Choosing Supply Chain Competitive Strategy based on a MCDM Model (A case study in Iran)

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***Abstract-*A key feature of present day business is the idea that it is the supply chains not companies, that competes, and the success or failure of supply chain is ultimately determined by the end consumer in the marketplace. Most of the companies realize that in order to evolve an efficient and effective supply chain, supply chain management needs to be assessed by its performance. Thus, this paper seeks to provide a performance comparative evaluation and choice of lean, agile and leagile supply chain strategy by using a combined approach of analytic network process and decision-making trial and evaluation laboratory techniques. Through this combined approach, the number of pair wise comparison matrixes and calculation volume decreases, leading to an increase in the calculation speed, which makes the approach easier to understand. The results also indicate that agile strategy is the most appropriate strategy.**

Keywords- Lean Supply Chain Strategy; Agile Supply Chain Strategy; Leagile Supply Chain Strategy; Multiple Criteria Decision Making (MCDM); Iran

I. INTRODUCTION

In the present day, as for business, it is the supply chain (SC) not companies, which competes, and the success or failure of supply chain is ultimately determined by the end consumer in the marketplace. Getting the right product, at the right time for the consumer is not only the linchpin for competitive success, but also the key to survival. Hence, customer satisfaction and market place understanding are critical elements for consideration when attempting to establish a new SC strategy [1]. The key and famous strategies of SC in industry and business areas are lean, agile and leagile strategies. Leanness in a supply chain maximizes profits through cost reduction while agility maximizes profit through providing exactly what the customer requires. The leagile supply chain enables the upstream part of the chain to be cost-effective and the downstream part to achieve high service levels in a volatile marketplace [2].

More importantly, the effective SC largely begins with a proper SC strategy. Hence, in order to implement the SC successfully, there is a critical issue of how companies can better evaluate and select a favorable SC strategy. However, the SC strategy selection usually involves subjective and qualitative judgment. The treatment of SC strategy selection is required to handle several complex factors in a more sensible and logical manner. Thus, the SC strategy selection is a kind of multiple criteria decision-making (MCDM) problem, and requires MCDM methods to solve the problem appropriately. Thus, this paper proposes an effective solution based on a combined analytic network process (ANP), Decision Making Trial and Evaluation Laboratory (DEMATEL) approach to help companies that need to select a favorable SC strategy, i.e. lean, agile and leagile. Also, an empirical study is presented to illustrate the application of the proposed method.

The present paper tries to present a framework for comparative evaluation of lean, agile and leagile supply chain strategies on the basis of interdependent variables, and by using experts' opinion in a case company.

II. LEAN, AGILE AND LEAGILE SUPPLY CHAIN

The term, "supply chain", is used to describe the flow of goods from the very first process encountered in the production of a product right through the final sale to the end consumer [3]. Two of the most widely recognized supply chain management philosophies having emerged are lean thinking and agile thinking. Lean thinking is associated with the concepts of total quality management (TQM), just-in-time (JIT) manufacturing and vendor managed inventory. Agile thinking is associated with flexible manufacturing and mass customization [4]. In 1980, lean thinking attracted a great deal of interest in the business environment and after that, in 1990, agile manufacturing emerged as a new strategy for companies. The former was a reaction to old production strategies, which resulted in too much waste and unsatisfactory quality, while the latter was a response to changing customer demand [5, 6]. Some earlier researchers think that agile and lean strategies are same [7], while some others suggest that agility is the next step after leanness, that is when lean principles are implemented in a system, then agility is the best to be achieved [5, 6]. In other word, they argue that agile manufacturing is an improvement over lean concepts [7]. Nevertheless, being extremely agile may increase the cost of regular operations and reduce the leanness of the system. Similarly, being extremely lean may reduce flexibility and lower the agility level. Therefore, a manufacturing system should be agile enough to handle the uncertainty of demands and meanwhile be lean enough to deliver goods at competitive prices and lead time [7]. Moreover, what is considered waste in a lean environment may be essential in an agile environment [8]. For example, an excess inventory of raw materials might help to satisfy a market opportunity in an agile environment, whereas a lean system would trim the inventory as much as possible [9]. Leanness focuses on the reduction and elimination of waste and doing more with less [2, 10, 5, 6], i.e. fewer inventories, less space, less money, less time to deliver products and works efficiently [11]. As Naylor, Naim and Berry [12] have argued "Leanness means developing a value stream to eliminate all waste, including time, and to ensure a level schedule." It also relates to concepts such as total quality management, equipment management and preventive maintenance, pull system and JIT. In fact, it is a collection of practices working together synergistically to create a streamlined and high-quality system that produces finished products at the pace of customer demand with little or no waste [13]. Agility is defined as the ability of an organization to respond rapidly to changes in demand, both in terms of volume and variety [10]. Naylor, Naim and Berry [12], go further in stating that: "Agility means using markets knowledge and a virtual corporation to exploit profitable opportunities in a volatile marketplace". Agility is holistic rather than functional, and of strategic rather than tactical importance [14, 15] and a business-wide capability [24, 31], that embraces organizational structures, information systems, logistics processes and, in particular, mindsets.

