A Conceptual Model for Supply Chain Relations Quality and Supply Chain Performance by Structural Equation Modeling: A Case Study in the Iranian Automotive Industry

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Abstract
Nowadays, Companies to develop close relationships with suppliers and customers alike are encouraged. Reviewing dimensions of quality and supply chain relationships, makes better understanding of relationships and interactions between suppliers and the cause it can be used to achieve supply chain performance (SCP). The aim of this paper, is presenting a conceptual model for supply chain relationship quality (SCRQ) and Supply Chain Performance (SCP) in supply chain (SC) of SAIPA Company.

In this study, after reviewing the related literature; firstly, the effective factors in the SCRQ and SCP were identified. Secondly, questionnaires were distributed among SAIPA supply chain experts. Then, 201 filled questionnaires were collected. Next, Factor Analysis and Structural Equation Modeling were used to discover the relation between SCRQ and SCP; as a result, the proposed model was extracted. Our findings show that there is the significant and positive relationship between SCRQ and SCP in supply chain of SAIPA Company.

Keywords: Supply chain relationship quality (SCRQ), Supply Chain Performance (SCP), structural equation modelling (SEM), Supply chain of SAIPA Company.

1. Introduction
Iranian automotive industry will become the most important industry in Iran through years. Jointing to World Trade Organization (WTO), from one hand will force companies to pay International Trade Tariffs and on the other hand multi-aspects competition is absorbing special consideration to this industry in Iran.

Importance of SC is convincing companies to tie their competitive existence to SCM (Zuckerman, 2002). Supply Chain Management (SCM) is set of approaches integrates suppliers, manufacturers, warehouses, and markets. This integration causes products manufactured in best cost, time, and place. This exactness will reduce total costs in SC and will satisfy customers’ demand (Simchi and Kaminsky, 2000.).

In recent years, relationships in SC are dealing with impressive changes. Companies eagerly courage to establish and develop close and long term relationships with their suppliers (Fynes et al.,
Identifying different aspects of SCRQ, is leading to better understanding of relations and interactions between suppliers and will promote SCP (Fynes et al., 2008). Empirical studies in SCR are focused on the nature of relationship process and researchers were underestimating study on SC effects on companies' performance (Fynes et al., 2004).

Empirical research in the area of supply chain (SC) relationships have predominantly focused on the nature of relationship processes rather than their effect on performance (Styles and Ambler, 2000). A review on literature obviously depict that not only are there some researches investigate interactions between different dimensions of SCR (Fynes et al., 2004; Woo and Ennew, 2004; Fynes et al., 2005a; Fynes et al., 2005b; Huntley, 2006; Rauyruen and Miller, 2007; Fynes et al., 2008 and Su et al., 2008), but also researchers studied SCP. However, there are a few ones focusing on SCR's effect on SCP (Fynes et al., 2004; Fynes et al., 2008). Any way this lack of study motivated us to consider relationship between SCRQ and SCP in SC of SAIPA Company in automotive industry.

The aim of this paper is investigating interactions between indicators supply chain relationship quality (SCRQ) and SCP in supply chain SC of SAIPA Company. This study was using second source data and case study. First we studied literature of SCRQ, SCP, and searches about SCRQ's impact on different aspects of a company. After reviewing the literature and identification of indicators, a questionnaire between experts was distributed and 201 questionnaires were completed. At the end we utilized structural equation modeling (SEM) by Lisrel 8.5 software and analysis output was published. By performing this research, we hope that some light is shed on the relationship between SCRQ and SCP in automotive industry.

2. Previous Research

2.1. Supply Chain Relationship Quality (SCRQ)

Keller (2002) found that long term and useful relationship between different parts of a SC can make a powerful SC. Also Saad et al. (2001) identified continuous and long term relationship between organizations is an important factor in SCM. Su et al. (2008) defined SCRQ as a degree that partners in a relationship are committing to have a long and active relationship. In Table 1 there is a short review of researches about quality of relationships between two businesses (B2B).

Table 1: A review of relationships between quality and performance in B2B

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Key dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fynes et al. (2004)</td>
<td>Trust, adaptation, co-operation, and communication</td>
</tr>
<tr>
<td>Fynes et al. (2005a)</td>
<td>Communication, co-operation, interdependence, commitment, trust, and adaptation</td>
</tr>
<tr>
<td>Fynes et al. (2005b)</td>
<td>Communication, co-operation, commitment, and adaptation</td>
</tr>
<tr>
<td>Rauyruen and Miller (2007)</td>
<td>Trust, satisfaction, commitment, and service quality</td>
</tr>
<tr>
<td>Fynes et al. (2008)</td>
<td>Communication, co-operation, adaptation, and trust</td>
</tr>
<tr>
<td>Su et al. (2008)</td>
<td>Trust, communication, co-operation, atmosphere, and adaptation</td>
</tr>
</tbody>
</table>

2.2. SCRQ's Dimensions

We define different dimensions in SCRQ operationally that is collected from literature study.

