

Identifying and evaluating effective factors on lean-agile supply chain

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Abstract: Today's competitive environments make lots of changes in organizations and manufacturing systems and in order to increase productivity, tools and techniques are developed. Lean thinking or production that is one of the most important of them has pointed such organization that accomplished the processes without wasting resources and with less resource assigning. In this research we study lean-agile supply chain and effective factors on it, in order to improve and promote supply chain management, identify models and lean-agile supply chain indicator and how the situation of soft drink industry in associate with being lean and agile is?, and what weakness and strangeness points this lean-agile supply chain has? The results show that customer-oriented 0.16 importance degree is the first priority for company in order to increase supply chain leanness and introducing new product with 0.13 importance degree is the first priority for company in order to increase supply chain agility.

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1. Introduction

Today's competitive environments make lots of changes in organizations and manufacturing systems and in order to increase productivity, tools and techniques are developed. Lean thinking or production that is one of the most important of them has pointed such organization that accomplished the processes without wasting resources and with less resource assigning. But in many of today unstable markets, with the aim of surviving and successfulness, it is not enough just to be lean and eliminate waste.

Today, deliver the right product in right price and right time to market is not the necessary and sufficient condition for victory in the field of competition. But it's just the condition for survival in competitive environments. In markets where price is the value of customer's view, the smooth time scheduling and eliminate waste might be the cause of successfulness, but essential factor in many today's markets is availability and the service level that are the causes of emergence of new patterns such as agility and quick responsibility. In other word, business environments' changes that are caused by customer's needs changes, is leaded to uncertainty in decision parameters and it is necessary that supply chain be flexible to deal with

these uncertainties. The successful organization is the organization that has competitive advantages in new environments and ability to adapt itself with customer's needs and market's changes.

In today's business world, supply chain management is considered as a tool for achieving short term economic revenue and long term competitive advantages. Supply chain management is considered as a set of approaches and efforts that supports manufacturers, suppliers and distributors and coordinates the value chain in such a way that the products are delivered in right volume, right time and right place in order to achieve customer satisfaction.

Agile supply chain approach is associated with interaction between company and market and external outside perspective to flexibility. The successful implementation of this approach needs quick and continuous respond to market's changes, organization's dynamic, consideration of growth and flexibility and customer's expectations. This approach focuses on unexpected market demand changes and attempts to resolve unpredictable problems by quick transportation, making lead times flexible and handling new technologies.

In this approach, systems and information technologies are used extensively and also by using EDI, information is quickly transferred to all of the chain.

In this research we study lean-agile supply chain and effective factors on it, in order to improve and promote supply chain management, identify models and lean-agile supply chain indicator and how the situation of soft drink industry in associate with being lean and agile is?, and what weakness and strangeness points this lean-agile supply chain has?

The organization of this paper is as follows. Section 2 discusses the literature review. In Section 3, we explain the process of the research. Section 4 is data analysis and the paper ends with concluding remarks in section 5.

2. Literature review

2.1. Supply chain management

Supply chain management means strategic coordination of traditional business tasks in one special organization and in its existing businesses, with the aim of long term performance improvement in one hand and whole of chain in another hand (Fine, 2000).

Supply chain management is the clear and obvious organizing, strategic coordination along trading partners and twofold goals development (i.e. improving organization performance and whole supply chain performance), (Jafarnezhad, 2005, p 538).

The major aim of supply chain management is to optimize the performance of supply chain in order to

add possible value on product with minimum cost. In other word this aim is consisting of associating and linking all agencies of supply chain in order to join to cooperate with company, as a one way to optimize productivity in supply chain and provide the most revenue to all relevance parts (Christopher, 2000).

2.2. The concept of agile supply chain

Parallel promotion in agile scope and supply chain management has led to introduce agile supply chain (Christopher, 2000). Where, agility has been accepted as a win strategy in widespread form, even has seen as a basic for surviving in some special business environments and the thought of creating agile supply chain had designed as a rational step for organizations (Ismail & Sharifi, 2005).