A new concept arising in recent years in the area of supply chain management is that leagility, and the advantages of leanness and agility are combined [12]: *Leagility is the combination of the lean and agile paradigm within a total supply chain strategy by positioning the decoupling point so as to best suit the need for responding to a volatile demand downstream yet providing level scheduling upstream from the decoupling point.* A central notion in the strategy of leagility is the supply chain decoupling point, which separates the lean process from the agile process in the supply chain. On the downstream side of the decoupling point is a highly variable demand with a large variety of products and all products are pulled by the end-user, that is, they are market driven, whereas upstream from the decoupling point, the demand is smoothed with the variety reduced and it is initially forecast driven. The lean paradigm can, therefore, be applied to the supply chain upstream of the decoupling point as the demand is smooth and standard products flow through a number of value streams. Thereafter the agile paradigm should be applied downstream from the decoupling point as demand is variable and the product variety per value stream has increased [18, 12, and 16]. The decoupling point is also the point at which strategic stock is held as a buffer between fluctuating customer orders and/or product variety and smooth production output [18, 12]. Its position changes depending on the variability in demand and product mix. An increase in product mix and fluctuating volume would force the decoupling point to move upstream, making the supply chain system more agile. A more stable business environment with reduced variability in demand or product mix would move the decoupling point downstream, making the supply chain system leaner [9]. Related to the concept of the decoupling point is postponement. Postponement is the delaying of operational activities in a system until customer orders are received rather than completing activities in advance and then waiting for orders [17]. The aim of postponement is to increase the efficiency of the supply chain by moving product differentiation (at the decoupling point) closer to the end user. Postponing the decoupling point reduces the risk of being out of stock for long periods at the retailer and of holding too much stock of products that are not required [18, 12]. Table 1 briefly shows the literature reviewed so far on lean, agile and leagile supply chain strategies.

TABLE 1 BRIEF REVIEW OF LEAN, AGILE AND LEAGILE SUPPLY CHAIN STRATEGIES

Author (s)	Year	Title	Findings
Perez et al.	2010	Development of lean supply chains: a case study of the Catalan pork sector	The article shows the structure of the specific chain in the Catalan pork sector is suitable to implement lean supply chain strategies according to the presented model [19].
Rahimnia & Moghadasian	2010	Supply chain leagility in professional services: how to apply decoupling point concept in healthcare delivery system	The specific condition of the patients forces the hospital to be highly agile and at the same time, it can benefit from lean strategies. By grouping healthcare services into three pipelines, it identifies decoupling points for the supply chain [5].
Rahimnia et al.	2009	Benchmarking leagility in mass services The case of a fast food restaurant chains in Iran	Despite the low customization in mass services, fast food restaurants have faced changing needs of the customers. To respond to these demands, the case study organization can adopt new strategies so that it could serve the customer with short lead times, low costs and high variety [6].
Wee & Wu	2009	Lean supply chain and its effect on product cost and quality: a case study on Ford Motor Company	Using the value stream mapping (VSM) case study how to demonstrate lean supply chain, all the measurable indices are helpful for cost reduction, quality enhancement and lead time reduction are shown [20].
Kisperska-Moron & Swierczek	2009	The agile capabilities of Polish companies in the supply chain: An empirical study	Relationships with business partners, IT technology and relations with competitors are four main factors contributing to the agility of companies and their respective supply chains [21].
B anomyong et al.	2008	Implementing leagility in reverse logistics channels	With the application of the leagile concept in the reverse logistics process, lead-time for product repairs and returns, as well as costs involved in reverse logistics, have been drastically reduced while customer satisfaction has increased significantly [22].

