

# Investigating the Effects of Business Strategies on Supply Chain in Esfahan Zobahan Complex

**Mohammad Reza Dalvi Isfahan**

Assistant Professor, Management Department, Islamic Azad University Dehaghan Branches,  
Iran

**Akram Yaghoobi**

M.A. Public Administration, Management Department, Islamic Azad University Dehaghan  
Branches, Iran

DOI: 10.6007/IJARBSS/v4-i3/729 URL: <http://dx.doi.org/10.6007/IJARBSS/v4-i3/729>

## **Abstract**

The aim of this study is "investigating the effects of business strategies on supply chain in Esfahan Zobahan Complex". Data were collected by using a questionnaire with the help of statistical software SPSS and LISREL statistical test such as the Kolmogorov – Smirnov, regression test, ANOVA test, Friedman test and test meaningful relationships (T-Value) is analyzed. The study sample consisted of all managers and assistants of Esfahan Zobahan Complex which is more than 103 people, that due to the whole of the statistical population of all the methods of total number has been used. The results indicate that the reduced cost leadership, differentiation, focusing on supply chain affects the Esfahan Zobahan Complex.

**Key words:** A business strategy, cost leadership strategy, differentiation strategy, focus strategy, supply chain

## **Introduction**

Today's turbulent business environment, success depends on the orientation of all parts of the organization, in line with the strategic direction. Strategies are the means by which a company can achieve its long term goals. The hierarchical approach strategy after corporate strategy, business strategy proposed and then the third level are functional strategies including strategies. Each level has a supportive role for higher levels to the ultimate goals and philosophy outlined in the corporate strategy will be fulfilled. The importance of survival strategies of the organization has attracted the attention of many researchers (Nayebzadeh, 1388: 31). Organized and managed policy-based business that which is influenced by many factors. First, a variety of activities such as processing activities, engineering or operations management services to the methods and forms they need. In addition, various periods in the life cycle of a business system application require different management. Work environment based on business system that is managed in various ways affect the structure of the system. Hence, there is no general method and uniform management. Business strategy emphasizes on improving the competitive position of products or services to a company or an entity in an industry or a specific market segment. Business strategy can compete (fight against all

competitors to gain advantage) or cooperative (collaborating with one or more competing for advantage against other competitors) or in both shape. Business strategy shows how a firm should compete in a particular industry or to work. There is fierce competition in today's organizations and the nature of the business environment on the one hand and the need to improve corporate status and consequently increasing the organizational agility, according to organizational policies and strategies to strengthen the commitment to make it more clear. (Mazloomi, 1386: 63).

On the other hand, the issue of supply chain management and has recently attracted the attention of the administrators. The supply chain to organizations can be seen as a network of different companies that cooperate with each other to try to create more added values to the final customer or consumer (if the costs are separate). Increase the added value by enhancing quality with lower cost is possible. (Balka, 2013). In fact upstream and downstream is formed of supply chain organizations and work processes between them including the production of raw materials, components, semi-manufactured goods, finished products or provide services such as transportation, distribution, warehousing, wholesale and retail production. . Thus the components of a supply chain will be including suppliers (materials and components), manufacturers, distributors, vendors, wholesalers, retailers, final consumers of products and.... Activities in the supply chain can function on a broad range of outcomes, including return on assets, return on investment, market share growth and progress and impact. Performance of the entire supply chain is the result of the activities of each member of the supply chain and adopts a common orientation whereby the group works (Mentzer et al, 2008). Great deal of research has done to find solutions to the coordination of distributed systems by managing inventory and supply chain (Wong, 2013). To obtain a competitive advantage and improve performance of supply chain management strategies should be directly supportive of and conducive to corporate strategy or in other words, supply chain strategies and organizational strategies are aligned (Cohen, 2005). Thus traditional approaches to supply chain management cannot meet the customers' expectations and benefit from a coordinated strategy with the characteristics of the supply chain, appropriate to create a system that provides an efficient supply chain. In this study, researchers sought to study the effects of the business strategies of the supply chain are in Esfahan Zob Ahan Complex. Therefore the main research question is that what is the business strategy impact on the supply chain?