2.2.1. Communication (CM)

Communication difficulties are identified as a major cause of problems among relationship parties (Lages et al., 2005). Also Anderson and Narus (1990) defined it as a meaningful and on time share of information in a formal or informal ways between companies. Mohr and Spekman (1994) stated that there are three aspects of communication behavior that are important in relationships. Firstly, the quality of the communication which includes aspects such as accuracy, timeliness, adequacy and
credibility. Secondly, the form of information sharing or the extent to which critical, and sometimes proprietary, information is exchanged. Thirdly, participation, or the extent to which both parties jointly engage in planning and goal setting. The quality of communication, information sharing and participation are all significant predictors of successful SC relationships.

2.2.2. Trust (T)
An important reason for unsuccessful relationships is the lack of trust between the partners. The establishment of trust is considered as the basic reason for the long-term successful relationships by both researchers and practitioners (Walter et al., 2002). Also Ryssel and Ritter (2000) defined it as customer trust as a degree that a customer believe a supplier is honest, suitable, and benevolent. In another definition, it is defined as expectations and attitudes that eventually are forming between partners in a relationship.

2.2.3. Adaptation (A)
How much a buyer or seller does invest on developing a relationship to make it more flexible? (Ford and Håkansson, 2006). Adaptations are important for a number of reasons. Firstly, they can represent considerable investments by one or both parties. Secondly, they may be of critical importance for the conduct of business. Thirdly, the investments frequently cannot be transferred to other SC relationships. Fourthly, the adaptations may have significant consequences for the long-term competitiveness of firms: adapting to one relationship may enhance the competencies and attractiveness of a particular supplier/customer (Fynes et al., 2005a).

2.2.4. Commitment (C)
How interested are partners in a relationship to increase their dependency? It suggests a kind of prospective approach that helps partners to face with unpredictable problems in future (Gundlach et al., 1995). Also Mohr and Spekman (1994) found a positive correlation between commitment and partnership success.

2.2.5. Interdependence (I)
A company's need to keep its interaction balance for approaching its goals. Interdependence between partners is affected by: 1) Amount of trade off between company A and company B, and percentage of benefits gained by each other's cooperation; 2) How much commitment does have company A to marketing strategies of company B?; 3) How much supportive are companies to make decisions, entering to a new market or leaving the present market? (Fynes et al., 2005a).

2.2.6. Co-operation (CO)
All the activities held in common or directed cooperation with others for obtaining shared points, goals and interests. This co-operation contained interests, future expectations, and special behaviors (Su et al., 2008). Co-operation in exchanging information on production schedules, new products/processes and value analysis can both reduce product costs and improve product/process innovations (Landeros and Monczka, 1989).

2.2.7. Atmosphere (AT)
Woo and Ennew (2004) are describing it as a result of relationship that shows closeness of two partners. They mentioned that atmosphere is like environment in some aspects like on technical principles from the external situation of a company. Of course there are some differences. Atmosphere is a result of relationship with others. Also Su et al. (2008) stated that Atmosphere exceeds trust and commitment, and it gives a wider perspective to understand relationship quality from partner-based view. The atmosphere surrounding the buyer–seller relationship is also of relevancy to the conceptualization of relationship quality. Therefore, the following hypothesis is proposed.
2.3. Supply Chain Performance (SCP)

There are a lot of empirical studies about SCR’s effect on operational performance in a company. These studies have different definitions of SC, measurement and performance approaches.

For instance, Narasimhan and Jayaram (1998) had shown that relationship quality leads to better operational performance. They had found that integration of different activities of SC like resource allocation is leading to operational goals consists of reliability, cost flexibility, and quality. They examined the relationship between sourcing decisions, manufacturing goals, customer responsiveness and manufacturing performance using structural equation modeling (SEM). They found that integrating SC activities involves aligning sourcing decisions achieves manufacturing goals in terms of dependability, flexibility, cost and quality.

Uzzi (1997) had mentioned to a clear relationship between relationship quality and performance in clothing industry in New York.

Fynes et al. (2004) stated that the recurring theme in all of these studies is the role of SC management in improving SC performance. They said that Thus while SC dimensions such as trust, and adaptation have been widely tested in the marketing literature in terms of their impact on marketing performance, their impact on SC performance has received less attention in the operations and supply chain management literature.

