Preface

INFORMATION TECHNOLOGIES, METHODS, AND TECHNIQUES OF SUPPLY CHAIN MANAGEMENT

The Use of Information Technology in Supply Chain Management

Section one consists of four chapters. Chapter 1 entitled "Enterprise Applications for Supply Chain Management" is written by Susan A. Sherer. Coordination of information to effectively operate and manage a supply chain can be a source of competitive advantage today. In order to gather, utilize, and effectively share information, companies continue to invest in information technology, acquiring and integrating many different types of enterprise applications. The foundation of most enterprise information infrastructures today is the enterprise resource planning system (ERP) which has greatly reduced the number of applications required to track and share information across cross functional business processes. However, many companies supplement basic ERP systems with legacy, custom, and best of breed applications to optimize supply chain execution and management.

These systems not only help run and manage the business, but support collaboration among supply chain partners. In addition to systems that primarily support traditional supply chain processes such as source, plan, make, deliver, and return, businesses must integrate information from systems that manage supporting processes such as design and engineering and customer focused applications. Applications such as business intelligence, and productivity, communication, and collaboration tools, must also be part of an enterprise information infrastructure for supply chain management. Without integrating these applications, effective analysis and information sharing cannot be achieved.

Most previous research has focused on subsets of a complete information systems infrastructure, for example, supply chain planning or customer relationship management or logistics or business intelligence systems. The main contribution of this chapter is that it brings together in a single framework all the various applications that are required to build an enterprise information infrastructure for supply chain management. The chapter organizes and describes all the different applications that make up an information infrastructure for supply chain management including ERP; e-procurement, supplier relationship management, and B2B marketplaces; advanced planning and optimization, and collaborative planning, forecasting, and replenishment; computer aided manufacturing; content providers of freight ratings, import/export compliance, and environmental health and safety; manufacturing integration and intelligence; vendor managed inventory systems; warehouse and transportation management systems, and transportation exchanges; reverse logistics tracking and management; computer aided design and collaborative product development and product lifecycle management; customer relationship manage-

ment; content management, productivity tools; and business intelligence. Chapter 1 includes examples of the use of the different types of applications. And it provides an overview of the different applications to assist in understanding the scope of applications needed to develop a complete information systems infrastructure for competitive supply chain management capabilities.

In Chapter 2, Debendra Mahalik and Gokulananda Patel explore "Information Technology Implementation Prioritization in Supply Chain: An Integrated Multi Criteria Decision Making Approach". In today's competitive business environment information technology (IT) is the key enabler for business survival and success. The role of IT has undergone a sea change from data accusation and processing to the function which supports and drives each components of business. Companies implementing Supply Chain Management (SCM) are looking for more responsiveness, greater flexibility, better supplier relations and improved customer satisfaction, which can be achieved through efficient IT implementation. Application of IT in different process of supply chain as an important and essential ingredient has already been felt by academic researchers as well as practitioners, resulting in concepts like Information Technology enabled SCM (ITeSCM). The real challenge lies in finding a way for the IT implementation in real situation, as SCM has number of process starting from supplier to the end customer through various stages. Some of the strategies taken for IT implementation in SCM have shown results which are more failure or partial successes in nature. The reasons may be many; some of them are implementation in one go, quick implementation, non availability of clear rules etc. Over a period practitioner are adopting a component approach for a success in implementation. In this approach also they are in a dilemma in selection of component in the whole Supply Chain for IT implementation. As the decision of component is a complex due to presence of multi criteria decision making and solving it in a traditional way does not always give better results. This calls for a better and more scientific approach.

Mahalik and Patel consider five components viz. Materials Management, Purchase Management, Production Management, Logistics & Distribution function and Customer interface for prioritization of computerization in SCM. These five components are considered as five alternatives before the company. The study is carried out in a company which is largest manufacturer of aluminum in India having fourteen plants and ten offices spread across the country. The study first identifies fifteen parameters viz. Process Improvement, Speed, Easy, Reliable, Productivity, Information availability, Accurate, Focus on core work, Resources utilization, Secure, Uniform Standard, Cost, Transparency, Corporate image and Environment through literature review as reasons to go for computerization in SCM. A structured questionnaire is prepared based on these fifteen variables and data is collected from the executives of the company. The collected data are subjected to factor analysis and three factors according to the importance like primary attributes, secondary attributes and tertiary attributes are identified.

It is found that there are five primary reasons for IT implementation in supply chain. The five primary reasons identified are Process Improvement, Speed, Easy, Reliable and Productivity. These five identified variables are considered as the criterion for evaluating the five alternatives before the company. Analytic Hierarchy Process (AHP) which deals with complex systems for a choice among several alternatives is used to find weights of criteria and alternatives. The weights so calculated are used as an input to for TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) analysis. TOPSIS is a very effective method in multi attribute decision analysis. It uses normalized matrix to find the superior project and inferior project (that is ideal solution and non-ideal solution), then calculates the distances of other projects from the ideal and the non-ideal solution. Then the relative closeness to the ideal solution is calculated. The relative closeness can be ranked in descending order. The relative closeness can be put in the range of 0-1, if it is close to 1, evaluating projects is said to be closer to the ideal. The alternatives

are ranked on the basis of value of closeness coefficient which is calculated for each alternative. According to the closeness coefficient, the ranking order of five alternatives is found to be - first computerize the materials management department followed by computerization of customer interface. The other departments as per the order for computerization shall be purchase, logistics and production department respectively. The management of any similar type of company can use the procedure for their IT implementation prioritization. The novelty of the chapter lies in integration of AHP and TOPSIS method for IT implementation prioritization.