Swafford et al.	2008	Achieving supply chain agility through IT integration and flexibility	Results from this study indicate that IT integration enables a firm to tap its supply chain flexibility which in turn results in higher supply chain agility and ultimately higher competitive business performance [23].
Krishnamurthy & Yauch	2007	Leagile manufacturing: a proposed corporate infrastructure	It is possible for a corporation to simultaneously pursue both lean and agile manufacturing strategies by adopting a leagile infrastructure. There is a decoupling point that separates the lean and agile portions of the enterprise [9].
Agarwal et al.	2006	Modeling the metrics of lean, agile and leagile supply chain: An ANP-based approach	A framework is presented for modeling metrics of supply chain performance. The paper explores the relationship among lead-time, cost, quality, and service level and the leanness and agility of a case supply chain. The paper concludes with the justification of the framework, which analyses the effect of market winning criteria and market qualifying criteria on the three types of supply chains: lean, agile and leagile [2].

III. METHODOLOGY

The purpose of this study is using a combined approach of ANP and DEMATEL techniques in order to select the best strategy for improving performance of supply chain of a case company. The case company is active in the electronic industry in Iran. A DEMATEL was used to construct interrelations between criteria, whose weights were then obtained through ANP. To collect the research data, we used a questionnaire as well as the interviews with ten experts in the case company. These experts have more than twelve years of experience in the area of purchasing and supply chain management. In order to aggregate their assessments, the geometric mean method was used for the ANP and the arithmetic mean method for the DEMATEL. The questionnaire consisted of two parts. In the first part, pair wise comparisons were performed in order to determine the relative importance of performance metrics. These pair wise comparisons are based on the Saaty's nine-point scale ranging from 1 (equal) to 9 (extreme). In the second part pair, wise comparisons were performed in order to determine the inner dependences between performance metrics.

In order to apply the combined approach of ANP and DEMATEL techniques, this paper proposes five main stages as follows.

Stage1: Model construction and problem structuring. Agarwal, Shankar and Tiwari [2], present a framework for modeling performance of lean (Le), agile (Ag) and leagile (Leg) supply chain on the basis interdependent variables, and then select the best strategy for improving performance of the case supply chain (Figure 1). Leanness, agility and leagility are the three most famous strategies for supply chain. Therefore, we can say that their framework is one of the most comprehensive frameworks for choosing supply chain strategy. Thus, we used their framework for the present study. But there are two differences between our study and Agarwal, Shankar and Tiwari [2]: (1) they study inner dependence only on enablers' level. But additional to that level, we study inner dependence in determinants and dimensions' level. (2) Because they use only ANP technique for solving problem, 117 pair-wise comparison matrixes (69 matrixes for calculating relative weights and 48 matrixes for calculating inner dependence between frameworks' metrics) are required in their study. However, combined approach of ANP and DEMATEL techniques are used in the present study, 78 pair-wise comparison matrixes (69 matrixes for calculating relative weights and 9 matrixes for calculating inner dependence between frameworks' metrics) are required. Therefore, through this combined approach, the number of pair wise comparison matrixes and calculation volume decreases, leading to an increase in the calculation speed, which makes the approach easier to understand.