Also Fynes et al. (2008) utilized quality performance, Delivery performance, cost performance, and flexibility performance to evaluate SCP. The questionnaire we use for gleaning data in this paper is what they implemented for their research.

2.4. Structural Equation Modeling (SEM)

SEM is a comprehensive statistical approach to testing hypotheses about relations among observed and latent variables. A major advantage of SEM is the ability to estimate a complete model incorporating both measurement and structural considerations. We tested the measurement and research models by applying a structural equation modeling (SEM) approach, using the computer software program LISREL 8.5 with 201 samples. We used a variety of indices to evaluate model fit. The seven fit indices used and values indicating acceptable model fit include:

1. The ratio of the $\chi^2$ statistic to its degrees of freedom, with values of less than 3 indicating acceptable fit;
2. Root mean squared error of approximation (RMSEA), with values below 0.08 representing acceptable fit;
3. Goodness of fit index (GFI), with values exceeding 0.9 indicating good fit;
4. Adjusted GFI (AGFI), with values exceeding 0.8 indicating acceptable fit (Ngai et al., 2007).

3. Hypotheses and Proposed Model

This Proposed model is composed of two kinds of variables: supply chain relationship quality (SCRQ) and Supply Chain Performance (SCP). The conceptual model incorporating the research hypotheses is shown in the following figure.
According to the above-mentioned figure research main hypothesis is

**H1:** SCRQ will positively influence SCP meaningfully.

**And Research Sub hypothesizes are**

**H2:** SCRQ is defined as a higher-order construct which represents (a) communication, (b) trust, (c) adaptation, (d) commitment, (e) interdependence, (f) cooperation, and (g) atmosphere.

**H3:** SCP is defined as a higher-order construct which represents (a) quality performance, (b) delivery performance, (c) cost performance and (d) flexibility performance.

4. Research Methodology

4.1. Research Method

Research method is used for this article is descriptive-correlation. This study was using second source (library and other recorded observations) data and case study. First we studied literature of SCRQ, SCP, SEM, and researches about SCRQ's impact on different aspects of a company. Criteria were extracted and we distributed questionnaires between experts and professionals in SAIPA's SC and 201 filled questionnaires were gathered. At the end we utilize structural equation modeling (SEM) by Lisrel 8.5 software and analysis output was published.

4.2. Statistical Population and Sample Size

The formal survey was conducted based on the preliminary survey and the duration is approximately four months, from August 2010 to November 2010. Statistical population in this research is including Industrial Experts (CEO, Logistic experts, Operational marketing managers) in SAIPA supply chain and composed of three levels in SC. Up streams (First level suppliers), company itself and Down streams (First level customer: SAIPA YADAK Company). There were 398 Experts in 6 companies.

With regard to population, sample size was determined and it was about 196 persons. We used random classified sampling for this research. Table 2 is illustrating the ratio of this groups and sample sizes. After distribution of 285 questionnaires with an overall response rate of 70.5%; we could gather 201 filled questionnaires from experts. Participants were informed of the main objective of the study, and also were presented with a written definition of keywords to build shared concept. They were
encouraged to sincerely respond to all the questions in the questionnaire and were assured of absolute anonymity.

Table 2: Population and sample size in 6 companies in SAIPA’s SC

<table>
<thead>
<tr>
<th>Company</th>
<th>SAIPA YADAK</th>
<th>SAIPA AZIN</th>
<th>SAIPA Press</th>
<th>MEGA Motor</th>
<th>SAZE GOSTAR</th>
<th>SAIPA</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC position</td>
<td>Down stream</td>
<td>Up stream</td>
<td>Up stream</td>
<td>Up stream</td>
<td>Up stream</td>
<td>Central part</td>
<td>...</td>
</tr>
<tr>
<td>Population size</td>
<td>46</td>
<td>39</td>
<td>36</td>
<td>45</td>
<td>180</td>
<td>52</td>
<td>398</td>
</tr>
<tr>
<td>% in population</td>
<td>11.5%</td>
<td>9.8%</td>
<td>9.1%</td>
<td>11.3%</td>
<td>45.2%</td>
<td>13.1%</td>
<td>100%</td>
</tr>
<tr>
<td>Sample size</td>
<td>24</td>
<td>23</td>
<td>20</td>
<td>28</td>
<td>77</td>
<td>29</td>
<td>201</td>
</tr>
<tr>
<td>% in sample</td>
<td>11.9%</td>
<td>11.4%</td>
<td>9.9%</td>
<td>13.9%</td>
<td>38.4%</td>
<td>14.5%</td>
<td>100%</td>
</tr>
</tbody>
</table>

4.3. Information Gathering Tools

Implemented questionnaires are composed of two parts: 26 questions about SCRQ's dimensions make the first part, communication, trust, adaptation, interdependence, and co-operation with 4 questions each and commitment and atmosphere with 3 questions. Second part was about SCP that contained 8 questions about quality performance, Delivery performance, cost performance, and flexibility performance (with 2 questions each).