In Chapter 3, Rebecca Angeles's survey study planned radio frequency identification (RFID) implementation by member firms of the Council of Supply Chain Management Professionals (CSCMP) focuses on the moderating role of information technology (IT) infrastructure integration and supply chain process integration between absorptive capacity attributes and two deployment outcomes --- operational efficiency and market knowledge creation. Applying the moderated regression data analysis method, the key finding of this study is that of the two proposed moderator variables, supply chain process integration more strongly moderates the relationship between three key absorptive capacity attributes that turned out to be significant --- business process modularity, standard electronic business interfaces, and breath of information exchanged and the two outcome variables, operational efficiency and market knowledge creation.

Use of standard electronic business interfaces for RFID brings several benefits. First, firms could develop a well-defined, robust, and tested RFID solution that has been tried and tested in the real world. Second, firms could avoid the costs of lengthy development efforts and vendor lock-in through the use off-the-shelf RFID software solutions that conform to strict specifications for solution components. Third, firms can use RFID software solutions that are compatible with a wide range of related software systems. The most recognizable standards are mentioned here. EPCglobal has developed standards for designing, implementing, and adoption electronic product code (EPC) and the EPCglobal Network, which specifies RFID specifications for supply chain operations. There is also the Electronic Product Code Information Service (EPCIS), which is a specification for a standard interface for accessing EPC-related information such as unique serial numbers that allow firms to track objects and collect real-time data about them.

Modularity of business processes is key to managing complexity and flexibility in global supply chains. This is crucial in today's digital marketplace where there is a need to integrate related business processes executed in a loosely coupled environment where messages are exchanged among supply chain trading partners across diverse IT platforms. Models are needed with business process modules that represent important supply chain workflows, rules, practices, and exception handling in a flexible manner.

The use of both standard electronic business interfaces and RFID business process modules is important in generating data of greater breadth than what is provided by routine transactional events. An important goal is to support RFID-generated intelligence that can deliver actionable data that decision makers can use for critical issues such as inventory levels, stock locations, delivery rates, missing or stolen products, etc. In addition to these operational data, though, customer-centric information that can be gathered from an RFID-enabled retail outlet, for instance, that addresses questions like --- "What are the store behaviors of my customers?" "What are they looking at in the store?" "What are they bringing to the fitting rooms?" "What sells and what doesn't sell?" "Which products convert to actual sales?" --- have the potential to extend market knowledge and support higher-level intelligence-based decisions.

This study is only one in a series of RFID research projects the author has conducted which feature the following topic areas: (1) "Effects of Reciprocal Investments and Relational Interaction in Deploying RFID Supply Chain Systems"; (2) "Moderated Regression: Effects of IT Infrastructure Integration

and Supply Chain Process Integration on The Relationships Between RFID Critical Success Factors and System Deployment Outcomes"; and (3) "Moderated Regression: Effects of IT Infrastructure Integration and Supply Chain Process Integration on the Relationships between RFID Adoption Attributes and System Deployment Outcomes."

George Kenyon and Brian D. Neureuther make "A Comparison of Information Technology Usage across Supply Chains: A Comparison of the U.S. Beef Industry and the U.S. Food Industry" in Chapter 4. Cattle ranching have long held a nostalgic value in the America consciousness; it also has significant health and monetary value as part of the U.S. food supply. Historically, the growth of the beef industry has been hampered by the various entities (breeders, cow-calf producers, stockers, backgrounders, processors, etc...) within the beef industry's supply chain. Traditionally, the participants of the U.S. beef industry have been very independent of each other; making communication and coordination efforts difficult. Unfortunately, over the last several decades, this independence and the economics of the marketplace has made it increasingly harder for ranchers to make a profit. One of the primary obstacles to growth and profitability in the beef industry is the large number of participants in the upstream side of the supply chain. Another obstacle is the lack of coordination between participants in the beef industry's supply chain.

Since the mid-1980's, significant advances have been made in information and communication technologies. These advances have enabled supply chain members to improve their ability to transfer information and to coordinate activities. In many industries the benefits of this improved capability has resulted in improved profitability. Many new companies have been founded to promote these technical advances in the beef industry; but have the profitability of ranching and processing operations in the beef industry improved?

Kenyon and Neureuther's research used data collected by a survey to analyze the performance of food processes and food manufacturing plants in the US to determine the degree to which information technologies are being utilized and the degree to which these new technologies have driven performance improvements in the beef industry's supply chain. Though there is significant usage of information technologies in the downstream portion of the food manufacturing supply chains, there has not been any significant improvement in plant performance. The usage of online technologies by upstream participants in the beef industry's supply chain has also failed to make any significant impact to the profitability of ranches. These findings raise serious concerns for the future of beef production in the United States. If the United States wants to continue being able to food its population and avoid becoming dependent upon foreign food sources, greater awareness of the infrastructural requirements of our agricultural supply chains needs to occur.

