Ranking the Affecting Factors on Supply Chain Performance (Case of Iran)

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This paper aims to identify and rank affecting factors on supply chain performance in Iranian auto parts manufacturing industry. To this aim, the research literature is addressed and finally 34 indices are identified and extracted to measure supply chain performance according to the opinions of connoisseurs and elites. surveying the above mentioned factors among practitioners, resulted in developing affecting factors on supply chain performance. therefore deploying statistical analysis lead to defining the more important ones, and ultimately they are ranked respectably. Results depicted that to our case industry, factors such as ordering time and order entry methods are the most important and some recently focused indices such as frequent delivery, continuous relationships and cost-effective innovations that are actually rooted in lean production are less important due to the lack of tendency by this industry toward lean production system. The findings also indicate that mass production system is the dominated approach in this industry.

JEL Codes: L25, M11 and L11

1. Introduction

As an important production paradigm in 21st century, supply chain management (SCM) plays an important role in improving the competition in an industry (Gunasekaran, 2004). Therefore, we observe rapid growth in theory and practices in such an erea (Schneeweiss, 2004). SCM is a competitive strategy in integrating suppliers and customers in order to improve accountability and flexibility in manufacturing corporations (Gunasekaran, 2004). In today's markets, technological and competitive factors are growing increasingly which makes it difficult and cost-ineffective for companies to produce what they need. Instead, outsourcing has become a major strategy for corporations. In a meantime, soaring globalization and customer orientation has led to the sensitivity of logistic issues in organizational planning. SCM is an approach formed from such points (Gunasekaran et al, 2001). It faces with challenges like trust-building and collaboration among supply chain (SC) partners, determining the best actions which can facilitate SC process integration, implementing the latest successful

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synergic information systems and the Internet technologies which stimulate efficiency, performance and quality in supply chain (Robinson and Malhorta,2005). It necessitates assessing SCMs. However, traditional assessment methods are less related to SCM since they are too limited to evaluate a wide range of activities. In recent decade, SCM has reached a remarkable growth in disseminating theories and operations of this area. Noteworthy, supply chain performance assessment, has not been sufficiently paid attention by the researchers (Theeranuphattana and Tang, 2008). In this line, Rolstandas noticed that no important research is conducted in SC performance within developing countries (Rolstandas, 1995). This paper attempts to study the most important indices in assessing supply chain performance in Iranian auto part makers.
In the following, at first we address supply chain management and performance assessment, then the methodology is provided and finally research findings are discussed. Some recommendations are also provided for other authors and industrial managers.

2. Literature Review

In modern business environments, manufacturers are facing with increasingly pressure of customers' requirements to personalize the product, to improve the quality and to respond demands. To keep the business under such pressure, most companies plan long-term strategic partnership with a few suppliers so that the increasing requirements of competition on efficiency, costs and accountability to customers have encouraged companies to establish strategic partnership with suppliers, downstream customers and logistic services providers (LSPs) in order to utilize their capabilities and to provide more values to customers which has led to development of supply chain management concept. Below, we study this managerial approach and literature on performance assessment.

2.1 Supply Chain Management

Planning, organizing and controlling the activities in supply chain are defined as supply chain management (Chan et al, 2003; APISC1). In other words, supply chain management is the integration of relevant activities by transferring and flowing the goods and services including their information streams from raw material resources to end users (Ballou et al., 2000; Hadfield and Nichols, 1999). As Stevens (1999) says, "Supply chain management is a system whose components include part suppliers, production facilities, distribution services and customers' services that are linked to each other through a material forward flow and information backward (feedback) flow" (Gunasekaran et al, 2001). There are also other definitions of supply chain management such as integrating key business processes from end user to major provider who supplies products, services and information and creates value for customers and other stakeholders (Remko and Van, 1998).

1. American Production and Inventory Control Society

According to Simchi et al (2000), supply chain management is a set of techniques to integrate providers, manufacturers, warehouses and shops effectively (Simchi et al., 2000). As a business philosophy, supply chain management has transformed business by increasing business skills and the performance of all members in supply chain (Cooper et al., 1997; Ferguson, 2000). Supply chain management is considered as a key to create a sustainable competition through improving inside and outside organizational relations (Ellinger, 2000).
Hence, by reviewing the mentioned supply chain management definitions, it can be concluded that supply chain management is: running all relevant activities to transfer goods from raw materials to end users. It includes finding the resources, production timelines, order process, inventory management, transfer, warehousing and customers' service. In the meantime, it involves needed information to monitor and coordinate the activities (Quinn, 1997).

