

Review and prioritizing the main affective factors on the supply chain quality management (SCQM) (case study: TONDAR 90 deputy, Iran Khodro Company, Tehran, Iran)

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Abstract: The main aim of this study is reviewing the main affective factors on Supply chain Quality Management (case study: TONDAR 90 Deputy, Iran Khodro Company, Tehran, Iran). This study is descriptive- survey and falls into the category of practical studies. 57 top experts, experts and Supervisors in the TONDAR 90 Deputy, Iran Khodro Company, are the population in this research. After the selection of the sample size, the validity and the credibility of the questionnaire were evaluated using the crambach alpha coefficient and the result was satisfactory. Afterwards, to study level of the main effective factors, the T-test (Binominal) was carried out and Kolmogorov-Smirnov test was utilized. The findings based on the conceptual model of the research and testing the hypotheses depict that the main affective factors on Supply chain Quality Management in this case study are abnormal. And according to one sample T-test, there is a correlation between the independent and dependant factors and the 5 hypothesis of the research are tenable and thus proved. Ranking the main factors analyzed in the conceptual model was based on the Friedman test. In the end, the criteria for prioritizing sub-factors affective on the Supply chain Quality Management are associated with fuzzy TOPSIS techniques.

Key words: Supply chain Quality Management (SCQM); TONDAR 90 Deputy; Iran Khodro Co; Fuzzy TOPSIS Technique

1. Introduction

With the growth of the field of supply chain management, a great deal of effort has gone into defining and creating the related field of supply chain quality management (SCQM) (Flynn et al. 1994, Choi and Eboch 1998, Kuei et al. 2001, Spekman et al. 2002, Flynn and Flynn 2005, Foster 2008, Kaynak and Hartley 2008). SCQM has been defined as: ‘... a systems-based approach to performance improvement that leverages opportunities created by upstream and downstream linkages with suppliers and customers’ (Foster 2008).

As evidence of the importance of this new field, the International Journal of Production Research, the Journal of Operations Management, and the Quality Management Journal have all recently published special issues in SCQM. This call for research is reflective of the degree to which both academics and managers in the field of operations management have become much more cognizant of supply chain management research and practice. This has resulted in an externalization of the traditionally internalized operations view by focusing more attention on upstream and downstream linkages.

Operations management has traditionally been explained by some version of an ‘inputs

transformation process – outputs’ view of the productive capability of the firm. From a quality perspective, operations managers have focused on internal activities such as process control, process improvement, product design improvement, and design of experiments. As a result, most six sigma improvement projects have focused on internal processes and cost reduction (Linderman 2008). Of course, the importance of suppliers and customers has long been emphasized by quality experts. This is found in Deming’s (1986) point about purchasing and not focusing on cost alone. We term the change of focus from an internal process orientation to one that emphasizes linkages with upstream and downstream firms ‘externalization’. Our theory is that as managers become more externalized; they will tend to adopt methods that are more holistic in nature – capturing not only internal processes but upstream and downstream processes and dynamics. With the emphasis on supply chain management, the roles of inter-firm and customer linkages have been elevated (Fawcett *et al.* 2006). This increased emphasis on linkages may have implications for how quality management is practiced and what is emphasized by quality managers. In this paper, we explore the differences between quality management practices of operations managers and supply chain managers, including what quality tools are emphasized by each type of manager. The term ‘tool’ is used broadly for this study. ‘Tool’ can mean a

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method such as benchmarking, an approach to improving quality such as process improvement (PIT) teams, or a managerial concept such as leadership. While SCQM is still in the definitional stage, rigorous studies of SCQM practices and tools have yet to emerge. It is expected that this study will provide direction for researchers and instructors of quality management who wish to emphasize supply chain management.

2. Literature review

With the growth of the field of supply chain management, a great deal of effort has gone into defining and creating the related field of supply chain quality management (SCQM) (Flynn et al. 1994, Choi and Eboch 1998, Kuei et al. 2001, Spekman et al. 2002, Flynn and Flynn 2005, Foster 2008, Kaynak and Hartley 2008). SCQM has been defined as: ‘... a systems-based approach to performance improvement that leverages opportunities created by upstream and downstream linkages with suppliers and customers’ (Foster 2008).