#### **Research Framework: Business Strategy**

Business strategies will emphasize on improving the competitive position of a company or a business unit's products (goods or services) in an industry or a specific market segment. Business strategy can be competitive (against all competitors to gain an advantage) or partnership (in partnership with one or more competitors to gain an advantage against other competitors) or to be both. Business strategy shows how a company should compete in a particular industry or work.

#### **Porter's competitive strategies**

Michael Porter overcomes other competing firms in the same industry, and proposes both public competitive strategies: lower cost and product differentiation. (Porter, 1980) from the general direction of these strategies say that every commercial enterprise of any type and size that is (even non-profit organizations) may use them.

■ **Strategy lower cost** is the ability of a company or a business unit in the design, manufacture and marketing of a product; much more efficiently than competitors.

■ **Differentiation strategy** is the ability to provide unique and superior value to the buyer in terms of life, specific features of a product or service after the sale.

Porter also believes that a company's **competitive advantage** in an industry where the company is determined by the competitive realm. Competitive realm is the scope of target market a company or business unit. Before taking advantage of one or both of the competitive strategy, corporate or business unit must identify the following:

- 1- Diverse range of products that will be produced ;
- 2- Channels of distribution;
- 3- Types of buyers that they will offer their products ;
- 4- The geographical scope of the company's sales ;
- 5 - Series of related industries that would compete with them.

This requires a firm grasp of their own resources to show. A company or business unit can have a wide market (market targeting medium or large) or a limited market (a particular sector of the market) choice. The combination of these two types of target market with the competitive strategy leads the emergence of several general strategies. When the target market is both broad differentiation strategy and cost less this two strategy are called the cost leadership and differentiation strategies. When these two strategies are to focus on a market segment (market), they focus on differentiation (differentiation focus) and focus on cost (fee-based). Research shows that companies with broad market strategy, in terms of return on assets than firms act with limited market strategy. In contrast, a company based on innovation and entrepreneurship in the market, the more chances to continue to operate in a broad market ( Decastro, 1998).

**Cost leadership** is a competitive strategy of cost-effective and aimed at mass markets, this strategy needs to perform these steps: 1- The construction of efficient-scale facilities, 2- track and try to cut costs by taking advantage of the experience; 3- control overhead and fixed costs; 4- Avoiding the Customer at the marginal income - building costs in areas such as R & D, service, sales force, advertising, and so on. The reasons for low costs, a pioneer in cost out of their products may be lower prices and still make a good profit. Some companies such as Wal - Mart, Alamo Welts Impotent, South West Airlines, and Timks and Gateway 2000 with the success of the strategy follow and implement. Low costs make the company able to defend against competitors. It can also earn profit in the intensive competition. High market share in a company means the company has more bargaining power against their suppliers (suppliers of raw materials, etc.); because they can buy larger quantities. Low price products of the company also act as a barrier, as only a few companies can compete with such a new industry. The result seems to be a return on investment in low cost companies is above average.

**Differentiation strategy** is targeting mass markets and they emphasized products throughout the industry, unique and exclusive. So the company or business unit may ask a higher price for their products. In this case, design or brand, technological, morphological features, distribution networks or services provided to the customer can be unique and special. Differentiation strategy is a reliable strategy for those companies who are looking for above-average returns. Because the attention and loyalty of customers to the brand, their sensitivity to commodity prices down. Therefore the once increased costs are passed on to buyers. Brand loyal shoppers

also acts as a barrier to entry because new firms must develop their distinctive competencies to be able to distinguish their products to compete successfully. Some of the companies that have used and followed successfully the strategies are include: Walt Disney, Mi. Tag, Nike and Mercedes-Benz in Germany. Research shows that higher levels of profitability differentiation strategy of low cost strategy because differentiation creates a barrier better against new competitors; However strategy is less costly for companies to create greater market share (Kavous, 1992).