Agility is total ability of supply chain and its partners for quick coordination with networks and operations to match with dynamic and unruly requirements of organization. Agility is the ability of supply chain to rapid respond to market changes and customer’s needs (Toloe ashlaghi, 2008).

According to Van Hook (2005), there are three specifications for association of supply chain and agility: skill in using and utilizing of undulations, quick respondent and particular respondent or respond even in small volumes. Agile supply chain is a set of specifications that make chain able to react quickly to arising changes in environment. There are some researches that had done according to Christopher and Van Hook model in 2000. They measured the agility of supply chain according to following model (Van Hook et. al, 2000).

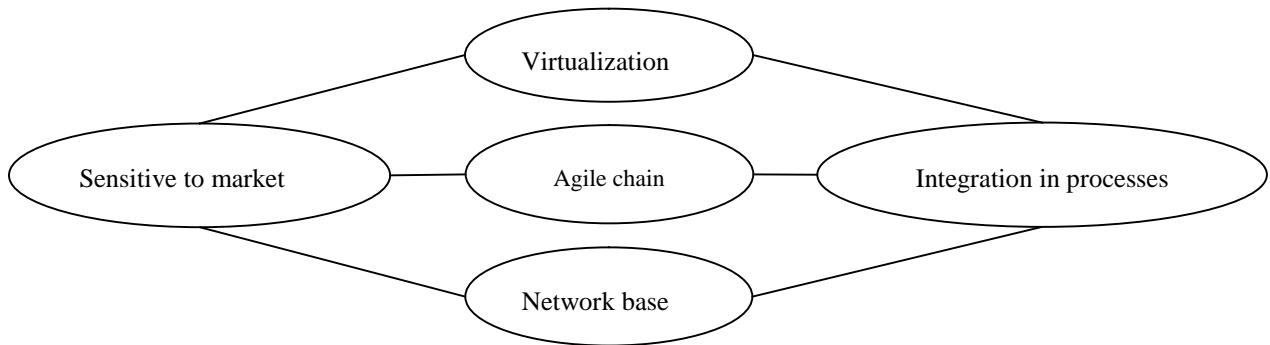


Fig 1, Agility model of supply chain

In fact, in this model there is a point that these mention’s factors that are intended to measure the agility, are themselves effect of other factors and are not the major cause for agility in supply chain. For example one chain is agile when it is sensitive to

market. This sensitivity itself is the effect of power of supply chain responsibility, or an agile supply chain for quick respondent to demands must be in a network form, in such a way that all chain’s partners connect to each other. These connections are used with the aim of

increasing speed of responsibility to changes. So in this research flexibility, responsibility, quickness and qualification are used as major indicators to measure agility according to proposed esmaeili and sharifi's indicators.

2.3. Agility capabilities

Agility capabilities include the abilities that should be created in organization; in order to have enough power of responsibility to changes. Power of responsibility that is the ability of changes' distinguishes and quick responds to them. The followings are: Strategic planning (Gunasekaran et. al, 2008), virtual firm, (Gunasekaran et. al, 2008; Faisal et. al, 2007) and, sensitive to market (Gunasekaran et. al, 2008; Ismail & Sharifi, 2005).

Competence: competence is a vast set of abilities that supply the tasks productivity in line with organization's goals. This factor is included connection, trust and commitment, culture and group decision making and integration mechanism. The sub-indicators are extracted from spekman et. al (2002). The following indicators have been extracted from (spekman et. al, 2002).

Flexibility: flexibility is the ability to produce and provide various products and achieve organization goals with similar resources and equipment. The flexibility is considered in four scopes; resource flexibility, market flexibility, system flexibility and logistic flexibility. According to Duclos et. al (2003), the types of flexibility are as follow:

Operation system: the ability of matching properties and operation in order to react to change in customer's needs in each loop of supply chain.

Market: the ability to customized produce in high level and create close relationship with customers including design and changing new or existing products.

Resource: changing supply chain in order to match supply goods with customer needs.

Logistic: the ability of receiving and sending products from supply resources to customers with effectiveness of cost.