As evidence of the importance of this new field, the International Journal of Production Research, the Journal of Operations Management, and the Quality Management Journal have all recently published special issues in SCQM. This call for research is reflective of the degree to which both academics and managers in the field of operations management have become much more cognizant of supply chain management research and practice. This has resulted in an externalization of the traditionally internalized operations view by focusing more attention on upstream and downstream linkages. Operations management has traditionally been explained by some version of an ‘inputs transformation process – outputs’ view of the productive capability of the firm. From a quality perspective, operations managers have focused on internal activities such as process control, process improvement, product design improvement, and design of experiments. As a result, most six sigma improvement projects have focused on internal processes and cost reduction (Linderman 2008). Of course, the importance of suppliers and customers has long been emphasized by quality experts. This is found in Deming’s (1986) point about purchasing and not focusing on cost alone. We term the change of focus from an internal process orientation to one that emphasizes linkages with upstream and downstream firms ‘externalization’. Our theory is that as managers become more externalized; they will tend to adopt methods that are more holistic in nature – capturing not only internal processes but upstream and downstream processes and dynamics. With the emphasis on supply chain management, the roles of inter-firm and customer linkages have been elevated (Fawcett *et al.* 2006). This increased emphasis on linkages may have implications for how quality management is practiced and what is emphasized by quality managers. In this paper, we

explore the differences between quality management practices of operations managers and supply chain managers, including what quality tools are emphasized by each type of manager. The term ‘tool’ is used broadly for this study. ‘Tool’ can mean a method such as benchmarking, an approach to improving quality such as process improvement (PIT) teams, or a managerial concept such as leadership. While SCQM is still in the definitional stage, rigorous studies of SCQM practices and tools have yet to emerge. It is expected that this study will provide direction for researchers and instructors of quality management who wish to emphasize supply chain management.

3. Materials and methods

The researcher then prepared to consider the issue of research methodology which is chosen. The purpose of this method is determining what research is needed to investigate particular issues and how to make him more accurate and using rapid method to achieve the desired question or questions. According to the present study to collect data, we need hypotheses test or answer questions concerning the current status of the subject. The methodology used in this study is descriptive. "Descriptive research" contains a set of methods that aim to describe the conditions or phenomena under study. Conducting research to further understanding is related to the situation and merely descriptive study can help the decision making process (Sarmad, Bazargan and Hijazi, 1385, 81). This study is descriptive- survey and falls into the category of practical studies. 57 top experts, experts and Supervisors in the TONDAR 90 Deputy, Iran Khodro Company, are the population in this research. After the selection of the sample size, the validity and the credibility of the questionnaire were evaluated using the crambach alpha coefficient and the result was satisfactory. Afterwards, to study level of the main effective factors, the T-test (Binominal) was carried out and Kolmogorov-Smirnov test was utilized. The findings based on the conceptual model of the research and testing the hypotheses depict that the main affective factors on Supply chain Quality Management in this case study are abnormal. And according to one sample T-test, there is a correlation between the independent and dependant factors and the 3 hypothesis of the research are tenable and thus proved. Ranking the main factors analyzed in the conceptual model was based on the Friedman test.

3.1. The statistical population and sample size

A scientific study is done to determine the effect on the target population. For this reason, the topic may find the traits, characteristics, functions, and factors or the relationships found between factors and also characters, actions and reactions and the factors involved in the community. The mass can be expressed as a set of objects or uniform symbols in which it is called a statistical population. The

population of such series is one of the basic concepts that do not define it, but rather is described. Thus, the set of objects can detect one or more characteristics in common, that can collect data (Safari et al, 1384, 51). 57 top experts, experts and Supervisors in the TONDAR 90 Deputy, Iran Khodro Company, are the population in this research.

In other definitions, target population can be defined as follows:

"The population consists of all those elements in a specified geographical scale which is shared with one or more characters." Criterion is:

"A characteristic trait is between all elements of the target population, target population and differentiator from other societies" (Hafez, M., 1377, 119).