**Pivotal costs** are lower cost of a competitive strategy that focuses on a particular group or geographic market and provides services only to a certain section of the market. Company or business unit that uses this strategy attempts to your target market and gain a competitive advantage in terms of costs. Fidel engineering firm is using this strategy. Fidel focus his efforts on building and selling cars simple tools for small producers. The company by holding down overhead costs and focus its research and marketing operations in its target market segment, has been implemented this strategy. They believe that a company or business unit that will focus their efforts better than their competitors can provide strategic purpose, adherence to this strategy. The company's strategy is to choose between profitability and market share of choices.

#### **Pivotal distinction**

Pivotal distinction is a differentiation strategy that focuses on a particular buyer group, product line, or specific geographic market. Kisy General Stores companies, Morgan Motor Company work (producing classic English sports car) and local health foods retailers have successfully implemented this strategy. Company or business unit when using this strategy is seeking to differentiate their products in a segment of your target market. Who believe that a company or business unit that will focus their efforts; Specific needs of a target market better than competitors can provide their own limits; they support this strategy. This is the same strategy that has been used effectively by Inner City Entertainment; The Company that is concentrated on the new film making high quality urban African American neighborhoods. The company owned and managed by Alisa and Danzell Starkswas successfully countless theaters on the south side of Chicago to cast. The company uses radio stations in the city to advertise their films and special exhibitions like Amistad.

#### **- Associated risks of competitive strategies**

No competitive strategy guaranteed success, and some companies that have successfully implemented one of Porter's competitive strategies, have realized that they cannot maintain and continue its strategy. As noted in Table 1, each of the general strategies has their own risks (disadvantages). For example, a company that has adopted a differentiation strategy should make sure that has a high price on their products, due to their high quality and competitive price that is far beyond the price. In other words, customers may not very sensitive to the high quality and high costs. The concept is the same as in Table 1 as the approximate cost is mentioned. Procter & Gamble Company benefiting of research and development and advertising in order to distinguish their products for many years was a successful strategy; until customers in the 90's reaching the location awareness turned to cheaper private brands. As a result, Procter & Gamble was forced to reduce costs so much is the customer's expectations.

Table (1): risks (disadvantages) general competitive strategy

<b>Disadvantages of focus</b>	<b>Differentiation Disadvantages</b>	<b>Disadvantages of Cost Leadership</b>
<p><b>The focus strategy is imitated too.</b></p> <ul style="list-style-type: none"> <li>• The purpose of the market is structurally unattractive:               <ul style="list-style-type: none"> <li>• The structure goes wrong.</li> <li>• demand disappears.</li> </ul> </li> <li>• broadly targeting rivals who have dominated the market segment or can be overcome.</li> <li>• There is little difference between market segments.</li> <li>• Benefits offers an extensive line rising.</li> <li>• New users focus on, divide industry into more sub-parts.</li> </ul>	<ul style="list-style-type: none"> <li>• Differentiation is not sustained.</li> <li>• Competitors are quick to discover</li> <li>• Differentiation bases will soon become less important to buyers.</li> <li>• Close approximation of the cost is forgotten. Those who focus on differentiation, they acquire a more distinct parts.</li> </ul>	<ul style="list-style-type: none"> <li>• Cost leadership is not sustained:               <ul style="list-style-type: none"> <li>• Competitors are quick to discover.</li> <li>• Technology will change.</li> <li>• Other bases of charges leadership go away.</li> </ul> </li> </ul> <p>Located adjacent to the distinction will not be considered .</p> <p>Has focused on the costs arrive even costs less than any of the market segments.</p>

Source: (Simon 1985:21)

**- Supply Chain**

Supply chain is the entire process of supplying goods and services to the final consumer. Naturally, it also includes coordination between all of the activities required to manage an operation (other than the operation) such as: marketing, design, and customer service, supervision of production, orders, logistics, distribution and warehousing. In simple terms, it means managing the flow of goods and services, increasing the switch, the supply chain process, internal and external processes and activities, source of production. Several explanations have been offered in the entire supply chain, which can be discussed in three approaches below and can be seen in this area (Hamidi and Maleki, 1389).

First approach: some of the supply chain between the buyer and seller are limited, this approach focuses only on purchasing the top of an organization.