Speed: speed is the ability of implementing the operation in shortest possible time that is included: distribution speed of new products to markets, quick and on time product delivery and speediness in operation time (Christopher, 2000; sharp et. al, 1999; Giachetti et. al, 2003; lin et. al, 2006).

2.4. The concept of lean supply chain

Lean production theory was introduced by womak and jones in 1990 and then developed to its deeper lean thinking concept in 1996 by them. In fact lean thinking concentrates on reduction and elimination of wastes and it is also called moda (Christopher and Towill, 2001). The original approach of lean system is TOYOTA that its focus is on efficiency handling of resources with stage planning (Ohno, 1988).

Lean thinking as the point of supply chain is value flow that eliminates all wastes and makes possible a stage planning (Naylor et. al, 1999). This strategy can include; inventories reduction, production's volume reduction, suppliers' delivery base volume reduction, supplier evaluation according to quality and delivery performance, long term relationship with suppliers, and eliminating bureaucracy (Treville et.al, 2004).

Lean principles can be used in markets where demand is high and consequently predictable and also diversity is low (Christopher, 2000).

Lean management system is founded on three main bases: strategic planning, organic structure, and human resource capabilities. A lean organization in order to grow must have obvious sight of its strategy, structure and capabilities (Motaghi and ayough, 2007).