Supply Chain Collaboration

Section two consists of five chapters. In Chapter 5, Mickey Howard, Richard Vidgen and Philip Powell discover "Strategies for E-Procurement: Auto Industry Hubs Re-Examined". While the wild expectations for business-to-business electronic marketplaces or 'e-hubs' have subsided, they continue to elicit interest in industries such as car production. Technology exists to create electronic marketplaces - 'one stop' procurement and product development hubs - but a key barrier to their development is collaboration amongst a critical mass of industry players. Howard, Vidgen, and Powell re-examine the received wisdom of the transition from supply chain to electronic hub. The initial proliferation of e-hubs by manufacturers and component suppliers is explained by long-term e-commerce developments by some

firms, countervailing power exercised by suppliers concerned over their lack of representation and the desire to develop core competence in electronic markets.

The research confirms that a consortium-based approach is adopted if price and control are the prime motivations. If supply chain management, supplier development and product innovation is of greater importance, then a private-based e-hub is adopted. In the auto industry, the introduction of e-commerce resulted in a mess of overlapping networks. This was a shallow structure, lacking in supplier integration and resembles an ad-hoc arrangement of spokes rather than a singular hub design. While suppliers worried over complexity in information exchange of using electronic media, an inter-firm system was introduced that combined a transactional approach for reducing price with a collaborative product development approach that required sharing organizational knowledge. The apparent strategies in the industry were not long-term. Manufacturers and suppliers cannot sustain a system characterized by duplicated services, multiple standards and restrictions on membership.

The chapter develops a framework that examines the benefits and barriers to firms joining e-hubs, applies the framework to the car industry, and proposes an e-procurement matrix that offers alternative strategies. Six cases from vehicle manufacturers and component suppliers demonstrate organizations were taken in by simplistic, technology-driven models professing to enhance competitive and co-operative capability. In moving from bespoke supply chain to electronic hub, this research found multiple barriers to information sharing, overlapping networks competing for membership, and isolated pockets of collaboration. This transitory phase involved conflict in motivation between price, collaboration and membership exclusivity, which prevented e-hubs from becoming fully integrated and the industry realizing full benefit from electronic markets. An e-Procurement strategy matrix highlights the difficulties of implementing e-market strategies that attempt to reconcile the mutually exclusive nature of buyer-supplier relationships: price versus collaboration, and inclusive versus exclusive hub membership.

If management commitment is the most critical success factor for information integration, what then if there is no management level? In Chapter 6, Stefan Henningsson and Jonas Hedman from Copenhagen Business School make an interesting exploration into why many industries are not optimally integrated in their information flows. Experiences from enterprise-wide integration initiatives during more than four decades indicate that industry-wide information integration could render substantial benefits for the industry as a whole. Yet, many industries' supply chains are only marginally integrated across individual actors.

The authors find two fundamental ways in which industry-wide integration differs from enterprise-wide integration: there is no common management level, and the economic units in the integration are the constituent units, not the industry. Management involvement has been emphasized as perhaps the most critical success factor for enterprise-wide information integration. The common economic unit enables increased costs in one part of the organization to lower the total cost in the company as a whole.

In the search to understand how these two particularities affect the industry-wide information integration, Henningsson and Hedman do in-depth investigations of the consequences in four agrifood industries, based on milk, sugar, pea, and pork production. They find that: Information integration was dominated by supply chain captains, dominant companies in the middle to the supply chain that controlled the integration agenda. Information integration that would have been desirable by other actors was hardly ever implemented. To the extent other actors information integration needs were met it was due to legislation or other governmental demand. Asynchronous costs and savings due to perceived or real difference in backward and forward integration worked hampering on the industry-wide integration. As long as the complete chain is within one economic unit this is not an issue, but as companies

exists at different places their benefits are not equal and if possible the unbeneficial contest integration. One way information integration was used to ensure availability of key resources and as lock on less powerful actors in the supply chain.

The authors make the eye-opening conclusion that the fundamental differences in the structure of the unit to be integrated, make traditional methods for enterprise-wide information integration, such as BPR, virtually impossible to apply on industry-wide information integration and that the disjoint economic responsibility forms a severe challenge in reaching potential benefits of industry-wide information integration.

Kenneth Saban and John Mawhinney provide a unique view of an ever growing business concern among SCM in Chapter 7 - "The Strategic Role of Human Collaboration in Supply Chain Management". The willingness and ability of the people that comprise the human capital of business organizations to collaborate within and between enterprises is proving to be the next frontier of competitiveness. Many have looked upon this challenge as one focused on the need for more and better technology, yet while technology and systems tools continue to develop at warp speeds, collaboration within and between businesses is slowly progressing. This research uncovers six factors that facilitate human collaboration and provides the foundation for the premise that it is the human element that drives collaborative technology and processes.

The relationships of these factors are depicted in the human collaboration model which provides clarity and logic to each component. The model establishes the framework for the four step managerial enhancement methodology to create a collaborative environment within an enterprise. While it has long been understood that internal collaboration is the first building block to inter-enterprise supply chain collaboration, this work confirms the critical factors that must be addressed to establish a human collaboration culture.