2.2 Performance assessment

Performance assessment is vital to any organization since makes it easy to understand its behavior, shapes it and improves competition (Fawcett and Cooper, 1998). Noteworthy, many efforts are done to measure performance in organizational level; however, there is shortcoming in intra-organizational level .It should be also noted that in organizational level, performance assessment is basically concentrated on tangible and financial factors (Austin, 1990).
Neely (1995) defines performance assessment as quantifying effectiveness and efficiency. Effectiveness is the amount of meeting customers' needs and efficiency is rate of economically using corporation's resources in time of measuring a predetermined level of customers' satisfaction. Hence, it can be said that performance assessment systems are a set of metrics which quantify effectiveness and efficiency (Neely et al., 1995). Lebas (1995) enounced that performance assessment as inserting the complicated reality if performance inside a sequence of limited signs which can be transferred and reported in similar conditions (Lebas, 1995). Sink and Tuttle (1989) claim that you can’t manage what you can not measure. They have provided it as the main reason of measurement (Sink and Tuttle, 1989). Performance assessment can provide important feedback by which managers will be able to monitor the performance, to reveal the progress, to increase the motivation and communications, and to identify the problems (Rolstandas, 1995; Wagonner et al., 1999). Performance assessment is an undistinguished element of planning, control and decision-making (Wagonner et al., 1999).
In the literature there are various models developed to measure organizations’ performance. Thor (1994) claims that there should be a set of measures. A balanced set of four to six measures which typically include productivity, quality and customer's satisfaction can represent an overall vision on performance ramifications (Thor, 1994).
To emphasize on performance assessment importance, Gong et al (2007) noted the study by Boston Advisory Group: a few firms achieve their aims on technological initiatives, obtained results are satisfaction and this process

requires performance assessment (Gong, 2008). Performance assessment which is based on reliable data is a factor which is considered crucial for a company to return its investments fully (Luo et al., 2008). Despite of the importance of performance assessment and passing one decade since its appearance in supply chain management and the expansion of papers on theory and practice in supply chain, adequate attention is not paid to performance assessment in supply chain (Cahn Qi, 2004).

2.3 Supply chain performance assessment

As a critical management tool, performance assessment supports to improve the performance in line with supply chain excellence. Although supply chain is converted to a common initiative in industrial levels and a vast number of papers are published on theories and practices of supply chain management, chain performance assessment has not been paid attention respectfully (Chan et al., 2003). To this reason most of the authors believe that supply chain performance assessment is not sufficiently paid attention and it is neglected (Beamon, 1999; Holmberg, 2000; Gunasekaran et al., 2001; Chan and Qi, 2003; Chan et al., 2003; Gunasekaran et al., 2004; Schmitz and Platts, 2004; Folan and Browne, 2005; Park et al., 2005). As a whole, there is a few efforts to adjust supply chain performance measures systematically. Additionally, neither there is a consensus among the authors on the most appropriate method of the assessment nor the categorization of the methods (Shepherd and Gunter, 2006).
As it's depicted in figure 1, Beaman (1999) identifies three measures to assess supply chain performance: resources, outcome, flexibility (Beamon, 1999).

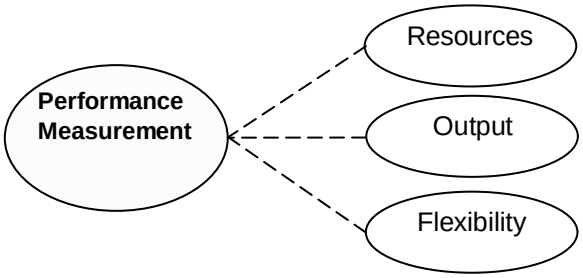

Figure 1. Beamon's model of performance measurement

Gunasekaran et al. (2001) developed a framework to assess the performance in strategic, tactical and operational levels of supply chain. Basically, the frameworks addresses to supplier, delivery, customer's services, costs and logistics (Gunasekaran et al., 2001). It should be noted that performance assessment measures are enlisted under these levels and they are used in present research. Figure 2 indicates the levels of performance assessment measures developed by Gunasekaran et al. Amstel and Hert (1996) showed that a special type of measures are utilized for logistics depended to assessment level (activity, performance field, inter-sections or inter-organizations) which differs from operational area (Cooper et al., 1998).