Second approach: the other group supply chain visibility with a wider look and it includes all the channels they provide for the organization, however, the supply chain will be including all suppliers of first, second and.... This attitude toward supply chain will provide only network analysis.

Third Attitude: Attitude Porter's value chain, ensuring that the supply chain includes all activities required to deliver a product or service to the final customer. The attitude fields

Manufacture and distribution of goods and services as part of the chain is added. In fact, with the vision of providing supply chain consists of three areas of production and distribution.

Based on the above three approaches, different definitions of supply chain management are presented. Some of them are mentioned in this section. Supply chains are composed of two or more organizations that are officially separated and the flow of material, information and financial flows are related to each other, this chain into all activities associated with the flow of goods and materials, from raw material procurement stage to the final delivery to the consumer. The other two streams are also present one flowing along the flow of goods and information flow of funds and other credits. Supply chain management emphasis on supply chain integration and information flows associated with their activities through improved supply chain relationships, to achieve competitive advantage by relying (Hamidi and Maleki 1389).

A supply chain consists of all the processes which are directly or indirectly involved in satisfying customer demand. The supply chain not only includes manufacturers and suppliers but also transport sector, warehouses, retailers and their customers (Chuvpra Mayndel, 2007).

#### **- Supply Chain Integration**

Efficient supply chain management is success while it is able to fully satisfy customer needs and create value for him, and at the same time guarantee long-term profitable business partners. In fact, the goal is to create a win-win model. Supply chains are in fact a partnership relationship that are formed between two independent supply channels through the sharing of information at different levels to achieve certain benefits including lower overall costs and inventories. Survive in today's competitive global market, is not related to market behavior but it depends on the ability Organizations deal with changing conditions and uncertainties in both the upstream and downstream partners. This requires a review of the management of the organization is using IT tools (Chopra, 2007). Today companies have to stay in the market, looking for ways to improve their flexibility and ability to respond and try the changes in their operational strategies and implementation methods and technologies that include the implementation of Supply Chain Management to compete. It should be said the exact strategies and operational planning, supply chain integration are the keys to success. The organization's strategy and supply chain strategy, which are the main indicators of combining goods movement flow of financial and operational information between the parties makes integration (Lee, 2002). One of the most important objectives of Supply Chains Management is integration. In supply chain management the word integrity means that the institutions and various members of a supply chain act as a whole. Higher level of integration is when members of their supply chain, and production activities are some aspects of their work harmoniously with others. The evolutionary process manufacturing industries, some companies are already feeling the traditional attitudes that if only rely on supply chain management; they sell them as would be expected (Kim et al, 2006).

In the research Stuck and colleagues (2000) have done, there are two types of integration among organizations and enterprises are expressed as follows.

Internal integration: it reflects the degree of interaction between departments within the organization.

External integration: it is known as supply chain integration and reflects the integration of logistics activities across organizational boundaries, including suppliers and customers.

In this context, Lee (2002) argues that supply chain integration, there are three key dimensions:

1. Data integrating: refers to the sharing of information and knowledge among members of a supply chain. For example, Definition of demand, inventory status, applications or production capacity.
2. Coordination, which refers to the transfer of decision-making, task or resource allocation to best each intersection in the supply chain.
3. Organizational communication: meaning relations between the enterprise and supply chain partners to coordinate joint actions.

### **- Supply Chain Flexibility**

Supply chain flexibility stems from the need for clients. Companies and organizations to maintain their competitive advantage against competitors have no choice except to respond quickly to the demands of the clients are from a variety of quality products, competitive prices, and fast delivery. As a result, companies must be flexible enough. Therefore require a flexible framework to analyze supply chain information requirements. (Douglas et al, 2003).

Swafford (2006) stated that flexibility one of the main features of supply chain. Based framework provides flexibility for agile supply chain and argues that the agility and flexibility of the affected companies in various sectors including new product development, supply chain, procurement and sourcing, manufacturing and distribution. (Chopra, 2007) is one of the most important features of supply chain flexibility considers the following five dimensions for measuring the flexibility of supply chain provides.