4.4. Reliability and Validity

4.4.1. Reliability

The summary statistiSCP of formal survey are shown in Table 3. For reliability evaluation we utilized Cronbach's alpha. The Cronbach's alpha reliability of all the ten latent variables are more than 0.6 ($\alpha$>0.6), which indicates all scales demonstrate good reliability.

Table 3: The summary statistiSCP of formal survey

<table>
<thead>
<tr>
<th>Instrument</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>$\alpha$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td>4</td>
<td>3.4440</td>
<td>0.62323</td>
<td>0.702</td>
</tr>
<tr>
<td>Trust</td>
<td>4</td>
<td>3.6692</td>
<td>0.71414</td>
<td>0.726</td>
</tr>
<tr>
<td>Adaptation</td>
<td>4</td>
<td>3.2761</td>
<td>0.64875</td>
<td>0.798</td>
</tr>
<tr>
<td>Commitment</td>
<td>3</td>
<td>3.2289</td>
<td>0.69252</td>
<td>0.711</td>
</tr>
<tr>
<td>Interdependence</td>
<td>4</td>
<td>3.4192</td>
<td>0.69191</td>
<td>0.703</td>
</tr>
<tr>
<td>Co-operation</td>
<td>4</td>
<td>3.5460</td>
<td>0.80781</td>
<td>0.868</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>3</td>
<td>3.1509</td>
<td>0.66991</td>
<td>0.650</td>
</tr>
<tr>
<td>SCRQ</td>
<td>26</td>
<td>......</td>
<td>......</td>
<td><strong>0.919</strong></td>
</tr>
<tr>
<td>Quality performance</td>
<td>2</td>
<td>3.3657</td>
<td>0.78541</td>
<td>0.723</td>
</tr>
<tr>
<td>Delivery performance</td>
<td>2</td>
<td>3.6816</td>
<td>0.66001</td>
<td>0.753</td>
</tr>
<tr>
<td>Cost performance</td>
<td>2</td>
<td>2.7761</td>
<td>0.73629</td>
<td>0.777</td>
</tr>
<tr>
<td>Flexibility performance</td>
<td>2</td>
<td>3.1915</td>
<td>0.92162</td>
<td>0.796</td>
</tr>
<tr>
<td>SCP</td>
<td>8</td>
<td>......</td>
<td>......</td>
<td><strong>0.819</strong></td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td>......</td>
<td>......</td>
<td><strong>0.936</strong></td>
</tr>
</tbody>
</table>

N = Number of questions (items), SD=standard deviation; $\alpha$= Cronbach's alpha coefficient.

4.4.2. Validity

For evaluating validity of questionnaires, we used content validity and construct validity.

4.4.2.1. Content Validity

Content validity deals with how representative and comprehensive the items were in creating the scale. It is assessed by examining the process by which scale items are generated (Moon and Kim, 2001). Content validity assured us that all aspects and parameters that impact on main content were evaluated.
For testing content validity after devising a framework for questionnaire, we asked 16 experts to modify it if needed. These experts evaluated all implemented criteria in questionnaire and modified it.

4.4.2.2. Construct Validity

Construct validity determines the extent to which a scale measures a variable of interest (Moon and Kim, 2001). In this research, we used factor analysis for considering the structure of research. Exploring factor analysis and criteria factor was used to investigate the construction of questionnaire. Factor analysis depicted that all mentioned criteria are measured in these questionnaires.

5. Data Analysis

Data analysis is accomplished by inferential statistics techniques particularly exploratory factor analysis and confirmatory factor analysis. In this section, 26 variables related to SCRQ and 8 variables related to SCP are factored through factor analysis method. Results shown in Tables 4 to 5.

The relationships between variables are identified using exploratory factor analysis and then the factoring is implemented. The result is applied in structural equation modeling (SEM) used in confirmatory factor analysis. The variables are properly factored during the exploratory factor analysis. Through confirmatory factor analysis in structural equation modeling (SEM) factoring is either accepted or rejected.