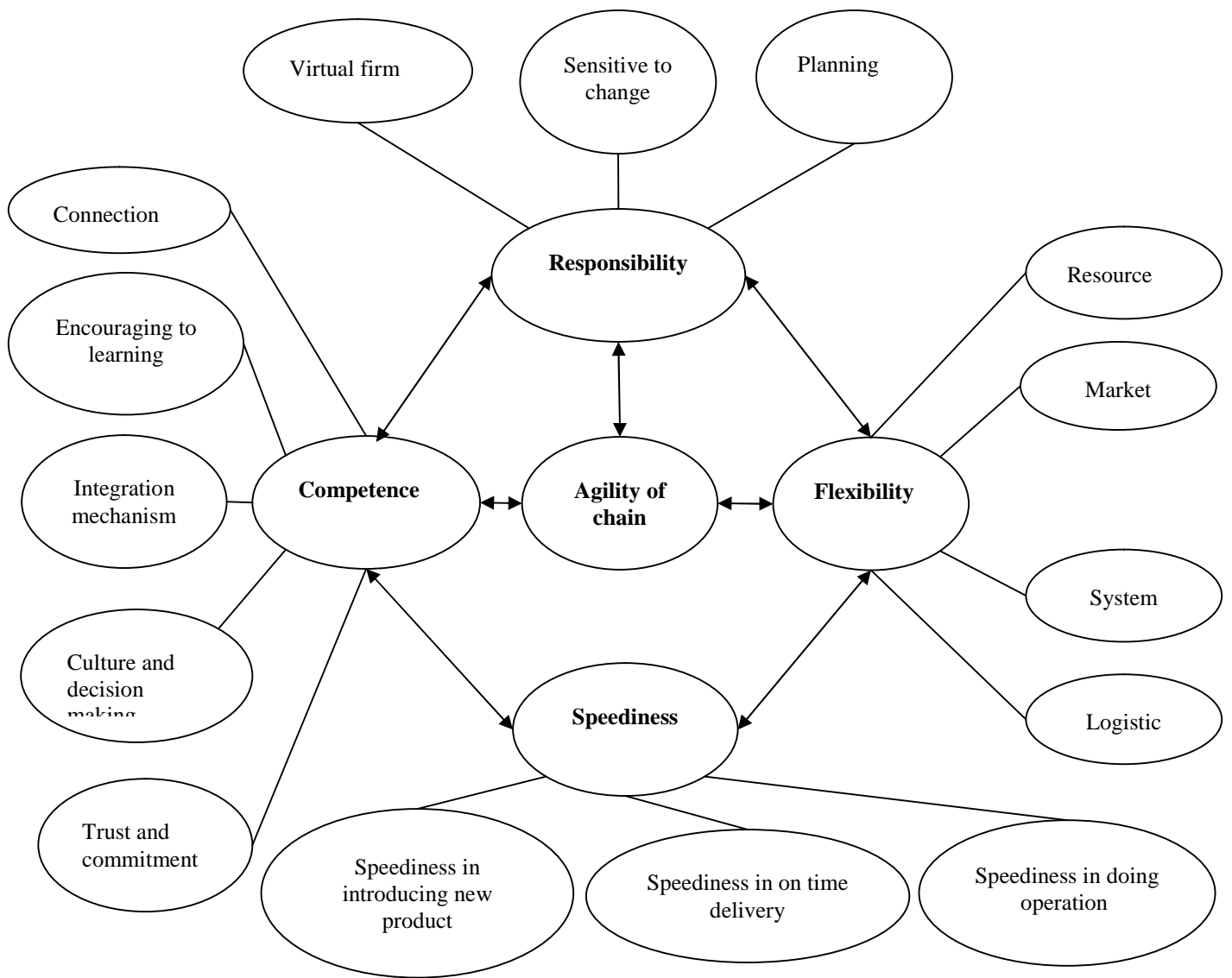


Fig 2, Agility evaluation model

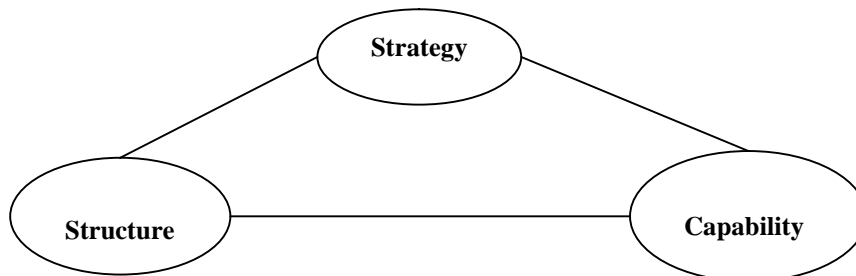


Fig 3, three main bases for growth

2.4.1. Nine keys for developing

Strategy management, structure and capabilities are easy to talk before implementing, actually in dynamic environment. In mass production organizations these specifications of developing processes of product were traditional and are constructed based on primary pioneers thinking of organization about future. Without having clear picture of future, the changings cause to disconnect between strategies, structure and

capabilities of organization and make organization confused. Often business leaders with traditional system focus on financial strategy and don't consider capabilities and structure. The result that is obtained in most cases is old structure and lake of operational capabilities with discontinuous strategies.