1. Product and production flexibility or the companies or organizations the ability to customize products to meet specific customer demands.
2. Flexibility in production volume or the companies or organizations the ability to adjust production capacity in order to respond to changes in customer demand.
3. Flexibility in the design of a new product or the company or organization's ability to launch new or modified products.
4. Flexibility in the distribution or the ability of firms or organizations to make more widely available products.
5. Flexibly in respond or the ability and companies or organizations to respond to market needs.

### **Hypothesis**

- 1- Leading supply chain cost reduction is effective in Zob Ahan Isfahan Complex.
- 2- Separation of Supply Chain at Zob Ahan Esfahan Complex transition effects.
- 3 - Focusing on supply chain impact in Zob Ahan Esfahan Complex.

**Research Methodology**

The present study based on the nature of the research method is descriptive - survey is the branch of the field.

**Statistical Society**

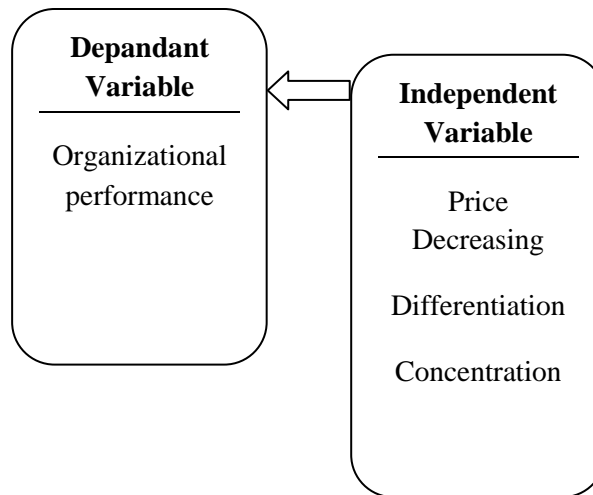
The study sample consisted of all managers and assistants of Zob Ahan Esfahan Complex which is more than 103 people, that due to the whole of Statistical Society of all of the total number of methods has been used.

**Data collection tools**

Data collection methods associated with hypotheses and tools used by the census questionnaires, interviews, library, internet and document study is reporting.

**Research variables**

Variables in this study include:



**Reliability and Validity**

In this study, the researcher made questionnaire was used to assess the effects on the supply chain has been in business strategy. In this study, the validity is used. In accordance with these principles in order to get the validity of professors and experts were asked to study the question of reform in the questionnaire apply, collecting, summarizing and applying ideas and put them back after the questionnaire surveys, run again, ultimately a question of professors and experts approved by the reached. And for determining the reliability of the questionnaire, the Cronbach's Alpha was used.

$$r_a = \left( \frac{k}{k-1} \right) \left( 1 - \frac{\sum \delta_j^2}{\delta^2} \right)$$

Alpha value for each factor was calculated from the output of statistical software SPSS. Cronbach's alpha coefficient in this study indicates acceptable consistency of asking questions and taking responsibility for same. Cronbach's alpha coefficient in this study was a pilot study with the 30 questionnaires distributed between managers and assistants took part production, are described as below.



Table: Reliability of Research variables

Cronbach's alpha	Variable
0.82	Price Decrease
0.79	Differentiation
0.81	Centralization
0.80	Supply Chain
0.82	Total

**Methods of data analysis**

Independent sample Kolmogorov - Smirnov test for normal distribution of study variables, analysis of variance to assess differences in variables meaning, Friedman test to examine the difference between supporting factors and the study of structural equation modeling technique was used to evaluate the appropriateness of questions. And then using regression analysis, we investigated the effect of the Research variables. Both descriptive and inferential analysis of the data was examined.

First hypothesis: cost reduction Leadership is effective on supply chain in Zob Ahan Esfahan.

Table: regression test of the first hypothesis

Model	Not Standardized coefficient		Standardized coefficient	t	Meaningful level
	B	error	Beta		
1 (Constant)	.490	.171		2.860	.005
Costs	.834	.054	.837	15.364	.000

Results of regression analysis between independent variables (cost strategy) and dependent variables (supply chain) shows that there is significant positive correlation between these two variables. Significance level is less than 05 /. Beta value obtained is equal to 83 /. Thus H1 is assumed that the impact of the strategy on supply chain costs is confirmed.