This work establishes the importance of the human element in the collaboration model, identifies the critical factors of a successful collaborative environment, and provides logical process for addressing these issues. The authors have bridged the divide between theoretical research and practical application in this innovative work.

In Chapter 8, Frank Wolf and Lee Pickler present "Supply Chain Dispute Resolution: A Delphi Study". Wolf and Pickler noticed that conflict resolution in the field of SCM is different from conflict resolution in other areas of business conflict. In a supply chain, there is a pressing need for swift settlement of disputes in order to preserve the larger good of members along the chain. Even less formal forums like mediation and arbitration can be too slow and too costly to be of practical value. Just as business bankruptcies are in many cases preventable, supply chain conflict may be preventable by knowing where to look. The business relationship suffers dearly if the conflict resolution process becomes too legal. With the average supply chain having four tiers, any dispute between any two levels calls for direct settlement between the parties. Only when the nature of the dispute affects all parties, will the supply chain anchor step in to preserve the greater good.

The subject of supply chain dispute resolution is not well developed, yet enormously important. Nature itself provides many reasons for supply interruptions. The prevention of man-made supply chain failures is a productive research endeavor, and the purpose of this work. Preventive measures include frequent communication between parties, coordination, supply chain re-design and cultural awareness, information technology and freed back. The Delphi Method requires multiple interactions with the same survey participants, plus feedback at each iteration. Getting participants to sit still that long can test their patience, unless the feedback is quick and benefits the parties. Their recommendation is to speed up the

process in order to not lose survey members. In this study the members were executives in aerospace, food marketing, defense and materials, import-export.

Supply chain managers should pay close attention to the needs of each participant and orchestrate what are typically 4 levels/tier chains, into a well functioning whole, supported by Information Technology and frequent contact between the parties. Disputes must be settled rapidly and on the spot if possible. Common dispute issues are the day-to-day payments, quality, and pricing of products and services. For issues like accidental patent infringement for example, New York law applies worldwide, as it does to most commerce. Arbitration and mediation, voluntary or contractually mandated are alternative methods for settlement. Governmental help is not usually wanted by the parties. United Nations trade harmonizing efforts like UNCITRAL are not well known.

Chapter 9 entitled "Fair Distribution of Efficiency Gains in Supply Networks from a Cooperative Game Theory Point of View" is written by Stephan Zelewski and Malte L. Peters. One principal aim of supply network management is to realize efficiency gains by coordinating the activities of all actors in a supply network. When efficiency gains are realized in supply networks, a distribution problem arises. The cooperating actors know that they are realizing efficiency gains by mutually coordinating their activities. Each actor is interested in maximizing his own gain probably even at the expense of the other actors in the supply network. Therefore, supply networks suffer from a built-in conflict between cooperation and defection. The problem lies in distributing efficiency gains among the actors in a manner that the actors will accept as fair and thus find it advantageous to cooperate with each other.

The contribution presents a solution concept involving τ-value from cooperative game theory for the problem of distributing efficiency gains in supply networks that aims at distributing efficiency gains in a fair manner. The first main contribution of the work is that the proposed method determines a unique solution of the distribution problem. This unique solution is a recommendation for allocating the efficiency gain among the actors of a supply network in a fair manner. The second main contribution is that the proposed method ensures that the distribution results can be communicated easily. The distribution results are obtained by successively restricting the solution space. This successive procedure facilitates the communication of the distribution results. This is a major advantage over other solution approaches for distribution problems from cooperative game theory. These are the SHAPLEY value and the Nucleolus. These solution approaches suffer from a serious drawback: The fairness of the distribution results is hard to justify, since the 'logic' of these approaches is difficult to communicate. The third main contribution is that the application of the proposed method prevents a supply network from collapsing, since the actors accept the distribution results as fair and thus they remain in the supply network.

Over the past several years, a lot of research has been done on finding ways of realizing efficiency gains by coordinating the activities of all actors in a supply network. However, the problem of how to distribute the realized efficiency gains among the actors in a manner that the actors will accept as fair has been neglected in the specialized literature. Therefore, it has been important to fill this scientific gap. However, the readers should bear in mind that up to now there is no well tried software implementation of the proposed method available.

Other main contributions in this research area have been developed in two directions. On the one hand, the concept of the τ-value has been covered extensively in a monograph and has been developed further to cope with incredible threats as well as with insignificant actors; see Zelewski, S. (2009). *Fair distribution of efficiency gains in supply webs: a game theoretic approach based on the τ-value* (in German). Berlin: Logos. On the other hand, a generalized version of the τ-value, the χ-value, has also been applied on the problem of distributing efficiency gains; see Jene, S., & Zelewski, S. (2011).

Fair Distribution of Profit in Supply Chains. In W. Kersten, T. Blecker, & C. Jahn (Eds.), *International Supply Chain Management and Collaboration Practices* (pp. 299-313), Lohmar et al.: Eul. Jene, S., & Zelewski, S. (2011). Distributive Justice in Supply Chains – Fair Distribution of Collectively Earned Profits in Supply Chains. In E. Sucky, B. Asdecker, A. Dobhan, S. Haas, & J. Wiese (Eds.), *Logistics Management* (in German), Vol. III (pp. 115-132), Bamberg: University of Bamberg Press.