The software SPSS 18.0 is applied for first analysis and Lisrel 8.53 is applied for the second. In the following sections, the results of exploratory factor analysis and after that the results of SEM are presented. The secondary hypothesis, that is H2 and H3, are studied. Finally, the main hypothesis is explained after the confirmatory factor analysis of both sides of the model separately. In fact we have tested our proposed model in three steps:

1. SCRQ: its latents and indicators;
2. SCP: its latents and indicators; and
3. The effect of SCRQ on SCP.

5.1. The Results of Exploring Factor Analysis

5.1.1. Exploring Factor Analysis Result of SCRQ's Questionnaire

We considered 26 questions by factor analysis and based on 201 gathered questionnaires; KMO was 0.802 showing that the sample size was enough. Also considering the fact that sig. in Bartlett test was lower than 0.05. The Total Variance Explained for the seven factors in the questionnaire was found to be 68.63%, which explains the variance of the concept of SCRQ, in fact indicating a high level of reliability for the questionnaire. The result of Exploratory Factor Analysis for the SCRQ model has been shown in Table 4.

Table 4: Rotated Component Matrix for the SCRQ model
5.1.2. Exploring Factor Analysis Result of SCP's Questionnaire

We considered 8 questions by factor analysis and based on 201 gathered questionnaires; KMO was 0.743 showing that the sample size was enough. Also considering the fact that sig. in Bartlett test was lower than 0.05. The Total Variance Explained for the four factors in the questionnaire was found to be 88.66%, which explains the variance of the concept of SCP, in fact indicating a high level of reliability for the questionnaire. The result of Exploratory Factor Analysis for the SCP model has been shown in Table 5.

Table 4:  Rotated Component Matrix for the SCRQ model - continued

<table>
<thead>
<tr>
<th></th>
<th>.574</th>
<th>.388</th>
<th>-.010</th>
<th>.182</th>
<th>.136</th>
<th>.116</th>
<th>-.048</th>
</tr>
</thead>
<tbody>
<tr>
<td>A3</td>
<td>.449</td>
<td>.381</td>
<td>.199</td>
<td>-.222</td>
<td>.393</td>
<td>-.206</td>
<td>.178</td>
</tr>
<tr>
<td>A4</td>
<td>.157</td>
<td>.288</td>
<td>.690</td>
<td>-.138</td>
<td>.145</td>
<td>.056</td>
<td>.055</td>
</tr>
<tr>
<td>I1</td>
<td>.408</td>
<td>.242</td>
<td>.497</td>
<td>.125</td>
<td>-.016</td>
<td>.223</td>
<td>-.043</td>
</tr>
<tr>
<td>I2</td>
<td>.032</td>
<td>.107</td>
<td>.729</td>
<td>.018</td>
<td>.017</td>
<td>.235</td>
<td>.168</td>
</tr>
<tr>
<td>I3</td>
<td>.087</td>
<td>.027</td>
<td>.731</td>
<td>.480</td>
<td>.152</td>
<td>-.120</td>
<td>-.102</td>
</tr>
<tr>
<td>I4</td>
<td>.333</td>
<td>.266</td>
<td>.303</td>
<td>.089</td>
<td>.351</td>
<td>.445</td>
<td>.251</td>
</tr>
<tr>
<td>T1</td>
<td>.253</td>
<td>.160</td>
<td>.305</td>
<td>.089</td>
<td>.351</td>
<td>.445</td>
<td>.251</td>
</tr>
<tr>
<td>T2</td>
<td>.163</td>
<td>-.067</td>
<td>.049</td>
<td>.227</td>
<td>.217</td>
<td>.807</td>
<td>.013</td>
</tr>
<tr>
<td>T3</td>
<td>.134</td>
<td>.249</td>
<td>.346</td>
<td>-.061</td>
<td>-.013</td>
<td>.702</td>
<td>.324</td>
</tr>
<tr>
<td>T4</td>
<td>.449</td>
<td>.376</td>
<td>.028</td>
<td>.151</td>
<td>.259</td>
<td>-.098</td>
<td>.451</td>
</tr>
<tr>
<td>AT1</td>
<td>.129</td>
<td>.160</td>
<td>.072</td>
<td>.066</td>
<td>.271</td>
<td>.153</td>
<td>.789</td>
</tr>
<tr>
<td>AT2</td>
<td>.349</td>
<td>.143</td>
<td>.103</td>
<td>.293</td>
<td>-.203</td>
<td>.098</td>
<td>.686</td>
</tr>
</tbody>
</table>