Second hypothesis: Differentiation is effective on supply chain in Zob Ahan Esfahan.

Table: regression test of the second hypothesis

Model	Not Standardized coefficient		Standardized coefficient	t	Meaningful Level
	B	error	Beta		
1 (Constant)	2.506	.258		9.731	.000
Differentiation	.168	.077	.213	2.188	.031

Second hypothesis: Differentiation is effective on supply chain in Zob Ahan Esfahan.

**Table: regression test of the second hypothesis**

Model	Not Standardized coefficient		Standardized coefficient	t	Meaningful Level
	B	error	Beta		
(Constant)	2.506	.258		9.731	.000
1 Differentiation	.168	.077	.213	2.188	.031

Results of regression analysis between independent variables (Differentiation) and dependent variables (supply chain) shows that there is significant positive correlation between these two variables. Significance level is less than 05 /. Beta value obtained is equal to 21 /. Thus assumed that Differentiation 1 H has an impact on the supply chain is confirmed.

Third hypothesis: Distinction is effective on supply chain in Zob Ahan Esfahan.

**Table: regression test of the third hypothesis**

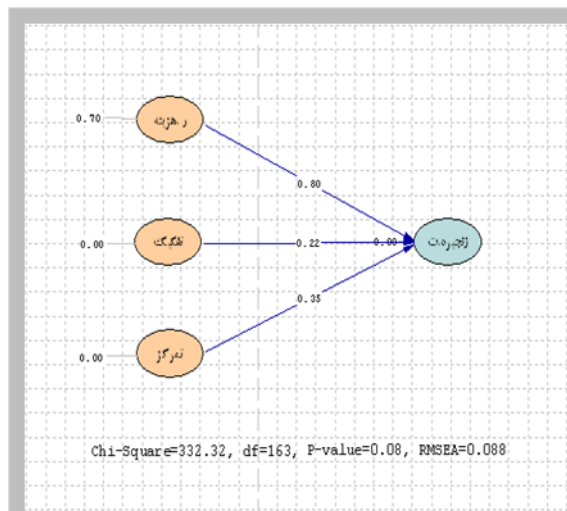
Model	Not Standardized coefficient		Standardized coefficient	t	Meaningful Level
	B	error	Beta		
(Constant)	2.262	.254		8.916	.000
1 Differentiation	.256	.080	.305	3.220	.002

Logistic regression analysis, the independent variable (concentration) and dependent variables (supply chain) shows that there is significant positive correlation between these two variables. Significance level is less than 05 /. Beta value obtained is equal to 30 /. 1 H thus assumed that the impact is focused on the supply chain is confirmed.

**Evaluation of models:**

One of Lisrel output, independent agents will be analyzed, which is shown in Figure 1.

Figure 4.1 - Model of The main research



According to the outlet end, the value / df is calculated equal to half There is / df below shows the proper fit of the model. Whatever the value of / df is less, the proposed model is more appropriate model according to the following results are obtained from Lisrel output.

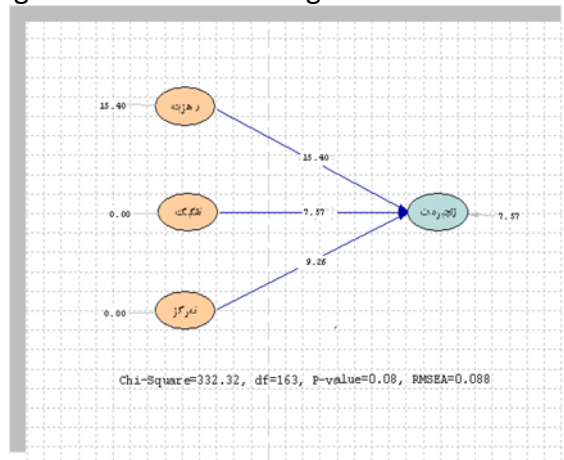
$$0.08 = \text{RMSEA} \ \& \ 0.08 = \text{Value} - p \ \& \ 2.03 = \chi^2 / df$$

The Value higher than the standard significance level (5% = a) is therefore proposed model is an appropriate model.