In Figure 1, cost, quality, service level and lead-time are the major determinants of the proposed framework. These determinants have dominance over the identified dimensions in the framework the dominance can be shown from Market sensitiveness, Process integration, Information driver and Flexibility. Market sensitiveness involves issues related to quick response to real demand [2]. It is characterized by three enablers: delivery speed (DS), new product introduction (NPI) and customer responsiveness (CR). Information driver involves making use of information technology to share data between buyers and suppliers. This enables the supply chain to become demand driven. Electronic Data Interchange (EDI), means of information (MOI), such as Internet, data accuracy (DA), enables supply chain partners to act upon the same data with real time demand. Flexibility is related to adaptability and versatility. It is a measure of reaction capabilities. Source flexibility (SF), Make flexibility (MF) and Delivery flexibility (DF) are the main enablers of flexibility. Process integration (PI) means collaborative working among buyers and suppliers, joint product development, common systems and shared information. Collaboration across each partner's core business processes (CPB), company specific issues on demand side (CDS) such as quality, cost, etc. and company specific issues on supply side (CSS) such as buyer–supplier relations, vendor managed inventory, information sharing, etc. are the main enablers of the process integration. Enablers of the framework assist in achieving the controlling dimension of supply chain performance. There are also relationships between enablers in same cluster (inner dependency) and different clusters (outer dependency). Leanness, agility and leagility are three supply chain strategies, one of which we should select for the case company.