Production Planning and Inventory Management

Section three has four chapters. In Chapter 10, "Dynamic Price and Quantity Postponement Strategies", Yohanes Kristianto examined why the price and quantity postponement affect oppositely over the supply chain profit and recommend ways of using those two postponement strategies. The research draws attention to the fact that in mass customized manufacturing, the choices of contract type are important to maximize the profit, depending on the product commonality. The dynamic behavior analysis in this chapter helps decision makers to decide their long term postponement policy with regard to their manufacturing types, namely make-to-stock or make-to-order. The analysis results also support both modularity and customization principles in mass customized products, where decision uncertainty can be reduced by making closer customer order decoupling, point to sales point.

Chapter 10 suggests that product developers design common platform products and decide the price according to customer specific requirements. A practical evidence of the proposed model comes from an example of airline pricing strategy retained its market share by postponing the ticket price just after the demands are observed. Further investigations reveal that this market share is also retained by increasing the commonality amongst products which regards the part interchangeability as a main ingredient of product substitutability.

It is recommended: Price postponement is superior to production postponement at many respects. This type of contract guarantees profit stability and at the same time supports the product standardization effort. Price postponement is also a dominant strategy for substitutable products. This conclusion is at odds with the previous literatures on price and production postponements. This discrepancy is caused by the previous literatures perhaps assuming that in Bertrand price-like competition, the quantity setting will avoid both firms having to reduce their production quantity further. On the contrary, this chapter assumes sticky prices and quantities, where it pushes both firms to cooperate at higher levels. By sticky prices and quantities, this chapter is more appropriate for common platform based products instead of two widely differentiated products. Production quantity postponement (make-to-order) is a dominant strategy for highly differentiable products. This conclusion supports the previous literatures, who discuss postponement strategies differentiation according to their applicability.

In Chapter 11, Seong-Hyun Nam, Hisashi Kurata, John Vitton and Jaesun Park show "Determining Optimal Price and Order Quantity under the Uncertainty in Demand and Supplier's Wholesale Price". In the turbulent business environment of today, it is critical for manufacturers in a high-tech durable product industry to understand how to make operational decisions in the presence of unexpected or unknown variables associated with product demand and supplier's wholesale price. Nam et. al. proposed in their chapter a very useful and practical optimization model that helps manufacturers deal with such production related uncertainties. The model developed in Chapter 11 focuses on how the manufacturer should reflect those uncertainties in their pricing and order quantity policy in order to achieve its desirable profit. In the process of modeling, the authors integrated two major variables of forecasting error associated with demand uncertainty and risk incurred from unpredictable changes in supplier's wholesale

price. They also showed the stochastic steps to reach optimal decisions on price and order quantity based on the different levels of coordination between a manufacturer and its supplier.

Chapter 11 contains two important managerial implications. First, they found that there may be significant performance improvements of manufacturers from creating a collaborative work relationship with their suppliers. If the use of a coordination mechanism mitigates the uncertainties associated with product demand and supplier's wholesale price, then manufacturers may be able to have increased power to make the right operational decisions. Although high levels of coordination require an investment cost, an important advantage of the close interaction with suppliers may be the manufacturer's superior decision-making capability. Second, the findings of the model enable manufacturers to formulate their optimal pricing and ordering strategies to handle production related uncertainties. If the optimization policy with a quality coordination mechanism can lead to improved operational performance associated with product availability, then manufacturers may be able to offer better customer service, thus improving sales. Recognizing research with a focus on supply-side uncertainty seems to be limited in the SCM field. This chapter contributes to the understanding of the effect of supplier's wholesale price uncertainty on a manufacturer's operational decisions.

Ibrahim Al Kattan and Taha Al Khudairi perform a "Simulation of Inventory Control System in a Supply Chain Using RFID" in Chapter 12. Most companies using SCM are interested in new technologies such as RFID application to track information of assets and its utilization, reducing inventory and labour cost. The cost and the payback period of RFID implementation are one of the most important factors facing any company in adopting this technology. Recently, the cost RFID implementation became more acceptable and has shown significant benefits in cost saving and service enhancement. However, the lack of transparency of costs/benefits, data collision represents some of challenges for RFID.

Chapter 6 does examine the impact on customer service, as expressed in terms of the number of lost customer and its impact on the company's market. This is actually an area that is likely to be of interest to companies seeking an RFID solution. This research used simulation model to compare the saving of labor cost during scanning operations, reduction in inventory cost and loss of customer's good-will. Two scenarios with and without use of RFID were developed using computer simulation modeling to evaluate supply chain system to assess the benefit of RFID. These two models were tested using RFID technology and the current barcode used by ABC Company. Subsequently, several comparisons have been accomplished by measuring both the total inventory cost and customer satisfaction for the entire supply chain storages for both systems.

A quantitative analysis based on a simulation model used to compare two scenarios through the entire inventory systems and customer service for ABC Company. The installation and unit cost of RFID implementation were estimated and considered to be the main barrier. The model can offer the policy-makers insight into how RFID might improve SCM system performance. The RFID risk and challenges are in technology, Return on Investment (ROI), privacy/security and implementation. The models make possible for company consider moving from a barcode system to the RFID application. The application showed the RFID solutions face similar problems as they would with adoption of other technology solutions, including general corporate fear of change and unclear implementation costs and processes. Users should also expect to maintain dual systems and processes (existing and new RFID systems) for several years to work out issues and wait for supply chain partner participation.