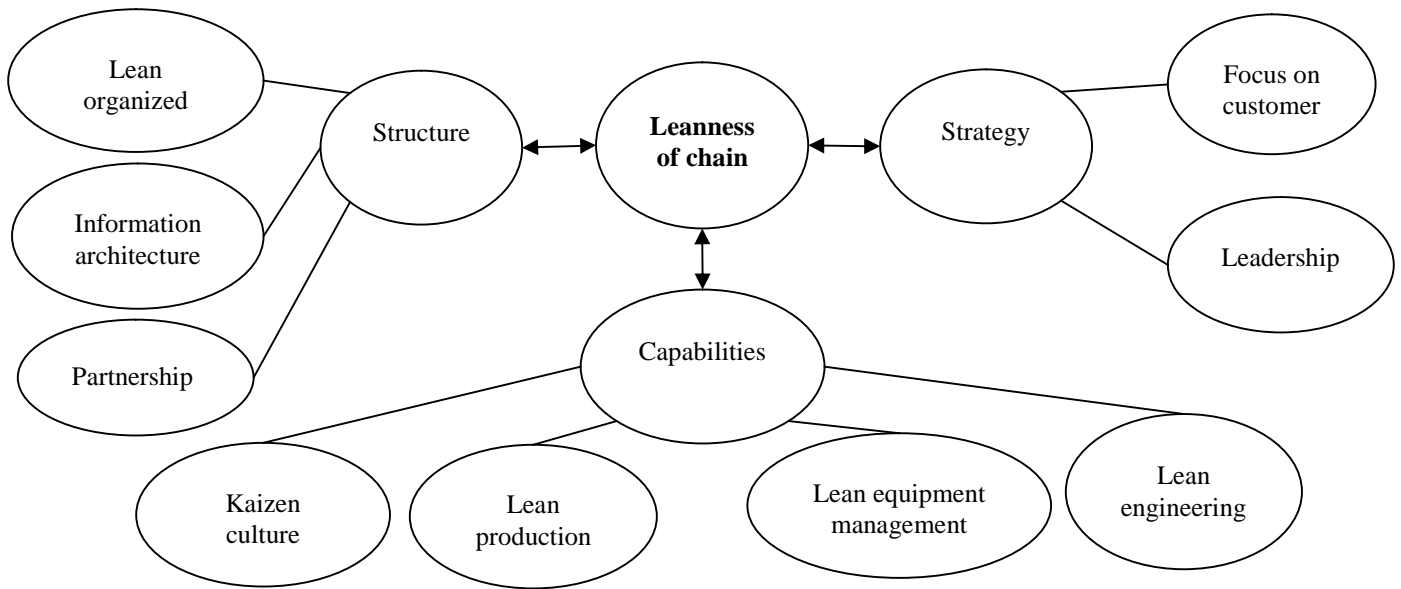


Fig 4, leanness evaluation model

2.5. Lean- Agile supply chains

The purpose of two lean and agile approaches is to respond to customers with low cost, but they are basically different in method (Goldsby, 2006). Most of researches show that there are a lot of ways to create lean- agile strategy integration (Childerhouse,

2000). Rational choice and integration of appropriate aspects of these patterns offers specific strategy that called lean-agile supply chain strategy.

3. Methodology

3.1. Lean and agility degree evaluation

For evaluating the leanness we use linguistic scales (five point likert scale). Fuzzy data are aggregated by fuzzy relations and then fuzzy aggregated data will be crisped. In final stage normalization of fuzzy weights will be done. For evaluating agility we use the same way as mentioned above.

The statistic population of this study is the experts in DAINAMIN sport's soft drinking producing that are ten people. In this study likert scale is used for designing questionnaire that is the most common. The scales are from one that shows very low to five that shows very high. In this study we use cronbach's alpha to compute reliability of questionnaires. The formula for computing cronbach's alpha

$$r_a = \left(\frac{j}{j-1} \right) \times \left(1 - \left(\frac{\sum S_j^2}{S^2} \right) \right)$$

Where j is the numbers sub- questions of questionnaire, S_j^2 is variance of jth sub-exams and S^2 is the total variance (Sarmad et al, 2006).

Table 1, Reliability of agility questionnaire

Row	The cronbach's alpha importance	The current situation of cronbach's alpha	Dimension
1	0.91	0.828	Responsibility
2	0.938	0.884	Competence
3	0.89	0.869	Flexibility
4	0.923	0.892	Speediness

Table 2, Reliability of lean questionnaire

Row	The cronbach's alpha importance	The current situation of cronbach's alpha	Dimension
1	0.908	0.819	Strategy
2	0.892	0.83	Structure
3	0.921	0.853	Capabilities

Also, according to concept of reliability (Khaki, 2008), these study's questionnaires have been confirmed by experts and academic professors.

4. Data analysis

After fuzzy computing and crisping fuzzy numbers, the arithmetic mean was calculated for each criterion (see table 3). Also in order to evaluate the importance of each criterion the normalization had done.

Table 3, leanness degree of supply chain in current and ideal situation

indicator	Current situation	Ideal situation	
strategy	Customer oriented	2.800	4.700
	Leader ship	2.890	3.890
structure	Lean organized	3.170	4.400
	partnership	3.110	4.400
	Information architecture	3.170	4.250
capability	Kaizen culture	2.900	4.350
	Lean production	2.690	4.500
	Equipment management	3.170	4.330
	Lean engineering	3.000	4.450

According to table 3 we can consider the importance of customer oriented sub-indicator in supply chain leanness. Also we can consider lean production sub-indicator that is far from ideal situation. These two sub-indicators can be put in our first priority in order to improve.

