Management*, 11:1, 33-53.
- McKay, K., M. Pinedo, and S. Weber S. (2002), "Practice-Focused Research Issues for Scheduling Systems," *Production and Operations Management*, 11:2, 249-258.
- Mulani, N.P., and H. Lee (2002), "New Business Models for Supply Chain Excellence," *The ASCET Project*, 4, 14-18.
- Portugal, V., and D.J. Robb (2000), "Production Scheduling Theory: Just Where Is It Applicable?," *Interfaces*, 30:6 (Nov-Dec), 64-76.
- Schwartz, J. (2001), "Business Volatility Bred by Internet?," *Bangkok Post*, April 7, p.9.
- Simchi-Levi, D., P. Kaminsky, and E. Simchi-Levi (2000), *Design and Managing the Supply Chain – Concepts, Strategies, and Case Studies*, Irwin McGraw-Hill.
- Shapiro, J. (2001), *Modeling the Supply Chain*, Duxbury/Wadsworth Group, Pacific Grove, CA.
- Shinawatra, Thaksin (2001), "The Importance of Improving SME Value Chains," *Proceedings of the APEC SME 2001 Conference on Strategic Alliances for Efficient Supply Chain Management*, Bangkok (August 1-2), 10-15.
- Sirirangkamanont, S. (2002), Private Communication.
- Sopadaeng, A. (2002), Thai VCML Researcher's Consortium Symposium, Nov 2.
- Stevens, G.C. (1989), "Integrating the Supply Chain," *International Journal of Physical Distribution & Materials Management*, 19, 3-8.
- Suri, Rajan (1998), *Quick Response Manufacturing*, Productivity Press, Portland, OR.
- Trowbridge, P. (2001), "A Case Study of Green Supply-Chain Management at Advanced Micro Devices," *Greener Management International*, 35 (Autumn), 121-135.
- Womack, J.P., and D.T. Jones (2000), "From Lean Production to Lean Enterprises," in *Harvard Business Review on Managing the Value Chain*, Harvard Business School Publishing, Boston, MA., 221-250.
- Wu, S.D, R.O. Roundy, R.H. Storer, and L.A. Martin-Vega. (2002), "Manufacturing Logistics Research: Taxonomy and Directions," Working Paper in pdf file.