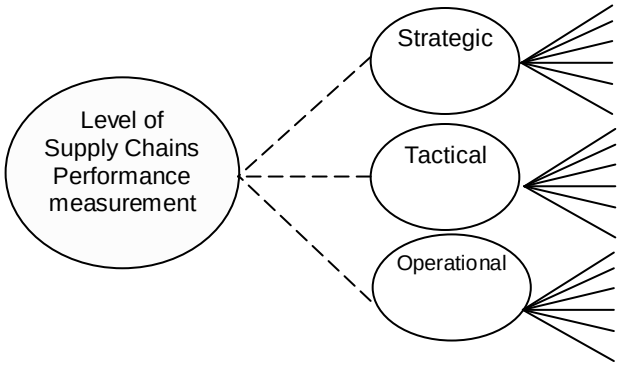

Figure 2. Gunasekaran's model of performance measurement

Chan and Qi identified six key processes (supplier, internal logistics, manufacturing, external logistics, marketing, sale and end users) and provided inner, outer or mixed measures for each one (Chan et al., 2003). Also, they divided performance measures into qualitative and quantitative measures. According to them, some examples of qualitative measures include: customer's satisfaction, resilience, information/material flow integration, risk effective management and provider's performance. Some quantitative measures include: (1) cost-based measures such as minimizing the costs, minimizing the investments on inventories, maximizing the profit and maximizing return on investment (ROI); (2) customer-based measures such as maximizing the percentage of meeting orders (fill rate), minimizing product delivery delays, minimizing responding time to customer, minimizing LT (lead time between receiving an order and delivery) and minimizing function duplication. (3) productivity-based measures such maximizing the usage of capacity and resources (Chan et al., 2003). Figure 3 indicates measures developed by Chan and Qi. In addition to that, SCOR (Supply Cain Operations Reference) model was introduced by Supply-Chain Council (SCC) in 1996 (Theeranuphattana and Tang, 2008). This model was developed to help companies to increase the effectiveness of their supply chains and to create a process-oriented for SCM (Stewart, 1997). SCOR is base model for lots of businesses which provides a framework consists of SC's business processes, measurements, best practices and technological traits (Theeranuphattana and Tang, 2008). This model supports hundreds of functional measurements along with five performance traits: confidence, accountability, flexibility, costs and asset measurements. The definition of each measurement is provided in table 1.

Table 1.Definitions of provided factors in SCOR

Row	Index	Definition
1	SC confidence	SC performance is in right product delivery in right time, in right place, in right status and packaging, in right volume, in right docs and to right customer.
2	SC accountability	SC speed in providing the customers with products.
3	SC flexibility	SC agility in responding to market changes to obtain or keep competitive advantage.
4	SC costs	SC operational costs.

5	SC asset measures	Accountability to demands which includes all fixed and working assets.

Noteworthy, other authors have introduced paramount measures for SC performance assessment.