4.1. Leanness improved priority

Table 4 shows the gaps between current ideal situations of leanness indicators that are obtained by difference between ideal and current situation. According to table 5 the total gaps is 12.37 and finally the weight of each indicator is obtained by dividing the gap of each indicator on total gaps.

Table 4, gaps between current and ideal situation of lean indicator weights

	Leanness indicator	Gap	Gap weight
Strategy	Customer oriented	1.9	0.16
	Leader ship	1	0.08
Structure	Lean organized	1.23	0.10
	partnership	1.29	0.10
	Information architecture	1.08	0.09
capability	Kaizen culture	1.45	0.11
	Lean production	1.81	0.15
	Equipment management	1.16	0.09
	Lean engineering	1.45	0.12
		12.37	

With comparing current and ideal situation our important priority is improving the gap between these two situations. Accordingly the absolute values of differences between two tables show us the priorities. So the customer-oriented and lean production indicators are our first priority to improve.

The total weights of current and ideal leanness indicators are 26.9 and 39.27 respectively. With dividing each indicator on its total weight, the weight of each indicator will be obtained.

Table 5, leanness indicator weights in current and ideal situation

	Leanness indicator	Current situation	Ideal situation
Strategy	Customer oriented	0.104	0.120
	Leader ship	0.107	0.099
Structure	Lean organized	0.118	0.112
	partnership	0.116	0.112
	Information architecture	0.118	0.108
capability	Kaizen culture	0.108	0.111
	Lean production	0.1	0.115
	Equipment management	0.118	0.110
	Lean engineering	0.112	0.113

As mentioned above in conceptual model of research, the nine indicators are able to categorize in three main criteria (strategy, structure and capability). So we need to compare the importance of these three criteria. According to table 6, that shows the weights of each criterion in current and ideal situations, we can conclude that structure is in better situation than other criteria.

Table 6, current and ideal main lean indicator situations

Criterion	Current	Ideal
Strategy	0.212	0.219
Structure	0.351	0.332
Capability	0.437	0.449

4.2. Agility supply chain evaluation

With the same leanness evaluation's procedure, agility had evaluated. After fuzzy computing and crisping fuzzy numbers, the arithmetic mean was calculated for each criterion (see table 7). Also in order to evaluate the importance of each criterion the normalization had done.

Table 7, agility degree of supply chain

	Indicator	Current	Ideal
Responsibility	Strategic plan	2.450	4.500
	Sensitive to change	2.460	4.700
	Virtual firm	3.000	3.800
Competence	Encouraging to learning	2.330	3.330
	Integration mechanism	1.330	4.000
	Common culture	3.130	4.600
	commitment	2.000	3.750
	trust	2.330	4.330
	connection	3.000	4.500
	Common decision making	2.000	3.330
Flexibility	Flexibility of operation	2.750	4.200
	Market	2.660	4.500
	Logistic	2.600	4.000
	Resource	2.270	3.900
Speediness	Introducing new product	1.330	5.000
	Delivery	2.670	3.750
	Doing operation	2.875	4.280

Table 7 shows the distance of sub-indicators from their ideal situations. In table 7 we can consider two introducing new product and integration mechanism's sub-indicator that have significant distance from their ideal situations and after that commitment and common decision making that are in low levels.

Table 8 shows the gaps between current and ideal situation agility indicators that are obtained by differences between current and ideal situations. As it's seen in table 8 total gap is 29.285 and finally the weight of each

indicator will be obtained by dividing each indicators gap on total gap. Accordingly introducing new product is our first priority to improve.