In Chapter 13, N. Anbazhagan and B. Vigneshwaran demonstrate a "Two-Commodity Markovian Inventory System with Set of Reorders". With the fast expansion of activities in Business and Industrial sectors, many inventory systems are increasingly found to operate with more than single commodity.

These systems unlike those dealing with single commodity, involve more complexities in the reordering procedures. In the modeling of such systems, initially models were proposed with independently established reorder points. But in situations where several products share the same transport facility or are procured from the same source, the above method overlooks potential savings associated with joint ordering and hence may not be optimal. This motivated the researchers to build a multi commodity especially two commodity inventory models. In this aspect the authors developed two commodity inventory control system with coordinated and joint ordering policies.

Recently the authors developed a model for associated commodities like products like specific blood group and its accessories for transfusion of blood, computer and table, television and holding stand. The challenge of managing a production/inventory system in the presence of random demand and lead time has inspired a considerable amount of research effort in recent years. Marketing of consumable goods which has high obsolete rate is a challenging task that has to be dealt carefully. Incentive for bulk purchase of prime commodity together with associated gift article is one strategy to boost sale volume at the same time to avoid the risk of getting obsolete state. This motivated the researchers to build inventory models dealing with two items in stock, of which one is regular with stochastic demand and the other one is a gift item supplied to a customer for the bulk purchase of the regular item. The bulk order scheme is actually equivalent to price break for bulk purchase, but it differs from classical price break models because in their model, the sales promotion for gift article is taken into account.

The significance of modeling such stochastic systems can be directly attributed to the severity of their potential negative effort on operating costs and customer service measures in modern manufacturing and business environments. Previously, Anbazhagan and Vigneshwaran assumed a model with a joint ordering policy which places orders for both commodities whenever the total net inventory level drops to a prefixed level. The demand points for each commodity form independent Poisson processes and the lead time is distributed as negative exponential. Unit demand for both commodities is assumed for efficient use of transaction reporting system control. Here the authors have extended the above model by assuming the set of reorder levels with prescribed probability distribution for reordering. This is a more realistic model in which the vendor or manager has the freedom to reorder the required quantity with probabilistic stint of the random environment. The author has received Young Scientist Award (2004) from DST, New Delhi, India, Young Scientist Fellowship (2005) from TNSCST, Chennai, India and Career Award for Young Teachers (2005) from AICTE, India. He has successfully completed one research project, funded by DST, India.

Logistics

Section four has three chapters. In Chapter 14, Reza Farzipoor Saen takes "A New Look at Selecting Third-Party Reverse Logistics Providers". Many companies have realized that their core competencies are not in the logistics-field, and have progressively sought to buy logistics services and functions from third-party reverse logistics (3PL) providers. The 3PL providers play a role in helping organizations in closing the loop for products. Traditionally, reverse logistics is an activity within organizations delegated to the customer service function, where customers with warranted or defective products would return them to their supplier. The outsourcing of non-core processes and activities makes it possible to focus on core manufacturing activities, while, at the same time, 3PL providers have specific logistics core competences, and they can manage logistics processes more efficiently than their customers.

The use of Data Envelopment Analysis (DEA) in many fields is based on total flexibility of the weights. However, the problem of allowing total flexibility of the weights is that the values of the weights obtained by solving the unrestricted DEA program are often in contradiction to prior views or additional available information. Also, many applications of DEA assume complete discretionary of decision making criteria. However, they do not assume the conditions that some factors are nondiscretionary. To select the most efficient 3PL provider in the conditions that both weight restrictions and nondiscretionary factors are present, a methodology in the context of DEA is introduced.

Chapter 14 is the first attempt that discusses 3PL provider selection in the presence of both weight restrictions and nondiscretionary factors. The contributions of the chapter are as follows: The proposed model does not demand exact weights from the decision maker. In traditional models of 3PL provider selection, the weights are allocated in a crisp value, while in the proposed model; weights are defined in an interval. It is clear that interval definition of the weights for the decision maker is easier than the crisp weight assignment. The proposed model considers nondiscretionary factors for 3PL provider selection. The proposed model considers weight restrictions for 3PL provider selection. Weights restrictions and nondiscretionary factors are considered simultaneously. A numerical example demonstrates the application of the proposed method.

In Chapter 15, Bjørnar Aas and Stein W. Wallace concentrate on "Management of Logistics Planning". We are all living in a world where information availability is steadily increasing. At the same time, our capability to solve complex problems is increasing more or less at the same pace. This is at least true when we look at the big picture. However, snapshots at a micro level usually show a significant bias in one or the other direction. In a business setting, such a bias typically represents waste of resources, low customer service levels, lost business opportunities and so on. Companies, departments or employees fail to utilize existing information, or the necessary information is lacking.

The general understanding and acceptance of this reality description is not a topic of much discussion, but when addressing specific problems, for instance at a task-level, to obtain an objective conclusion is very often extremely difficult. The analysis would typically be complicated by a lack of data to establish a good picture of the present situation. To make it worse, this is very often accompanied by the presence of a number of more or less well-qualified subjective interpretations of the situation. Further, the problem that is addressed is usually interacting with several other problems with their corresponding, often contradicting, goals, unclear priorities and so on.

