15th International Research/Expert Conference
"Trends in the Development of Machinery and Associated Technology"
TMT 2011, Prague, Czech Republic, 12-18 September 2011

A COMPREHENSIVE ANALYSIS FOR THE METRICS OF SUPPLY CHAIN DESIGN STRATEGIES

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ABSTRACT
Supply chain management is turning the world of business on edge, figuratively and literally. This study aims to reveal the relationship among key performance indicators of a supply chain. As supply chain management is the integration of key business processes from consumers through suppliers, which provides products, services, and information that add value for customers and other stakeholders; its success relies on the precision designed supply chain.
This research explores the strategies for design and performance measurement of different supply chain types based on fuzzy entropy approach. Main purpose of the proposed approach is to present a structured framework analyzing the market winning criteria and market qualifying criteria on the five types of supply chains in a fuzzy environment, based on entropy approach embedded into fuzzy analytic hierarchy process.
Keywords: Fuzzy Sets, Supply chain design, Fuzzy Analytic Hierarchy Process, Entropy

1. INTRODUCTION
Supply chain management has emerged as one of the major areas for companies to gain a competitive edge. Managing supply chains effectively is a complex and challenging task, due to the current business trends of expanding product variety, short product life cycle, increasing outsourcing, globalization of businesses, and continuous advances in information technology [8]. The key issues underlying a success story of a supply chain management are coordination, cooperation, configuration and contract concepts which are directly included in supply chain design framework.

Underlying reasons of varied SC design are uncertainties in demand and supply, product type and design, process design of firms. These issues characterize the design of supply chain and/or the process of selection of a supply chain design. Demand uncertainty is linked to the predictability of the demand for the product. Functional products are ones that have long product life cycles and therefore stable demand, while innovative products are products that have short life cycles with high innovation and fashion contents—and which, as a result, have highly unpredictable demand [8]. Therefore, the design strategy of the chain naturally varies depending on the product type, whether it is an innovative product or a functional product.

There are many studies including supply chain design in the literature [2,3,6,7,9,10]. There are three main problem areas in supply chain management: Location Selection, Inventory Optimization, and

Network Design, and there are both strategic and operational elements in each of these decision areas [4]. Location selection is the geographic placement of production facilities, stocking points, and sourcing points that is the natural first step in creating a supply chain. Managing inventory is controlling stock levels within the physical distribution function to balance the need for product availability against the need for minimizing the costs related to inventory. Supply chain network design strives to update the geographical distribution of suppliers, plants, warehouses and customers by analyzing updated information on cost of labor, taxes, transportation costs and production capacity, so the company should actively evaluate the cost benefit of certain geographical sites regarding all potential savings.

2. THE PERFORMANCE OF SUPPLY CHAINS

Supply chain covers all the linkages of services or goods extending from suppliers, to the company itself, and on to customers and to meet business goals it strives to enrich its management methods to facilitate coordination and cooperation. Hill [5] introduced the concepts of order winners, the criteria make company win the order, and order qualifiers, the criteria gain company such competitiveness. In achieving competitiveness, he distinguished between different classes of factor that influence a company's ability to success. Those factors that cause the company to beat the competition in obtaining orders are referred as order winners; those for which company has to meet certain acceptable standard to be considered by the market as competitors are referred to as order qualifiers; other factors are less significant in creating competitiveness. If selling price is the driver in the market, the objective should be reducing the cost without reducing the quality of service level or increasing lead time; then this goes for a lean supply chain, centralize as much production and inventory as possible, keep inventory generic and maximize reach. On the other side, if service level or availability is the driver in the market place, then this must be increased without reducing quality or increasing cost or lead time; then this goes for an agile supply chain for which service level is the order winner.

Table 1 Comparison of 5 Types of Supply Chain (inspired by Agarwal et al., 2006)

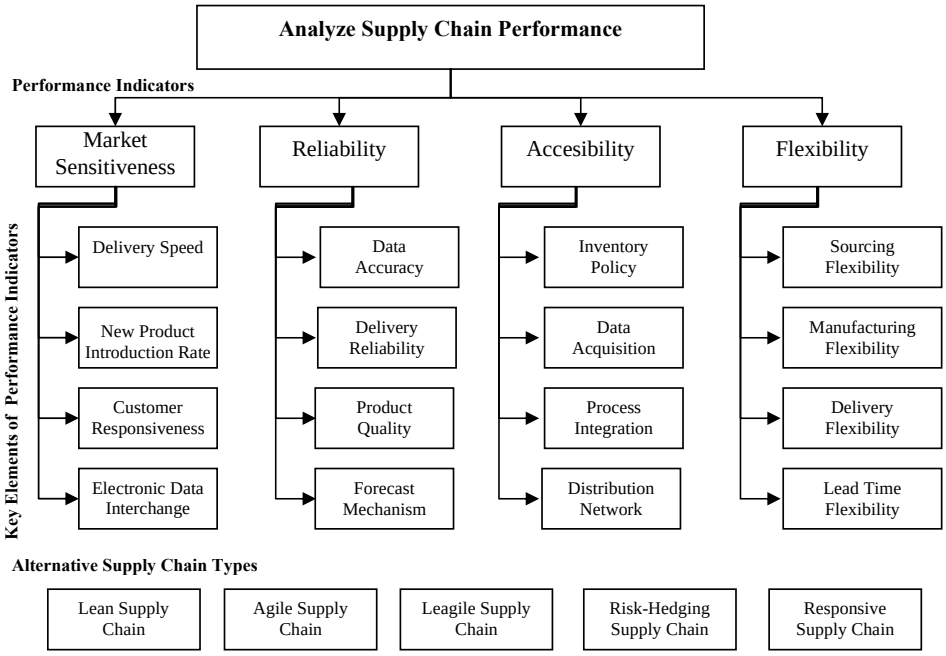
Attributes	Lean supply chain	Agile supply chain	Le-agile Supply Chain	Risk-Hedging Supply Chain	Responsive Supply Chain
Market Demand	Predictable	Volatile	Volatile & Unpredictable	Volatile	Predictable
Customer Drivers	Cost	Lead time and Availability	Service Level	Lead Time and Cost	Quality & Availability
Purchasing Policy	Buy Goods	Assign Capacity	VMI	VMI	Assign Capacity
Quality	MQ	MQ	MQ	MQ	MQ
Cost	MW	MQ	MW	MW	MQ
Lead Time	MQ	MQ	MQ	MQ	MQ
Service Level	MQ	MW	MW	MW	MW