Table 8, gaps between current and ideal situation of lean indicator weights

	Agility indicator	Gap	Gap weight
Responsibility	Strategic plan	2.05	0.07
	Sensitive to change	2.24	0.08
	Virtual firm	0.8	0.03
Competence	Encouraging to learning	1	0.03
	Integration mechanism	2.67	0.09
	Common culture	1.47	0.05
	commitment	1.75	0.06
	trust	2	0.07
	connection	1.5	0.05
	Common decision making	1.33	0.05
Flexibility	Flexibility of operation	1.45	0.05
	Market	1.84	0.06
	Logistic	1.4	0.05
	Resource	1.63	0.06
Speediness	Introducing new product	3.67	0.13
	Delivery	1.08	0.04
	Doing operation	1.405	0.05
		29.285	

As it's considered in table X, total current and ideal agility indicators are 41.185 and 70.47 respectively. The weight of each indicator will be obtained by dividing each agility indicator on total agility.

Table 9, Table 5, lean indicator weights in current and ideal situation

With considering table Y it's obvious that all indicators except introducing new product and integration mechanism are close to each other and these two indicators had the most effect on agility distance to ideal situation. It could be said that the most important reason can be the weakness of R & D in finding out new opportunity in new markets and also the low speed in research and development that are the main causes for having low speed to introduce

new product to market. On the other hand one of the most important reasons for having distance with ideal

situation is integration mechanism that is the process of exchange information in supply chain.

As mentioned above in conceptual model of research, the seventeen indicators are able to categorize in four main criteria (responsibility, competence, flexibility and speediness). So we need to compare the importance of these four criteria. According to table 10, that shows the weights of each main criteria in current and ideal situations, we can concluded that speediness has significant gap in its current and ideal situation the main effect of this gap is introducing new product sub-indicator. So this criterion is our first priority in order to improve.

Table 9, Table 5, lean indicator weights in current and ideal situation

	Agility indicator	Current	Ideal
Responsibility	Strategic plan	0.059	0.064
	Sensitive to change	0.060	0.067
	Virtual firm	0.073	0.054
Competence	Encouraging to learning	0.057	0.047
	Integration mechanism	0.032	0.057
	Common culture	0.076	0.065
	commitment	0.049	0.053
	trust	0.057	0.061
	connection	0.073	0.064
	Common decision making	0.049	0.047
Flexibility	Flexibility of operation	0.067	0.060
	Market	0.065	0.064
	Logistic	0.063	0.057
	Resource	0.055	0.055
Speediness	Introducing new product	0.032	0.071
	Delivery	0.065	0.053
	Doing operation	0.070	0.061

Table 10, current and ideal main agility indicator situations

Criteria	current	Ideal
Responsibility	0.192	0.184
Competence	0.391	0.395
Flexibility	0.25	0.236
Speediness	0.167	0.185

5. Conclusion

With considering the result of previous section we can conclude that the customer-oriented factor has the most important effect in leanness of PADIDEH DINAVAND Company. This indicator with 0.16

importance degree is the first priority for company in order to increase supply chain leanness. Lean

production and lean engineering are the next priorities. So the company must consider these factors in order to achieve leanness.

The priorities of company in order to improve leanness in its supply chain are as following:

1-customer-oriented, 2- Lean production, 3- Lean engineering, 4- Kaizen culture, 5- Lean organized, 6- Cooperation, 7- Information architecture, 8- Equipment management, 9- Leadership.

As it is considered, the leadership indicator has the best situation through other effective indicator on leanness in company.

With analyzing the results, it's considered that introducing new product factor has the most important effect in agility of PADIDEH DINAVAND Company.

This indicator with 0.13 importance degree is the first priority for company in order to increase supply chain agility. Integration mechanism and sensitive to market are the next priorities. So the company must consider these factors in order to achieve agility.

The priorities of company in order to improve leanness in its supply chain are as following:

1-Introducing new product, 2- Integration mechanism, 3- Sensitive to market, 4- Strategic plan, 5- Trust, 6- Market flexibility, 7- Resource flexibility, 8- Commitment, 9- Common culture, 10- Connections, 11- Common decision making, 12- Operation flexibility, 13- Logistic flexibility, 14- Speediness of doing operation, 15- Speediness of delivery, 16- Virtual firm, 17- Encouraging to learning.

So, as it is considered the encouraging to learning indicator has the best situation trough other effective indicators on supply chain agility.

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