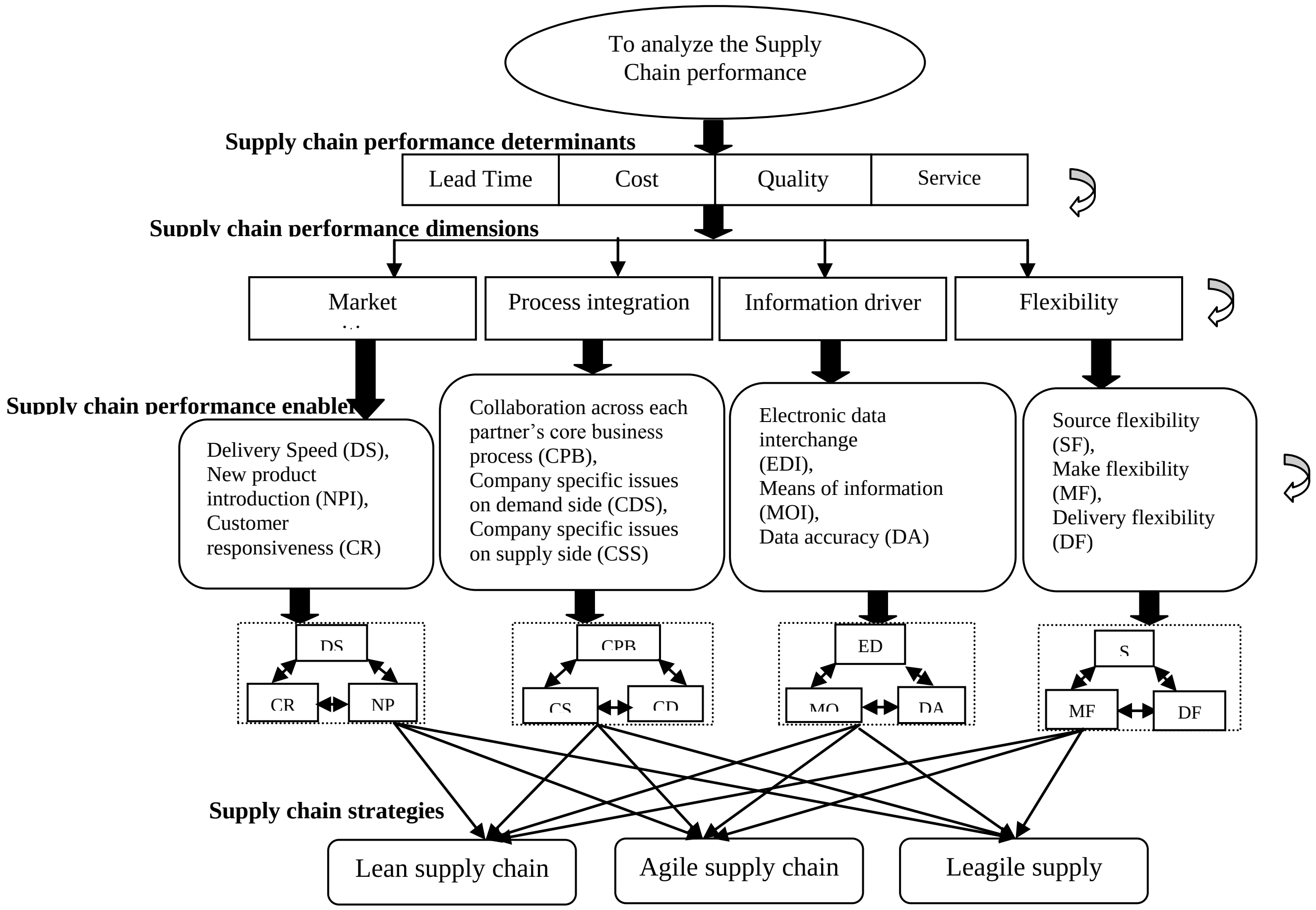

Fig. 1 Framework for Modeling Metrics of Supply Chain Performance [2]

Stage2: Pair-wise comparison matrixes between component/attribute levels:. On a scale of one to nine, the decision-maker has been asked to respond to a series of pair wise comparisons with respect to an upper level control criterion (based on Saaty's method). These are conducted with respect to their relative importance towards the control criterion. Pair wise comparison matrix is used, the relative weight of each determinant (Eigenvector) is obtained (see Table 2). These values have been obtained through experts' opinions that are heading the supply chain operation. Similarly, comparison matrixes for other metrics of framework i.e. dimension, enablers and SC strategies are prepared on the upper level control criterion, and the resultant e-Vectors are imported. In the assessment process, a problem may occur in the consistency of the pair wise comparisons [24]. The consistency ratio provides a numerical assessment of how inconsistent these evaluations might be. If the calculated ratio is less than 0.10, consistency is considered to be satisfactory. The results (Table 2) show the lead time determinant (0.51) is the most important for supply chain performance improvement. The result indicates that the management of the case supply chain should focus on reducing the lead time. This result could be due to the competitive or customer pressure for reducing the lead time. Service level (0.32), quality (0.123) and cost (0.06) play the next most important roles, but they are less important than lead time.

TABLE 2 PAIR-WISE COMPARISON MATRIX FOR THE RELATIVE IMPORTANCE OF THE DETERMINANTS (CONSISTENCY RATIO: 0.0118)

	Cost	**Quality**	**Lead time**	**Service level**	**e-Vector**
Cost	1	0.50	0.125	0.14	0.06
Quality	2	1	0.25	0.33	0.11
Lead time	8	4	1	2	0.51
Service level	7	3	0.50	1	0.32

Stage3: *Calculation inner dependence of performance metrics with DEMATEL technique*. In order to apply the DEMATEL smoothly, this paper refines the version used by Fontela and Gabus [25], and proposes four main steps as follows [26].

Step1: Generating the direct-relation matrix. First, measuring the relationship between criteria requires that the comparison scale be designed as four levels: 0 (no influence), 1 (low influence), 2 (high influence), and 3 (very high influence). Next, experts make sets of the pair wise comparisons in terms of influence and direction between criteria. Then, as the result of these evaluations, the initial data can be obtained as the direct-relation matrix that is a $n \times n$ matrix A, in which aij is denoted as the degree to which the criterion i affects the criterion j.

Step2: Normalizing the direct-relation matrix. On the basis of the direct-relation matrix A, the normalized direct-relation matrix X can be obtained through formulas:

$$X = k.A \tag{1}$$

$$k = \frac{1}{max_{1\le i\le n}\sum_{j=1}^{n} a_{ij}}, \quad i,j = 1,2,\dots,n \tag{2}$$

Step3: Attaining the total-relation matrix. Once the normalized direct-relation matrix X is obtained, the total-relation matrix T can be acquired by using formula (3), in which the I is denoted as the identity matrix

$$T = X(I - X)^{-1} \tag{3}$$

Step 4: Obtaining the inner dependence matrix. In this step, the sum of each column in total-relation matrix is equal to 1 by the normalization method, and then the inner dependence matrix can be acquired.