*MQ stands for Market Qualifier, MW stands for Market Winner

The performance of supply chain management and supply management professionals is commonly measured in terms of amount of money saved for the organization and will be saved for the organization. This means its success mostly depends on its responsiveness, flexibility and reliability characteristics concurrently with decreasing costs.

3. HIERARCHICAL FRAMEWORK FOR SC PERFORMANCE EVALUATION

The hierarchical decision making problem to assess the performance of is illustrated in Figure 1.

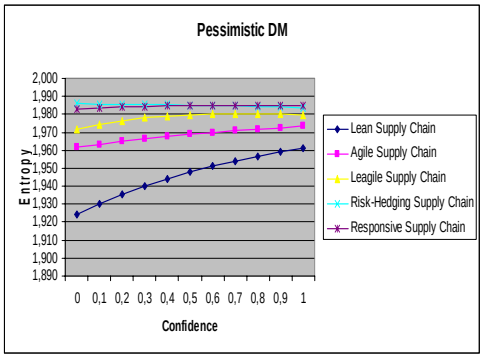


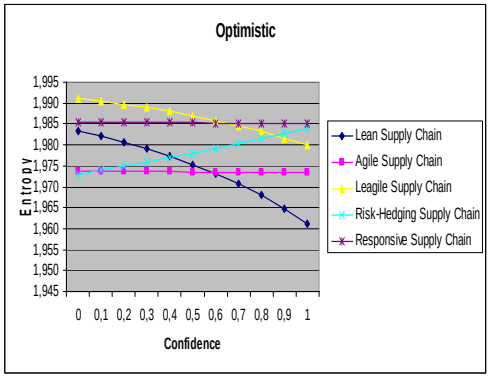
4. ENTROPY BASED FUZZY AHP

Evaluation procedure of entropy based fuzzy AHP is summarized as follows: firstly, the hierarchy structure for problem is constructed. Secondly, Evaluations for importance weights and performance levels are collected. Third step includes utilizing entropy based fuzzy AHP method. After calculations, the interval arithmetic and optimism index is applied. Lastly entropy concept is utilized to calculate aggregate scores to rank the alternatives for the best performance.

5. CASE STUDY

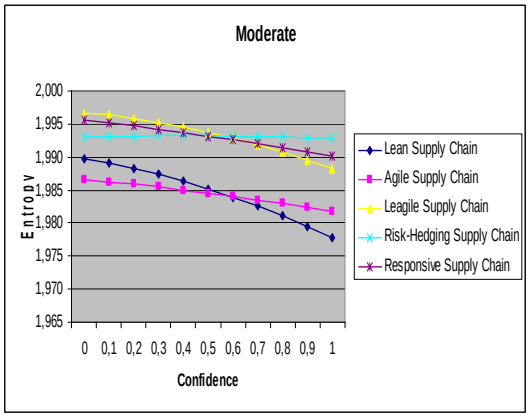
In this study, we collected experts' thoughts from ceramic sanitary materials sector, that one of its core competencies is its supply chain's design. All criteria in the same hierarchy are evaluated in comparison matrix that is conducted nine-point scale.





We explored the design strategies and performance measures of different type of supply chains. Under pessimistic conditions, while confidence level increases lean supply chain's entropy value gets higher values. Contrary to this, under moderate and optimistic conditions; this supply chain strategy's entropy value decreases as confidence level decreases. Adopting lean supply chain is a valuable and applicable

strategy under uncertain conditions; however under certain conditions decision makers start to avoid the lean strategy. For an optimistic decision maker, until 0.6 confidence level leagile supply chain is accepted as the best strategy. After this confidence level, the decision maker's choice shifts to responsive supply chain. A similar situation occurs for moderate decision; leagile supply chain is an acceptable strategy until 0.5 confidence level for moderate decision maker. After this confidence level, decision maker's choice shifts to risk hedging supply chain.



For ceramic sector, according to three kinds of decision maker behaviors, agile supply chain and lean supply chain are not preferable strategies in any conditions. In Turkey, from quality and cost perspectives, companies must perform extremely well because of the market's characteristics and excessive supply. High-level profit increases the number of firms and the competitiveness. At the point of considering that ceramic sector's most important customer is construction sector, on-time delivery has vital importance emanating from the project based structure of the construction business. Therefore, construction firms especially give full weight to service level criterion and perceive as a key indicator.

6. CONCLUSIONS

When supply chain types are examined, risk hedging supply chain and responsive supply chain performs best in the meaning of service level and cost. Numerical results confirm that risk-hedging supply chain strategy and responsive supply chain strategy are acceptable and appropriate for Turkish ceramic firms.

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