Table 1 summarizes the characteristics of study participants are presented for each grade. This table shows that about 14 % of the top experts, 32% experts and 54 % are supervisors.

Table 1: Characteristics of study participants according to institutional Posts

Title	Frequency	Percent
Top experts	8	14
Experts	18	32
Supervisors	31	54
Total	57	100

3.2. Conceptual model

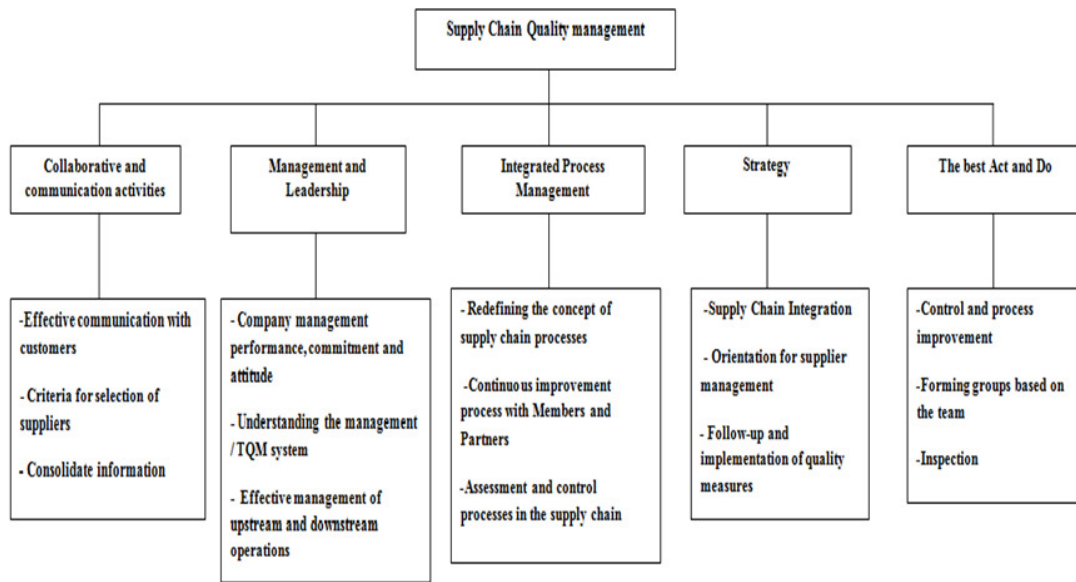


Fig. 1: Conceptual model

In this study, conceptual model (Fig. 1) contains: Collaborative activities and communication, Management and Leadership, Integrated Process Management, Strategy, The best act and Do (as independent factors) and Supply chain Quality Management (as independent variable).

3.3. Research hypotheses

The hypotheses with regard to the conceptual model of the research are as follows:

- 1-There is a correlation between Collaborative activities and communication, and Supply chain Quality Management.
- 2-There is a correlation between Management and Leadership, and Supply chain Quality Management
- 3-There is a correlation between Integrated Process Management and Supply chain Quality Management.
- 4-There is a correlation between Strategy and Supply chain Quality Management.
- 5-There is a correlation between the best act and Do and Supply chain Quality Management.

3.4. Validity and reliability of measurement instruments

Validity refers to rightfulness and correctness (Khaki, 1378, 288). Reliability or validity means that the measuring instrument measures the extent to the desired attribute. To measure the validity of different methods, we should consider its importance for the poor measurement that can trump any scientific research due to its worthless. To increase the reliability and validity of master degree, we discuss top experts and experts and the questions due to eyes modification. 30 questionnaires were distributed to each variable in the statistical population and all ambiguities were identified and corrected. Thus, some questions were deleted and replaced with some other experts' digits mentioned finally in the view of the clarification and then the final questionnaire was distributed.

The following instruments were used to improve the content validity of the questionaire:

- 1-Using the comments of some professors, senior specialists and experts in the fields of industrial engineering and management.
- 2-Similar questionnaires, articles, books, and magazines.
- 3-The initial distribution of questionnaires among some of the directors and top experts and assistants working in different parts of TONDAR 90 Deputy, Iran Khodro Company.