Aas and Wallace's experience from working with industry for many years is that the situation described is present in many different facets within all industries and companies. However, for this chapter, experiences and examples from logistics in the Norwegian oil & gas industry have provided the authors with much empirical evidence. In Chapter 15, the particular challenges of logistics management are addressed by exploring how logistics planning should be managed in order to be as efficient as possible. This is done by establishing the availability of information and problem-solving capability as the core parts of logistics planning. Thereafter, a conceptual model for the management of logistics planning is proposed and discussed.

With this research, the authors have managed to successfully establish an innovative conceptual contribution within the field of logistic management which would be extremely useful, particular at operational level. Notwithstanding, the contributed knowledge of this chapter has also been proven to be an excellent contribution when teaching logistics.

In Chapter 16, Duangpun Kritchanchai, Albert Wee Kwan Tan and Peter Hosie make "An Empirical Investigation of Third Party Logistics Providers in Thailand: Barriers, Motivation and Usage of Infor-

mation Technologies". The authors observed that Third Party Logistics (3PL) in Asia has emerged as an important trend in logistical management. In particular, 3PL in developing countries continue to develop rapidly and gain importance. While a great deal has been written about the usage of information technology (IT) in general, there is still a lack of research specifically in the field of small and medium size 3PLs. In particular, there have been few empirical investigations into the use of IT in relation to 3PLs in Asia. The authors of this chapter have conducted an empirical study designed to investigate the profiles of 3PLs in Thailand and their company strategies for providing logistics service and their use of IT.

Their research has provided a good overview of 3PL companies in Thailand, mainly SME and their markets and IT implementation status. The majority of companies surveyed have implemented the basic IT systems but in order to compete with the larger companies and they will need to consider investing more in this area as well as in IT manpower. These companies according to the authors should develop an IT system that is flexible and able to accommodate legacy data, Internet and related web-based services logistics information systems. Web-based information will help to reduce communications barriers such as complex logistics operational systems.

According to the authors, 3PL companies in Thailand and other developing countries receive little support for training and education. Government support is needed to train and educate employees for these smaller logistics companies. In addition, educating the customers on how to use the logistics information system will certainly help to improve customer satisfaction.

Having conducted the survey in Singapore and Thailand, the authors have replicated the surveys in Malaysia, United Arab Emirates (UAE) and Finland so that comparison can be made among the countries involved. The results gathered from these surveys are largely similar in terms of barriers and motivation. The findings are published in journal papers subsequently.

Supply Chain Monitoring and Performance Management

Section five has four chapters. In Chapter 17, Dimitris Folinas and Ioannis Manikas conduct "Design and Development of an e-Platform for Supporting Liquid Food Supply Chain Monitoring and Traceability". Developing a traceability system is a very challenging and demanding effort. Such a system must be able to file and communicate information regarding product quality and origin, and consumer safety. Moreover, it must integrate a number of functionalities / features. The main features of such a system include adequate filtering and extracting of information from available databases and harmonization with international codification standards, Internet standards and up to date technologies. But first of all, it requires the existence of a conceptual framework, a model that fulfills all the above features.

The development of such a model requires the identification and analysis of each stage of the supply chain for each one of the product categories under study, from farm to fork, including all factors that affect quality, such as packaging materials, agrochemicals, antibiotics, fertilizers, climate, soil etc. It also requires the modeling of the main entities of the proposed framework in order to design and develop the web-platform in a reliable and effective manner. In this study, the authors develop a reference model and a respective web platform for traceability management for liquid food by establishing and modeling these basic concepts and features. The proposed web platform aims to support efficiently food traceability by monitoring and administering the data gathered from the various production and logistics processes along the supply chain.

Another critical aspect for the development of any information system is also its testing in real life cases. Thus the lessons learned for the implementation of the proposed web platform in a particular dairy

production line in Greece is also presented and analyzed. Synoptically, the following outcomes were emerged by the above application; industrial stakeholders - especially production and quality assurance managers - noticed that the main benefits derived from implementing the developed traceability management system were: user friendliness, since it required more business than technical background by the users, pragmatic identification of traceability requirements, and risk reduction. Moreover, the system functionality was based on data already available from databases that support HACCP and ISO standards, while data communication tools (RFID, EPC) are based in EAN-UCC standards. Data processing uses XML technologies and information filtering is achieved by implementing the six elements model (PML) presented and analyzed above. On the other hand, users with technical background observed that the main feature of the proposed platform is the simplicity in use and the ability of communicating information through commonly accessible means such as the Internet, e-mail, and cell phones.

Chapter 18 entitled "A Composite Method to Compare Countries to Ascertain Supply Chain Success: Case of USA and India" is written by Mark Gershon and Jagadeesh Rajashekharaiah. The operation of the global supply chain contributes to the success or failure of all multinational corporations. Most analysis assumes that the structure of that supply chain, its locations and facilities, are in place. But the bigger issue is one of design. In which countries should the main supply chain facilities be located?