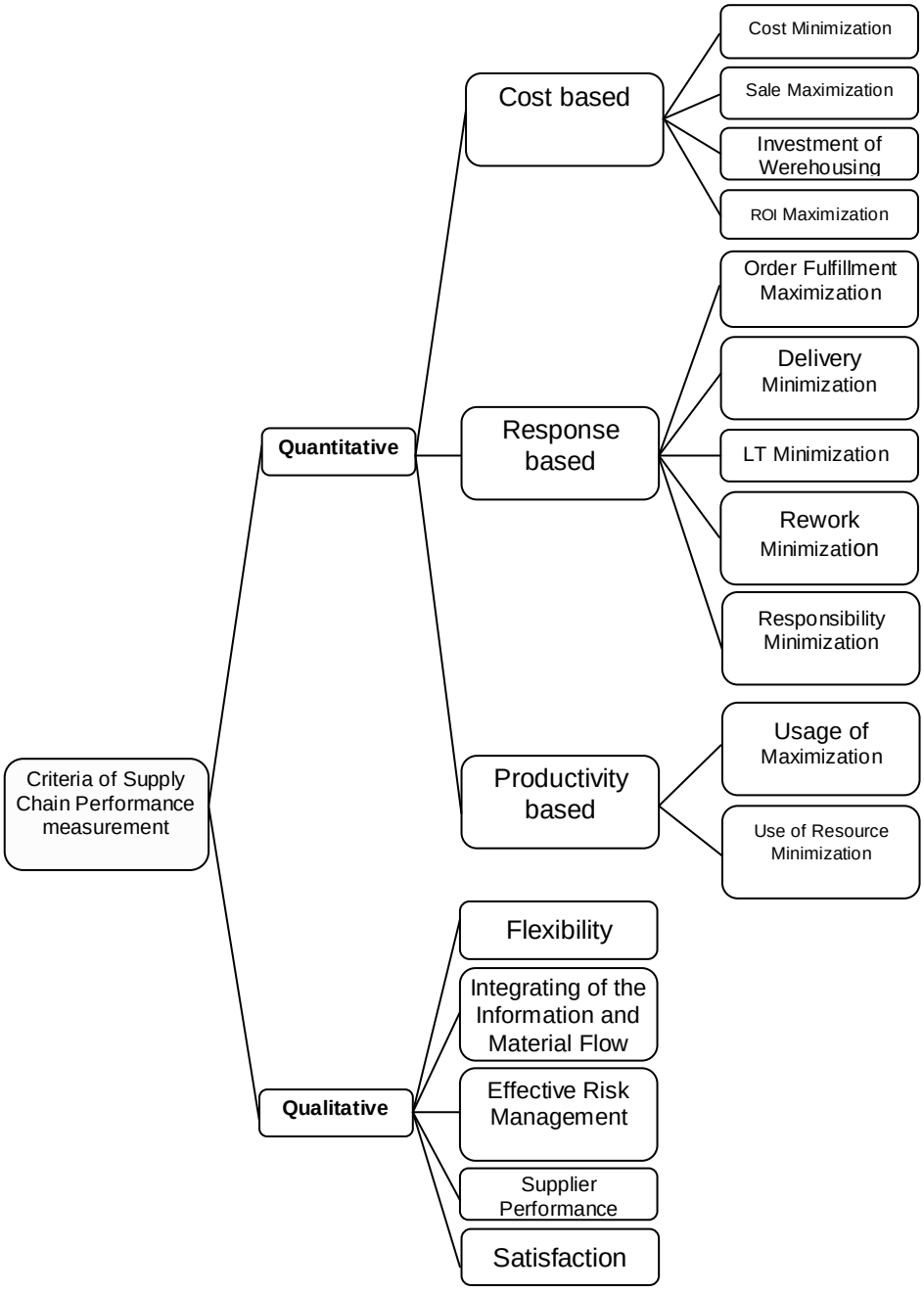

Fig 3. Chan and Qi performance measures (1999)

Theoretically, loan defaults occur when borrowers are not willing and or able to repay loans (Hoque 2004). This paper focuses on the borrowers' ability to repay loans. Among the many factors, high interest rates is the most important one which influences borrowers' ability to repay loans. It widely reported (that high interest rates has devastating effect on investment and growth of an economy though McKinnon (1973) and Shaw (1973) underscored the important of higher real interest rates during inflationary pressure to promote savings and investment in financially repressed economies. Rittenburg (1991) found that too high interest rates was detrimental to investment and growth.

3.Methodolgy

This paper is a survey to rank affecting factors on supply chain performance in auto part manufacturing industry. Initially, affecting factors on SC performance are addressed on the basis of literature and elites' opinions; then, industrial connoisseurs' ideas were gathered for identified factors by a questionnaire; afterwards, KS test is used to analysis the data and to determine the goodness of obtained data from questionnaires. Considering KS test, it is clear that all variables (affective factors on SC performance) significance are under 0.05 in all tests and lead to rejects H0 ,which analyse the variables according to the predetermined distributions. Therefore, it is fully apparent that the distribution of achieved data through questionnaire shows that data do not follow normal, exponential, Poisson and uniform statistical distributions. Noteworthy, normal test results for 34 variables are shown in table 2.

Table 2. KS test results to Normal distribution of data

Test/Factors	1	2	3	4	5	6	7	8	9	10	11	2
Test Statistic	3.525	2.220	2.562	3.385	2.775	2.281	3.341	3.276	3.039	2.312	2.540	3.242
Sig	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Test/Factors	13	14	15	16	17	18	19	20	21	22	23	24
Test Statistic	2.650	3.587	2.486	2.260	2.696	2.128	3.169	2.761	2.327	2.484	3.480	2.468
sig	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Test/Factors	25	26	27	28	29	30	31	32	33	34		
Test Statistic	3.361	2.632	2.487	3.365	2.428	2.053	2.217	2.542	2.759	2.324		
sig	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		

As it mentioned above, according to test results, no variables enjoy statistical distributions (normal, uniform, Poisson and Exponential). Therefore, in present study, data are treated as a distribution-free community. Hence, distribution-free (non-parametric) tests were used to analyze it. In the meantime, sign test is used to identify more important factors than other factors. Finally, Freedman's non-parametric test is used to rank identified important factors in sign test. It should be noted that a questionnaire was designed to measure the importance of criteria and it was evaluated in terms of reliability and validity. The questionnaire was distributed among experts and was collected after determining the sample volume. Data analysis was done by SPSS 15 statistical software and its executive period was limited to summer 2010.