3.5. Reliability of the questionnaire

Reliability analysis is to validate the accuracy and reliability of the interpretation and the words of the phrase. If a measurement tool is suitable for trait variable, at the same time, we consider another place that achieved for similar results. In other words, a reliable and valid instrument means that the property equally has reproducible and quantifiable results (Hafeznia, 1377). In this regard, Cronbach's alpha was used to estimate the reliability of this technique.

There are multiple responses to a questionnaire which are, in fact are examined in recommended test. The method used to calculate the internal consistency of the characteristics, is using measuring instruments. As said, if the alpha coefficient is greater than 0.7, the test of reliability is acceptable.

a-Cronbach relationship is:

$$\alpha = \frac{N}{N-1} \left[\frac{S_t^2 - S_i^2}{S_t^2} \right]$$

Si2: Total Variance

α: Cronbach's alpha coefficient

St2: total variance

N: Number of questions (Sarmad, Bazargan and Hijazi, 1385, 169). Table 2 shows that the Cronbach's alpha values for all factors are greater than 0.7, so reliability are confirmed.

Table 2: Cronbach's alpha values for factors of study

Row	Questionnaire	Cronbach's alpha values
1	SCQM	0.88
2	Collaborative activities and communication	0.83
3	Management and Leadership	0.86
4	Integrated Process Management	0.84
5	Strategy	0.78
6	the best act and Do	0.81

3.6. Fuzzy TOPSIS Technique

Topsis (prioritization method respecting similarities) has been known as one of MCDM classic methods that was developed by Hwang and Yoon in 1981 to solve problems. It was based on ideal determination. Chosen alternative should have the shortest distance from positive ideal and on the

other side longest distance from negative ideal (Hwang & Yoon, 1981). using this model in Iran has been started in early 1370 (solar Iranian calendar) and its use has limited to recent years. (Hwang and Yoon, 1981).

Decision making steps through Topsis -phase technique is as following:

Step 1- gaining weight vectors $w \sim j$

Step 2- normalizing gained matrix by asking experts in relation to strategies that is following matrix:

$$\tilde{R} = [\tilde{r}_{ij}]_{m \times n}$$

Related to interest standards

$$\text{Related to interest standards } B \subseteq \{1, \dots, n\} \quad (1)$$

Related to cost standards $C \subseteq \{1, \dots, n\}$ formula

3.

$$\tilde{r}_{ij} = \left(\frac{a_{ij}}{d_j^*}, \frac{b_{ij}}{d_j^*}, \frac{c_{ij}}{d_j^*}, \frac{d_{ij}}{d_j^*} \right), \quad j \in B \quad (2)$$

$$\tilde{r}_{ij} = \left(\frac{a_j^-}{d_{ij}}, \frac{a_j^-}{c_{ij}}, \frac{a_j^-}{b_{ij}}, \frac{a_j^-}{a_{ij}} \right), \quad j \in C \quad (3)$$

Step 3: So the weighting matrix is like following fomula:

$$\tilde{V} = [\tilde{v}_{ij}]_{m \times n}, \quad i = 1, 2, \dots, m, \quad j = 1, 2, \dots, n$$

$$\tilde{v}_{ij} = \tilde{r}_{ij} \otimes \tilde{w}_j \quad (4)$$

Step 4: determining Fuzzy Positive Ideal

Solution11 (FPIS) \tilde{v}_j^* and Fuzzy Negative Ideal

Solution *(FNIS) \tilde{v}_j^-
(5,6 formula)

$$\tilde{v}_j^- = \begin{cases} \min_{i=1, \dots, m} \tilde{v}_{ij}; j \in B \\ \max_{i=1, \dots, m} \tilde{v}_{ij}; j \in C \end{cases} \quad (5)$$

$$\tilde{v}_j^* = \begin{cases} \max_{i=1, \dots, m} \tilde{v}_{ij}; j \in B \\ \min_{i=1, \dots, m} \tilde{v}_{ij}; j \in C \end{cases}$$