Table 5:  Rotated Component Matrix for the SCP model

<table>
<thead>
<tr>
<th></th>
<th>Flexibility performance</th>
<th>Quality performance</th>
<th>Delivery performance</th>
<th>Cost performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>QP1</td>
<td>.336</td>
<td>.755</td>
<td>.249</td>
<td>-.199</td>
</tr>
<tr>
<td>QP2</td>
<td>.024</td>
<td>.830</td>
<td>.140</td>
<td>.328</td>
</tr>
<tr>
<td>CP1</td>
<td>.390</td>
<td>.519</td>
<td>-.126</td>
<td>.569</td>
</tr>
<tr>
<td>CP2</td>
<td>.104</td>
<td>.046</td>
<td>.279</td>
<td>.871</td>
</tr>
<tr>
<td>FP1</td>
<td>.121</td>
<td>.182</td>
<td>.889</td>
<td>.202</td>
</tr>
<tr>
<td>FP2</td>
<td>.494</td>
<td>.114</td>
<td>.704</td>
<td>.068</td>
</tr>
<tr>
<td>DP1</td>
<td>.849</td>
<td>.064</td>
<td>.269</td>
<td>.095</td>
</tr>
<tr>
<td>DP2</td>
<td>.823</td>
<td>.278</td>
<td>.136</td>
<td>.163</td>
</tr>
</tbody>
</table>

5.2. The Results of Confirmatory Factor Analysis

5.2.1. X model; Measurement Model of SCRQ

In the initial step we applied confirmatory factor analysis in Lisrel 8.5 and eventually conducted path diagram of X model as per Figure 2. We have tested relationship between SCRQ latent and its indicators. Fitness's indices in Table 6 shows good fitness of our X model, proving selected indicator are good representative for each dimension of SCRQ. Also SCRQ is defined as a higher-order construct which represents (a) communication, (b) trust, (c) adaptation, (d) commitment, (e) interdependence, (f) cooperation, and (g) atmosphere. So our second hypothesis (H2) is supported.

Table 6:  SCRQ model fitness indices

<table>
<thead>
<tr>
<th>fitness indices</th>
<th>Measure of Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-Square/df</td>
<td>2.5152</td>
</tr>
<tr>
<td>P-value</td>
<td>0.000</td>
</tr>
<tr>
<td>Root Mean Square Error of Approximation (RMSEA)</td>
<td>0.072</td>
</tr>
<tr>
<td>Goodness of Fit Index (GFI)</td>
<td>0.98</td>
</tr>
<tr>
<td>Adjusted Goodness of Fit Index (AGFI)</td>
<td>0.92</td>
</tr>
</tbody>
</table>
Figure 2 shows the extent each variable describes SCRQ. The ranking of the variables is as follows: 1. Communication, 2. Commitment, 3. Adaptation, 4. Atmosphere, 5. Trust, 6. Interdependence, 7. Cooperation.

Also, the followings are the results of figure 2:

1. The significant factors in Communication are CM2 and CM4 with the same correlation coefficient of 70%, which are “the exchange of information informally” and “providing proprietary by both parties”.

2. The significant factor in Commitment is C3 with the correlation coefficient of 79%, which is “strongly committing to the relationship with the customer”.

3. The significant factor in Adaptation is A2 with the correlation coefficient of 71%, which is “tailoring the production system to meet the requirement of the supplier”.

Chi-Square=734.44, df=292, p-value=0.00000, RMSEA=0.072
4. The significant factor in Atmosphere is AT1 with the correlation coefficient of 73%, which is “the harmonic atmosphere surrounding the working relationship with the supplier”.

5. The significant factor in Trust is T1 with the correlation coefficient of 78%, which is “the characteristic of the level of trust based on past and present experience”.

6. The significant factor in Interdependence is I2 with the correlation coefficient of 64%, which is “the difficulty to find an alternative supplier”. Also, I1 and I4, which are “the difficulty of finding a new customer for the product” and “relying heavily on us to achieve own business objectives”, are important due to their similar correlation coefficient of 62%.

7. The significant factor in Cooperation is CO4 with the correlation coefficient of 83%, which is “cooperating with respect to quality practices”. Also, CO1 with the correlation coefficient of 80% is of great importance, which is “cooperating with respect to product design”.

5.2.2. Y Model; Measurement Model of SCP

In next step we adopted confirmatory factor analysis for SCP and its indicators in Lisrel 8.5 and eventually conducted path diagram of Y model as per Figure 3. We have tested Relationship between SCP latents and its indicators. Fitness's indices in Table 7 shows good fitness of our X model, proving selected indicator are good representative for each dimension of SCP. Also SCP is defined as a higher-order construct which represents (a) quality performance, (b) Delivery performance, (c) cost performance and (d) flexibility performance. So our third hypothesis (H3) is supported.