To answer this question, this chapter provides a methodology for comparing the required infrastructures, both physical and political, of countries prior to making the location decision. India and the United States are the two countries used in the chapter to demonstrate the approach. Three methods are provided and applied to the example countries. These are the Global Comparative Index (GCI), the Analytical Hierarchy Process (AHP) and Data Envelopment Analysis (DEA).

For each country, supply chains are assessed regarding the contribution that they make to improving business processes, return on investment, and the functionality of the entire supply chain. The first major contribution is the set of metrics that define success, factors to consider in evaluating the supply chain. Both quantitative and qualitative measures are used, with the quantitative measures divided into financial and non-financial measures. The composite method provided is a multi-level approach that combines the three methodologies. The goal is to begin at the global level, and finally refine the analysis to the level of the firm. At the highest level, it uses the GCI to decide about the suitability of the country for establishing a supply chain. Next, AHP allows the decision makers to compare partnering countries using pair wise comparisons. Finally, DEA is used to create a series of inputs and outputs for the comparison of each country.

The application showed the USA to be ranked higher than India. This was due to its advantages in infrastructure, and a weighting of the factors to emphasize the importance of infrastructure. India ranked close to the USA because of its large and highly skilled workforce. The DEA helped to identify key areas for improvement. For example, India needs to improve both reliability and capacity to pass out the USA. The main result is not any conclusive opinion about any particular countries. Instead, it is the methodology for making such comparisons.

In Chapter 19, Firat Kart, Louise E. Moser, and P. M. Melliar-Smith display "An Automated Supply Chain Management System and Its Performance Evaluation". The world of commerce is moving rapidly towards global just-in-time manufacturing and build-to-order products. These business processes reduce inventory carrying costs, but can increase logistic and administrative costs. Manufacturers must be able to respond quickly to requests for quotations, and must be able to negotiate prices, availability, and delivery times with their potential suppliers. Even so, their supply chains might be disrupted unexpectedly,

such as by earthquakes in Japan or by floods in Thailand. Human negotiators are too slow, and are too costly because of the highly variable workloads.

SCM involves information flow, product flow, and financial flow. This chapter describes MIDAS, an automated SCM system based on the Service Oriented Architecture that focuses on information flow in the supply chain. At each manufacturer, MIDAS maintains a database of the components and materials required for each product. MIDAS also maintains globally a registry of suppliers. A manufacturer can consult the registry to discover potential suppliers of components or materials, and to discover alternative suppliers. This information can be regarded as a virtual inventory that replaces the traditional physical inventory. MIDAS contacts several potential suppliers to obtain quotations for the prices, availability, and delivery times of a product, and also for packaging, transportation, storage, finance and insurance, before selecting a supplier and placing an order.

The processing of an order from a customer involves two phases, a Waiting phase in which the order can be aggregated with orders from other customers, and a Quotes phase in which quotations are obtained from alternative suppliers for the components and materials required to fill the order. MIDAS is based on the premise that it is the customers' satisfaction that counts. The durations of the Waiting phase and the Quotes phase are investigated to balance order completion time and to obtain the best quotation.

There are many challenges to be faced in establishing an automated SCM system, particularly in agreeing on a standard and in securing its widespread adoption. MIDAS represents a first step in that process, of great interest to those who will design the standard, and also to those awaiting the widespread availability of an automated SCM system.

In Chapter 20, Reza Saen and Mark Gershon describe "Supplier Selection by the Pair of AR-NF-IDEA Models". In a world where companies are trying to reduce the number of suppliers in their supply chains, the problem of how to select the optimal set of those suppliers to be included is an important one. That is the problem addressed in this chapter. A methodology for ranking suppliers is developed and demonstrated. The supplier selection problem is a multi-criteria decision problem. For this type of problem, DEA is a useful approach to measure how well each potential supplier performs on the multiple criteria relative to other suppliers in the same market. Using this approach, it is possible to evaluate each supplier's performance relative to the best suppliers in the market, using the DEA efficiency measures.

This issue is one that has been addressed previously in many forms, including the use of DEA. However, previous models have relied on the availability of cardinal data. But a complete set of cardinal data is not available in most situations. The IDEA (Imprecise DEA) approach described here allows for a combination of cardinal and ordinal data to be used. Previous models have also assumed that the selection criteria are chosen by management and in this way are discretionary and in the control of management. But there are often non-discretionary measures as well, ones that are outside the control of management. The approach presented handles both sets of criteria.

Their model is a pair of AR-NF-IDEA models. It yields a final efficiency score for each Decision Making Unit characterized by an interval. After describing the use of virtual weight restrictions, the chapter describes how to find the virtual assurance regions. These provide the bounds of the interval. A numerical example is provided next, using 18 suppliers to be ranked. Three criteria are used: total cost, distance and supplier reputation, the three most commonly used factors for a problem of this type. The resulting efficiency intervals are provided for all eighteen suppliers as well as a list of peer group suppliers for each.

The main contributions of the chapter are as follows:

- The inclusion of nondiscretionary factors
- The ability to treat weight restrictions
- The ability to use imprecise data
- The expansion of the criteria considered to go well beyond using only cost
- Demonstration that the approach is computationally efficient for practical use

Additional applications could be used for ranking in other situations. Examples include project selection in project portfolio design or in Six Sigma applications.

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