For example, calculations related to determining of inner dependence of supply chain performance determinants are shown below. After experts' assessments are aggregated, the direct-relation matrix (Table 3) can be obtained; hereby the inner dependence matrix (Table 4) can be acquired.

TABLE 3 THE DIRECT-RELATION MATRIX

	Cost	**Quality**	**Lead time**	**Service level**
Cost	0	2	1	1
Quality	2	0	2	1
Lead time	3	2	0	2
Service level	2	3	1	0

TABLE 4 THE INNER DEPENDENCE MATRIX

	Cost	**Quality**	**Lead time**	**Service level**
Cost	0.156123	0.212747	0.20797	0.206984
Quality	0.248833	0.189436	0.278	0.244375
Lead time	0.324562	0.30297	0.245317	0.336638
Service level	0.270481	0.295028	0.268712	0.212003

Stage4: *Calculation relative weights of strategies under controlling determinants.* After the pair wise comparisons are completed, super matrixes are computed in three steps [24, 27, and 28]. The relative weights of strategies supply chain i.e. lean, agile and leagile under controlling determinants are calculated. In the first step, the initial super matrix is created directly from all local priorities that are derived from pair wise comparisons among elements influencing each other. In other words, in this step, the priority weights and inner dependants of criteria (calculated in previous stages) are entering the appropriate columns of a super matrix. In the second step, the weighted/ stochastic super matrix is calculated. Since there usually is interdependence among clusters in a network, the columns of an initial super matrix usually sum to more than one. The initial super matrix must be transformed first to make it stochastic, that is, each column of the matrix sums to unity. The last step is composition of a limiting super matrix, which is created by raising the weighted super matrix to powers. Raising a matrix to powers gives the long-term relative influences of the elements on each other. To achieve a convergence on the importance weights, the weighted super matrix is raised to the power of$2k + 1$, where k is an arbitrarily large number, and this new matrix is called the limit super matrix [29]. The limit super matrix has the same form as the weighted super matrix, but all the columns of the limit super matrix are the same. By normalizing each block of this super matrix, the final priorities of all the elements in the matrix can be obtained.

For example, limit matrix associated with calculation of relative weights of strategies supply chain, under controlling lead time (LT), is shown in Table 5. In our illustrative example convergence is reached at 21^{st} power.

Stage5: *Selection of best alternative.:* After calculating the relative weights of strategies under controlling each determinant (cost, quality, lead time and service level), we should form super matrix similar to previous stage in order to select the best strategy. Initial super matrix and limit super matrix respectively are shown in Table 6 and Table 7. Limit super matrix is converged at 17^{th} power. The final results are shown in Table 7. Table 7 indicates that for the illustrative problem, the most significant alternative paradigm for better supply chain performance is agile supply chain followed by leagile supply chain.

TABLE5 THE LIMIT SUPER MATRIX UNDER CONTROLLING LEAD TIME

Leadtime	Ms	PI	ID	F	DS	NPI	CR	CPB	CDS	CSS	EDI	MOI	DA	SF	MF	DF	Le	Ag	Leg
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
0.1129	0.1129	0.1129	0.1129	0.1129	0.1129	0.1129	0.1129	0.1129	0.1129	0.1129	0.1129	0.1129	0.1129	0.1129	0.1129	0.1129	1	0	0
0.6092	0.6092	0.6092	0.6092	0.6092	0.6092	0.6092	0.6092	0.6092	0.6092	0.6092	0.6092	0.6092	0.6092	0.6092	0.6092	0.6092	0	1	0
0.2778	0.2778	0.2778	0.2778	0.2778	0.2778	0.2778	0.2778	0.2778	0.2778	0.2778	0.2778	0.2778	0.2778	0.2778	0.2778	0.2778	0	0	1

TABLE 6 THE INITIAL SUPER MATRIX

Goal	Cost	Quality	Lead time	Service	Le	Ag	Leg
0	0	0	0	0	0	0	0
0.06	0.156123	0.212747	0.20797	0.206984	0	0	0
0.11	0.248833	0.189436	0.278	0.244375	0	0	0
0.51	0.324562	0.30279	0.245317	0.336638	0	0	0
0.32	0.270481	0.295028	0.268712	0.212003	0	0	0
0	0.5355	0.4436	0.1129	0.1754	1	0	0
0	0.2134	0.2489	0.6092	0.3114	0	1	0
0	0.2511	0.3075	0.2778	0.5132	0	0	1