Table 7: SCP model fitness indices

<table>
<thead>
<tr>
<th>Fitness Indices</th>
<th>Measure of Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-Square/df</td>
<td>1.24375</td>
</tr>
<tr>
<td>P-value</td>
<td>0.03025</td>
</tr>
<tr>
<td>Root Mean Square Error of Approximation (RMSEA)</td>
<td>0.070</td>
</tr>
<tr>
<td>Goodness of Fit Index (GFI)</td>
<td>0.97</td>
</tr>
<tr>
<td>Adjusted Goodness of Fit Index (AGFI)</td>
<td>0.95</td>
</tr>
</tbody>
</table>

Figure 3: Standardized Solutions Model for SCP

Chi-Square=19.90, df=16, p-value=0.03025, RMSEA=0.07
Figure 3 shows the extent each variable describes SCRQ. The ranking of the variables is as follows: 1. Flexibility performance, 2. Quality performance, 3. Cost performance, 4. Delivery performance.

Also, the followings are the results of figure 3:
1. The significant factor in Flexibility performance is FP2 with the correlation coefficient of 85%, which is “Variety (product line) flexibility”. Also, FP1 with the correlation coefficient of 80% is of great importance, which is “Volume flexibility”.
2. The significant factor in Quality performance is QP1 with the correlation coefficient of 63%, which is “Frequency of customer complaints”.
3. The significant factor in Cost performance is CP1 with the correlation coefficient of 69%, which is “Unit cost of product relative to competitors”.
4. And the significant factor in Delivery performance is DP2 with the correlation coefficient of 62%, which is “Percentage of orders delivered on-time”.

5.2.3. Structural Model; the Effect of SCRQ on SCP

For entering data gathered from questionnaires in SEM for investigating our main hypothesis, we define a new variable for every latent variable and use the mean of scored answers. So we define 10 variables (7 for SCRQ and 4 for SCP). In other words, we performed our Structural model applying 7 dimensions of SCRQ and 3 component of SCP.

As shown in Figure 4, SCRQ can determine 86.49 per cent (0.93\(^2\)) of SCP variances which is a significant role. Fitness's indices in Table 8 shows good fitness of the Structural model. So our main hypothesis (H1) is supported. Also “Communication”, “Commitment” & “Atmosphere” are fairly most important dimensions of SCRQ and in the SCP, “Delivery performance” and “Quality performance” are fairly most important dimensions of SCP.

Table 8: The Structural model fitness indices

<table>
<thead>
<tr>
<th>Fitness indices</th>
<th>Measure of Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-Square/df</td>
<td>2.6995</td>
</tr>
<tr>
<td>P-value</td>
<td>0.000</td>
</tr>
<tr>
<td>Root Mean Square Error of Approximation (RMSEA)</td>
<td>0.075</td>
</tr>
<tr>
<td>Goodness of Fit Index (GFI)</td>
<td>0.95</td>
</tr>
<tr>
<td>Adjusted Goodness of Fit Index (AGFI)</td>
<td>0.91</td>
</tr>
</tbody>
</table>

Figure 4: Structural model: the effect of SCRQ on SCP

Chi-Square=116.08, df=43, p-value=0.00000, RMSEA=0.075
6. Summary and Concluding Remarks

This research intended to investigate the relationship between SCRQ and SCP by using SEM in supply chain of SAIPA Company. For this investigation, first we studied in hand literature and extracted impressive criteria on SCRQ and SCP. Then we devised a questionnaire and distributed it to experts and professionals in SAIPA Company and its related suppliers. At the end, we analyzed output from questionnaires by utilizing SEM. We have tested our proposed model in three steps: 1. SCRQ: its latents and indicators; 2. SCP: its latents and indicators; and 3. The effect of SCRQ on SCP.

This study has some limitations. First, we measured SCRQ as independent variable which may differ in different industry and make it fairly difficult to generalize it. Second, we study perceived SCRQ and SCP rather than the reality.

In spite of the aforementioned limitations, there are important managerial implications obtained from the findings. According to research findings, SCRQ is defined as a higher-order construct which represents (a) communication, (b) trust, (c) adaptation, (d) commitment, (e) interdependence, (f) cooperation, and (g) atmosphere. Also SCP is defined as a higher-order construct which represents (a) quality performance, (b) delivery performance, (c) cost performance and (d) flexibility performance. Finally, we found that SCRQ will positively influence SCP meaningfully. Also “Communication”, “Commitment” & “Atmosphere” are fairly most important dimensions of SCRQ and in the SCP, “Delivery performance” and “Quality performance” are fairly most important dimensions of SCP.