$$FPIS = \{\tilde{v}_j^* \mid j = 1, \dots, n\}$$

$$FNIS = \{\tilde{v}_j^- \mid j = 1, \dots, n\} \quad (6)$$

step 5: calculation of size distances by fuzzy Oghlidos distance

$$D(\tilde{a}, \tilde{b}) = \sqrt{\frac{1}{4} [(a_1 - b_1)^2 + (a_2 - b_2)^2 + (a_3 - b_3)^2 + (a_4 - b_4)^2]} \quad (7)$$

distance of each strategy from positive ideal is calculated by formula 8

*. Fuzzy Negative Ideal Solution

$$d_i^* = \sum_{j=1}^n d(\tilde{v}_{ij}, \tilde{v}_j^*), i = 1, \dots, m \quad (8)$$

:distance of each strategy from positive ideal is calculated by formula 9:

$$d_i^- = \sum_{j=1}^n d(\tilde{v}_{ij}, \tilde{v}_j^-), i = 1, \dots, m \quad (9)$$

Step 6: calculation of relative proximity to positive and ranking (formula 10)

$$CI_i = \frac{d_i^-}{d_i^- + d_i^*}, \quad (10)$$

From combination of analysis of strong and weak points, opportunities, threats and Topsis-Fuzzy in 2008 by Celik et al. (2008) for writing and prioritization of strategies in 5 important ports of Turkey namely Ezmir, Mersinm, Heydarpasa, Embarli and Jampor was used. Six strategies, one for all ports and five for each one for one port were suggested and their performing caused a high increase in structural dimension of Turkish ports among European ports (Celik et al, 2009). Because of deficit information or unavailable information in real world, data aren't usually absolute; but often are fuzzy. So in this study, it was tried to use Topsis method with fuzzy data in order to dimension prioritization of main affective factors on SCQM (case study: TONDAR 90 Deputy, Iran Khodro Company). Examined standards are used for prioritization of mentioned sub-scales of effective factors on (SCQM). Fuzzy values of verbal factors for

acceptability of each alternative have been shown in table 3(Chen, 2000).

Table 3: verbal factors for weight determination of standards or scales

Very little	VL	(0, 0, 1, 2)
little	L	(1, 2, 2, 3)
Less than average	ML	(2, 3, 4, 5)
Average	M	(4, 5, 5, 6)
More than average	MH	(5, 6, 7, 8)
great	H	(7, 8, 8, 9)
Very great	VH	(8, 9, 10, 10)

4. Data analysis

In this part of the study, we try to be proportionate to the objectives and methodology of research (surveys) using statistical techniques to quantify hypotheses.

4.1. Kolmogorov-Smirnov Test

This test is done to check the normality of data distribution and was used in the statistical community. The results obtained from the use of these tests are presented in Table 4.

H0: The population of normally distributed data sets.

H1: The population distribution of abnormal data sets.

Table 4: One-Sample Kolmogorov-Smirnov Test Friedman Test

		Collaborative activities and communication	Management and Leadership	Integrated Process Management	Strategy	The best action and run it
N		57	57	57	57	57
Normal Parameters ^{a,b}	Mean	3.5571	3.8168	3.4247	3.1622	3.7814
	Std. Deviation	.53394	.56471	.56228	.57332	.53196
Most Extreme Differences	Absolute	.081	.076	.085	.087	.073
	Positive	.065	.058	.042	.053	.062
	Negative	-.074	-.077	-.087	-.072	-.081
Kolmogorov-Smirnov Z		1.047	3.761	1.025	1.106	1.085
Asymp. Sig. (2-tailed)		.034	.018	.004	.011	.027
a. Test distribution is Normal. b. Calculated from data.						

As seen in Table 3, obtained error value is less than R error variable. Therefore, to test the null hypothesis, using normal distribution of data in a statistical population is rejected. Thus, we use analysis of data from a series of nonparametric statistics.

4.2. Friedman test

The test to check whether the same factors that affect the priority of (SCQM) is used.

That is the same review priority hypothesis test factors:

H0: factors are identical.