3.1 Research tools

After identifying affecting factors on supply chain performance through literature and theoretical principles of past researches, variables introduced by connoisseurs were evaluated by Delphi technique. After 3 cycles, 34 factors were selected as affecting factors on SC performance. Considered factors were disperse and the necessity to categorize them led into designing a questionnaire to measure than and finally to rank them by distribution-free statistical (non-parametric) techniques. Table 3 enlists affecting factors on SC performance.

Table 3. Factors affecting on SC performance

1. Cycle Time	10. Level of supplier's defect free deliveries	19. Supplier assistance in solving technical problems	28. Quality of delivery documentation
2. Total Cash Flow Time	11. Delivery lead time	20. Supplier ability to respond to quality problems	29. Purchase order cycle time
3. Level of customer perceived value of product	12. Delivery performance	21. Rate of Return On Investment	30.Fill rate
4. Effectiveness of delivery invoice methods	13. Accuracy of forecasting techniques	22.inventory flow rate	31.Lead time
5. Range of product and services	14. Product development cycle time	23.order responsiveness	32.Customer satisfaction
6. Variations against budget	15. Order entry methods	24. Effectiveness of distribution planning schedule	33. Warehouse cost
7. Flexibility to meet particular customer needs	16. Delivery reliability	25. Quality of delivered goods	34.Rate of unfilled orders
8. Buyer-supplier partnership level	17.Information sharing and availability	26.Rejection rate	
9. Supplier cost saving initiatives	18. Master Production Scheduling	27. Frequency of delivery	

The questionnaire consists of 34 items and each question has measured a factor enlisted in table 3 through a Likert's five-item range scale. Each item has asked the respondents the importance of variables in table 3 as affecting factors on SC performance in Iranian auto parts manufacturing firms. Respondents have selected answers from extremely low to extremely high. Initially, the questionnaire was assessed in terms of facial and content validity by elites. Then 30 initial questionnaires were distributed and their possible ambiguities were analyzed. Finally, unlimited population sampling formula was utilized which necessitated to sample 125 subjects. In using this formula, p= 0.5 which shows that maximum needed sample for more confidence. Noteworthy, simple random sampling is used in this research. The population consists of some senior experts

and elites of the industry. It should be noted that 125 were gathered and during data analysis, deficient questionnaire were treated as omitted data.
To test the reliability of developed questionnaire, Chronbach's alpha was used which equaled to 0.89. It shows high reliability of the questionnaire. To test the validity, content analysis and facial credit by elites were used.

4. Data analysis

In this section, we attempt to rank affecting factors on SC performance by using deductive statistical results.
Initially, by using sign test with 99% confidence level, it is tried to identify important factors in elites' perspective. Therefore, two hypotheses are considered for all identified 34 effective factors and their correctness is measured.
H0: according to elites, x effective factor enjoys high importance.
H1: according to elites, x effective factor does not enjoy high importance.
Noteworthy, since Likert's five item range is used in questionnaire to measure the importance rate of affective factors on SC performance, those items are considered as important that are higher 3 or 60% so developed hypotheses are as follows:

H_0 : $\bar{x} \leq 3$ and/or $P \leq \%60$

H_1 : $\bar{x} > 3$ and/or $P > \%60$

The results are illustrated in table 4.

Table 4. Test results of each factor importance

Factors	Sig	Factors	Sig
1. Cycle Time	0.000	18. Master Production Scheduling*	0.422
2. Total Cash Flow Time	0.007	19. Supplier assistance in solving technical problems	0.000
3. Level of customer perceived value of product*	0.040	20. Supplier ability to respond to quality problems	0.000
4. Effectiveness of delivery invoice methods	0.000	21. Rate of Return On Investment	0.394
5. Range of product and services	0.000	22. Inventory flow rate*	0.003
6. Variations against budget*	0.322	23. Order responsiveness	0.000
7. Flexibility to meet particular customer needs	0.000	24. Effectiveness of distribution planning schedule	0.000
8. Buyer-supplier partnership level	0.000	25. Quality of delivered goods	0.000
9. Supplier cost saving initiatives	0.007	26. Rejection rate	0.000
10.Level of supplier's defect free deliveries*	0.390	27. Frequency of delivery	0.000
11. Delivery lead time*	0.466	28. Quality of delivery documentation	0.000
12. Delivery performance	0.000	29. Purchase order cycle time	0.000
13. Accuracy of forecasting techniques	0.000	30. Fill rate	0.004
14. Product development cycle time	0.000	31. Lead time	0.000
15. Order entry methods	0.000	32. Customer satisfaction	0.000
16. Delivery reliability	0.002	33. Warehouse cost	0.000
17. Information sharing and availability	0.000	34. Rate of unfilled orders*	0.466