Obtained results in this research is in a same direction in some aspects with other findings in different studies. For example, our results are supporting Fynes et al. (2008), shown that there was a positive relationship between SCRQ and SCP in 200 manufacturing companies in the electronics sector in the Republic of Ireland. They stated that SCRQ can be defined as a construct of communication, cooperation, trust and adaptation, and SCRQ has a significant positive impact on SCP.

However, in this research three other latent variables, Commitment, atmosphere and Interdependence, which have not been studied in Fynes et al. 2008, are taken into consideration. In addition to that, this research is mostly concentrated on car industry, which Fynes et al., 2008 is not.

Findings in this research are increasing our knowledge about relationship between SCRQ and SCP in automotive industry. For future studies we suggest more empirical studies in different companies supply chain. Also we suggest that researchers consider relationships between SCRQ and SCP in Automotive industry with investigating key elements in supply chain environment (like supply, demand, and technology uncertainty).

References


Appendix A

Respondents are asked to rate the extent or degree of current practice of the following items on a five-point Likert scale with 1=“strongly disagree” to 5=“strongly agree”.

**Communication** (Fynes et al., 2005a; Fynes et al., 2005b and Su et al., 2008)
- CM1—exchange of information in this relationship takes place informally, and not only according to a per-specified agreement.
- CM2—in this relationship, any information that might help the other party will be provided for them timely and forwardly.
- CM3—both parties in the relationship will provide proprietary information if it can help the other party.
- CM4—both parties keep each other informed about events or changes that may affect the other party.

**Cooperation** (Fynes et al., 2005a; Fynes et al., 2005b; Woo and Ennew, 2004, Su et al., 2008)
- CO1—we cooperate extensively with this supplier with respect to product design.
- CO2—we cooperate extensively with this supplier with respect to process design
- CO3—we cooperate extensively with this supplier with respect to forecasting and production planning.
- CO4—We co-operate extensively with this customer with respect to quality practices.

**Adaptation** (Fynes et al., 2005a; Woo and Ennew, 2004 and Su et al., 2008)
- A1—gearing up to deal with this supplier requires highly specialized tools and equipment.
- A2—our production system has been tailored to meet the requirement of this supplier.
- A3—we have made significant investments in tooling and equipment that are dedicated to our relationship with this supplier.
- A4—this supplier offers us new technical solutions timely when conditions change.

**Trust** (Fynes et al., 2005a; Fynes et al., 2005b and Su et al., 2008)
- T1—based on your past and present experience, how would you characterize the level of trust your firm has in its working relationship with this supplier?
- T2—we feel that this supplier can be counted on to help us.
- T3—we feel that we can trust this supplier completely.
- T4—this supplier has a high level of integrity.
Atmosphere (Woo and Ennew, 2004 and Su et al., 2008)
- AT1—I consider the general atmosphere surrounding the working relationship with this supplier as very harmonious.
- AT2—I regard the overall relationship with this supplier as very close.
- AT3—I believe mutual expectations for the project have been established with this supplier to a greater extent.

Interdependence (Heide and John, 1988; Frazier and Rody, 1991 and Fynes et al., 2005a)
- I1- It would be difficult for our company to find a new customer for this product if we lose this business.
- I2- It would be difficult for this customer to find an alternative supplier to us.
- I3- Our firm relies heavily on this customer to achieve our business objectives.
- I4- This customer relies heavily on us to achieve its own business objectives.

Commitment (Morgan and Hunt, 1994 and Fynes et al., 2005a)
- C1- The relationship that we have with this customer is something we intend to maintain indefinitely.
- C2- The relationship that our firm has with this customer deserves our maximum effort to maintain.
- C3- The relationship that our firm has with this customer is something we are very committed to.

Quality performance (customer satisfaction) (Voss and Blackmon, 1994 and Fynes et al., 2008)
- PQ1- Frequency of customer complaints.
- PQ2- Adequacy of customer complaint tracking/feedback systems.

Delivery performance (Choi and Eboch, 1998 and Fynes et al., 2008)
- DP1- Speed of delivery relative to competitors.
- DP2- Percentage of orders delivered on-time.

Cost performance (Fynes and Voss, 2001 and Fynes et al., 2008)
- CP1- Unit cost of product relative to competitors.
- CP2- Unit cost of product over life cycle.

Flexibility performance (Dixon, 1992 and Fynes et al., 2008)
- FP1- Volume flexibility.
- FP2- Variety (product line) flexibility.