**Significant relationship test (T-Value)**

In order to illustrate the significance of each of the parameters of the model are t-statistics. The statistical may be obtained of the coefficient error parameters (SD) which must be greater than 2 in the test, and in the Z-test is greater than 96/1, as these estimates are statistically significant with respect to the output end, the whole relationship between the calculated t is significant (t is greater than 2). So all the estimates presented are statistically significant. (Figure 4.2).

Figure 4.2 - confirmed significant relationships



**-Suggestions**

- A) The reduced cost leadership strategy is based on results of research on supply chain in Zob Ahan Esfahan is effective in the improvement of the following criteria are suggested:
  - Increase production volume to achieve economies of scale .

- Using cheap Manpower
- Quality management according to customer requirements
  - Strengthen cooperative systems in the organization and overall supply chain personnel in cooperation with the aim of controlling costs .
- Inventory management and optimization.

B) Because results of the study on supply chain strategy are Differentiation in the Esfahan Zobahan Complex is effective in the improvement of these indicators, the following is recommended:

- Flexibility to produce new products
- Evaluation of customer needs and self-help
- Effective planning for the supply of raw materials .
- To provide after sales service for customers
- Development of distribution channels to suit customer requirements

C) Because results of research focusing on supply chain strategy is effective in the Zob Ahan Esfahan in this area to improve following these measures are suggested:

- High-priced product offerings for specific market segments
- Develop market (to serve specific geographic markets)
- Increase market share through marketing activities
- Introduction of new products by improving or modifying present products
- Make decision-making power suppliers to supply consumers

#### **Resources:**

1. Hamidi, N. Maleki, M. (1389) Course in the Supply Chain Management. Sayegostar Qazvin.
2. NayebZadeh, SHahnaz (1388). Examine the relationship between coping strategies, business strategy and Saipa Diesel Performance, Journal of Management, Issue 17.
3. Mazloomi, Nader. (1386) present a model for designing control strategies for implementation and logistics business, Business Studies, No. 24.
4. Cohen, S... (2005). strategic supply chain management: the five disciplines for top performance
5. Bylka, S. (2013). Non-cooperative consignment stock strategies for management in supply chain. elsevier: Int. J. Production Economics, 143, 424-433.
6. Mentzer, J., Stank, T., &Esper, T. (2008). Supply chain management and its relationship to logistics, marketing, production, and operations management. Journal of Business Logistics, 31-46.
7. Wang, y. (2013). Consignment contracting:who should control inventory in the supply chain. european journal of operational research, 201, 760-769.
8. Chopra, S., &Meindl, p. (2007). Supply chain management: strategy planning and operation. pearson prentice hall.
9. Lee. (2002). aligning supply chain strategies with product uncertainties. California management review, 105-119.

10. Kim, D., Cavusgil, T., & Calantone, R. (2006). Information systems innovations and supply chain management: channel relationship and firm performance. *Journal of Academy of marketing science*, 40-54.
11. Kim, D., Cavusgil, T., & Calantone, R. (2006). Information systems innovations and supply chain management: channel relationship and firm performance. *Journal of Academy of marketing science*, 40-54.
12. Kim, D., Cavusgil, T., & Calantone, R. (2006). Information systems innovations and supply chain management: channel relationship and firm performance. *Journal of Academy of marketing science*, 40-54.
13. Kim, D., Cavusgil, T., & Calantone, R. (2006). Information systems innovations and supply chain management: channel relationship and firm performance. *Journal of Academy of marketing science*, 40-54.
14. Duclos, L., Vokurka, R., & Lummus, R. (2003). A conceptual model of supply chain flexibility. *Industrial management and data system*, 103, 446-456.
15. Duclos, L., Vokurka, R., & Lummus, R. (2003). A conceptual model of supply chain flexibility. *Industrial management and data system*, 103, 446-456.
16. Duclos, L., Vokurka, R., & Lummus, R. (2003). A conceptual model of supply chain flexibility. *Industrial management and data system*, 103, 446-456.