* deleted variables according to test results

As it is clarified in table 4, the significance rate of such variables as common conception of product value, budget deviation, right product delivery by supplier, delays in product delivery, major product schedule, capital and non-supplying customers' orders are higher than 0.01 which shows that H0 is rejected and H1 is supported. Thus, these seven factors have lower importance than other factors according to elites. Therefore, these seven factors are eliminated from the rest of the research.

Noteworthy, remained 27 factors are considered as affecting factors on SC performance. Hence, we would rank them by Freedman's nonparametric test. So, following hypotheses arise:

H0: according to elites, affecting factors on supply chain performance enjoy similar importance.

H1: according to elites, affecting factors on supply chain performance do not enjoy similar importance.

To reject or support hypotheses, we utilized SPSS 15 to conduct Freedman's test. Results are: $\chi 2 = 486.26$, freedom degree = 26 and significance level = 0.00. Since significance level < 0.01, H0 is rejected and H1 is supported in significance level = 99% which means that the factors are not from the same rank and their priorities are meaningful. Hence, table 5 indicates the results of factors ranking along with the average of each in terms of their importance order.

Table 5. Factors ranking results

Rank	Effective Factors in Supply Chain Performance	Average	Rank	Effective Factors in Supply Chain Performance	Average
1	Purchase order cycle time	17.81	15	Accuracy of forecasting techniques	14.52
2	Order entry methods	17.63	16	Lead time	14.49
3	Quality of delivered goods	17.31	17	Order entry methods	14.44
4	Supplier ability to respond to quality problems	16.06	18	Information sharing and availability	14.35
5	Buyer-supplier partnership level	16.04	19	Frequency of delivery	14.32
6	Cycle Time	15.96	20	Supplier assistance in solving technical problems	13.86
7	Delivery performance	15.96	21	Flexibility to meet particular customer needs	12.95
8	Rejection rate	15.95	22	Total Cash Flow Time	12.94
9	Effectiveness of distribution planning schedule	15.4	23	Supplier cost saving initiatives	11.7

10	Customer satisfaction	15.2	24	Delivery reliability	8.81
11	Range of product and services	15.06	25	Quality of delivery documentation	8.59
12	Order responsiveness	14.68	26	Inventory flow rate	8.34
13	Fill rate	14.6	27	Product development cycle time	6.5
14	Warehouse cost	14.53			

According to Freedman's test results shown in table 5, the most affecting factors on SC performance in Iranian Auto Part Manufacturing Industry include purchase ordering cycle, bill delivery methods, delivered product quality, suppliers' cooperation level, etc.

5. Findings and recommendations

In present research, after identifying affective factors on a supply chain performance in literate and localizing it by using elites' opinions of the industry in Iran, 34 indices were extracted to assess SC performance. Regarding the broadness and the importance of ranking such indices, we analyze them statistically by using questionnaire designing and polling the industrial connoisseurs. After data collection, initial statistical analysis showed that connoisseurs believe that common conception of product value, budget deviation, right product delivery by supplier, delays in product delivery, major product schedule, ROI and non-supplying customers' orders (lack of inventory). In other words, product delivery with a percentage of deficiency, delay in product delivery, incorrect production schedule and lack of inventory are accepted in this industry in Iran. Since these indices as lean management indices are considered as unimportant, one can conclude that the approach of this industry in Iran is a traditional mass production approach by accepting a percentage of error in experts' minds and this can be a major reason of its weakness. Therefore, it is recommended to change the attitudes of industrial managers and experts by using managerial tools and to institutionalize lean management approaches to soar its competition edge. In the meantime, indices ranking show that product innovation and its schedule, resilience in meeting customers' needs, inventory turnover and delivery confidence have lower ranks in this industry. Since mentioned factors are the main important assessment indices in lean management paradigm, it is too important pave the ground to change managers' attitudes on supply performance and to determine more important indices in shaping lean management approach and to create more value for end users.

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