TABLE 7 THE LIMIT SUPER MATRIX

Goal	Cost	Quality	Lead time	Service	Le	Ag	Leg
0	0	0	0	0	0	0	0
0.00	0.00	0.00	0.00	0.00	0	0	0
0.00	0.00	0.00	0.00	0.00	0	0	0
0.00	0.00	0.00	0.00	0.00	0	0	0
0.00	0.00	0.00	0.00	0.00	0	0	0
0.2455	0.2455	0.2455	0.2455	0.2455	1	0	0
0.4068	0.4068	0.4068	0.4068	0.4068	0	1	0
0.3476	0.3476	0.3476	0.3476	0.3476	0	0	1

IV. DISCUSSION

Agility is needed in less predictable environments where demand is volatile and the requirement for variety is high [30]. Lean works best in high volume, low variety and predictable environments. Leagility is the combination of the lean and agile paradigm within a total supply chain strategy by positioning the de-coupling point so as to best suit the need for responding to a volatile demand downstream yet providing level scheduling upstream from the de-coupling point [3, 12]. The combined approach of ANP and DEMATEL techniques proposed in this paper is an aid to supply chain managers in arriving at prudent decision when the complexities of decision variables and multi-criteria decision environment make their decision task quite complicated. This combined approach is used for selecting appropriate paradigm for improved SC performance of a case company. This could serve as one of the important tools for taking a strategic decision of this type. From Table 2, it has been observed that the lead-time (0.51) is the most important criteria for the selection of the framework for the supply chain strategy. This is followed by service level (0.32), quality (0.11) and cost (0.06). For the case, supply chain of electronics and the result favors reduction in lead-time and improvement of service level. Cost and quality are less supported because reduction in lead-time and improvement in service level will also help in reducing cost and improving quality. The priority values for different paradigms for improved SC performance are shown in Table 7. The final values for supply chain strategies are 0.4068 for the agile, 0.3476 for leagile, and 0.2455 for lean supply chain. For supply chain of the case company, ANP and DEMATEL techniques suggest that with existing priority levels of supply chain performance determinants, relative weight for agile strategy is higher than that of a lean or leagile strategy. Therefore, agility is the best strategy for case supply chain. Consistency ratio (CR) is calculated for all the pair-wise comparisons to check the inconsistency in decision-making. In the proposed model, CR varies from 0.002 to 0.09, which is within tolerable limit.

V. CONCLUSION

Leanness and agility have their particular advantages and each one can be applied in different situations. During the last decade, there have been some efforts to benefit from both strategies. Leagility is a concept aiming at combining lean and agile supply chains. This combination makes the total supply chain to afford the problems associated with both cost and service level. The leagile supply chain enables the upstream part of the chain to be cost-effective and the downstream part to achieve high service levels in a volatile marketplace. The ANP and DEMATEL techniques adopted here arrive at a synthetic score, which may be quite useful for the decision-makers. The purpose of the present work was to analyze the relative impact of different enablers on three SC strategies considered for a supply chain. The ANP is a relatively new MCDM method which can deal with all kinds of interactions systematically, unlike traditional MCDM methods which are based on the independence assumption. Moreover, the DEMATEL not only can be used as a way to handle the inner dependences within a set of criteria, but also can produce more valuable information for making decisions. Hence, this paper proposes a solution based on a combined ANP and DEMATEL approach to help companies that need to evaluate and select SC strategy. The results of this study showed that the most desired strategy for case company was agile supply chain. Because the proposed solution can handle the effects of dependences, it is relatively useful and makes the evaluation result to be more reasonable. Additionally, this study has contributed to extending practical applications of both ANP and DEMATEL in SC field. Furthermore, using the suggested analytical procedure, it can effectively handle any problem of selection with multi-faceted factors.

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