H1: Priority factors are not identical.

As seen in Table 5,6 the obtained sig is less than the error of study (0.05), so to test the null hypothesis, equal Priority factors are rejected.

Table 5:The results using the Friedman test.

Test Statistics ^a	
N	57
Chi-Square	83.815
Df	4
Asymp. Sig.	.000
a. Friedman Test	

Table 6: The ranking of the main factors

Factors	Mean Rank
Collaborative activities and communication Management and Leadership	3.32
Integrated Process Management	4.47
Strategy	4.16
The best action and run it	3.85
	3.51

As seen in Table 6, Management and Leadership is the first importance factor; Integrated Process Management is the second importance factor and third importance factor is Strategy.

4.3. Binomial test

The results of applying this test showed that all factors were desirable.

4.4. Result of applying Fuzzy TOPSIS Technique

The final result of Fuzzy decision making matrix and fuzzy weight of effective factors on Supply chain Quality Management (case study: TONDAR 90 Deputy, Iran Khodro Company, Tehran, Iran) by using experts' comments was resulted as following:

This test was used to assess the levels of the factors.

Table 7: Results of applying the binomial test

Factors	The Observed Rate	Ratio Test	Sig	Test Result
SCQM	0.82	0.6	0.000	Desired level
Collaborative activities and communication	0.75		0.000	Desired level
Management and Leadership	0.79		0.000	Desired level
Integrated Process Management	0.67		0.000	Desired level
Strategy	0.7		0.000	Desired level
the best act and Do	0.63		0.000	Desired level

Table 8: final ranking of sub-factors of main affective factors on (SCQM) (Case Study: TONDAR 90 Deputy, Iran Khodro company)

Main Factors	Sub Factors	D _i ⁺	D _i ⁻	C _i	Rank
Collaborative activities and communication	Effective communication with customers	2.438539	2.716553	0.594224099	3
	Criteria for selection of suppliers	2.110224	3.090242	0.508956518	10
	Consolidate information	2.561314	2.587559	0.468071316	15
Management and Leadership	Company management performance, commitment and attitude	2.361873	2.8244	0.619973673	1
	Understanding the management / TQM system	2.554583	2.647773	0.540392894	7
	Effective management of upstream and downstream operations	3.001229	2.139014	0.612935467	2
Integrated Process Management	Redefining the concept of supply chain processes	2.017396	3.157664	0.508619016	11
	Continuous improvement process with Members and Partners	2.687146	2.441314	0.544591466	6
	Assessment and control processes in the supply chain	3.0055	2.101331	0.518195462	4
Strategy	Supply Chain Integration	2.099394	3.094573	0.521656547	8
	Orientation for supplier management	1.935104	3.222448	0.505853128	12
the best act and Do	Follow-up and implementation of quality measures	2.31467	2.847924	0.503813631	13
	Control and process improvement	2.810787	2.363849	0.565729402	5
	Forming groups based on the team	2.556347	2.586767	0.540392894	9
	Inspection	1.983848	3.236443	0.502548655	14

As it is seen in above table "Company management performance, commitment and attitude" as the most important sub-factors that is important on main affective factors on (SCQM) (case study: TONDAR 90 Deputy, Iran Khodro company) .also "Effective management of upstream and downstream operations and Control Effective communication with customers" are in the next rankings.

5. Discussion and conclusions

This paper represents another step in the process of understanding and more clearly defining of the main affective factors of supply chain quality management. we found support for the hypothesis that operations and supply chain managers do approach quality management from differing

perspectives. In the following paragraphs, we will discuss these differences.

Based on the result of this research, Management and Leadership is the first importance factor; Integrated Process Management is the second importance factor and third importance factor is Strategy based on Friedman Test. Also, As it is seen in above table "Company management performance, commitment and attitude" as the most important sub-factors that is important on main affective factors on (SCQM) (case study: TONDAR 90 Deputy, Iran Khodro company). also "Effective management of upstream and downstream operations and Control Effective communication with customers" are in the next rankings.

Therefore, we propose to managers that more attention to these main factors for efficiency (SCQM) in all of the organization.

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