Identifying the factors and components affecting trust-based cooperation in the automobile supply chain and their impact on the performance of the chain member companies

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Abstract

The purpose of this research is to identify factors and components that affect a trust-based cooperation in the automobile supply chain and their impact on the performance of the supply chain companies. This paper includes 2 parts. In the first part, by studying the research history and literature and interviewing academic and industrial scholars and experts, four hidden variables of trust-based cooperation in automobile industry were identified and the basic research model was designed. In the second part, using Structural Equation verification and path analysis, the impact of these variables on trust-based cooperation and the impact of trust-based cooperation on the performance of the supply chain companies were studied. Research population consisted of Iran-Khodro and Saipa's supply chain companies including part makers, major car manufacturers and distributors. Data gathering method was questionnaires that were given to 400 companies – one questionnaire per company- 196 of which were returned and analyzed. In this phase, first, by confirmatory factor analysis and path analysis, validity and stability of the indexes that were derived from the model in the first phase, were tested, all of which were confirmed. Four hypotheses were developed based on the conceptual model of the research and tested by path analysis. According to the findings, 3 of the hypotheses were confirmed and one was rejected. Based on the results of the research, some suggestions were presented for improving the performance of companies in the automobile supply chain and for future researches.

Keywords: trust, supply chain, supply chain management, cooperation, automobile industry, structural equation modeling.

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Introduction

Nowadays one of the factors that have been challenging businesses including suppliers, producers and distributors, is extreme environmental changes (Otarkhani 2005). Rapid changes in customers' needs and demands have been challenging companies with the fact that their technical expertise which used to be their biggest competitive advantage is losing its function. Therefore, companies have realized that they are not able to provide all of their and their clients' needs on their own anymore and that competing as a single company cannot secure their profits and guarantee their survival. Thus they have adopted different tactics in order to avoid the existing hazards. One of these tactics is cooperation in form of a supply chain by moving all activities, from providing raw material to delivering products and after sales services and even reverse logistics, from company level to supply chain level. Therefore, nowadays, instead of focusing on competing with each other which results in on company's profit and another one's loss, companies are focusing on a relationship that guarantees profits for all members of the cooperation network. This paradigm works when the relationship between members is based on trust. That means that each

company believes that other companies make decisions that are beneficial for them as well and will not make actions that can cause them loss (Rezaiian 2003). The automobile supply chain is a job creating industry and its survival is a substantial factor in sustainable employment in the country. On the other hand, the automobile industry is the key link between many major industries such as petrochemical, steel, rubber and many others and any disruption in the supply chain of this industry, can cause disruption in the related industries and vice versa. Based on researches that were mostly done as doctorate theses, cooperation and especially trust-based cooperation is one of the most influential factors in the performance of the members of the supply chain. Trust-based cooperation can increase the quality of industrial products and the speed of serving customers and decrease the cost of products. Ergo, the subject of this research can help identify the factors and components of a trust-based cooperation and play a great role in improving the performance of the members of the supply chain and consequently enhance the performance of the companies of the chains.

In this paper, first, by studying the research history and literature and interviewing academic and industrial experts of automobile industry,

components of trust-based cooperation were identified, and then using PLS software and Structural Equation verification and path analysis, the structure and relationships between variables were studied and credibility of the model was tested.

Research's theoretical foundations and literature

The expression "supply chain" was first used by Oliver and Webber in 1982. From these researchers' perspective, a supply chain's goal is to turn logistics to the main concern of management. Later, in 1984, holi han used the term in several articles to describe management of flow of raw material in organizational borders (Westbrook 2004). Chandra and Grabis in 2007 explain that supply chain is a complicated system that is comprised of many simple components interacting and sharing information with each other and with their environment, while reforming their inside structure based on these interactions. Chopra and Mindle (2007) defined supply chain as all the institutions that participate in providing customers' needs directly or indirectly. These institutions include suppliers of raw material and parts, producers, distributors, wholesalers, retailers and final consumers. Socks and others in 2002 explained that supply chain includes 5 flows of goods, services, information, finances and

knowledge.

The concept of supply chain was established in 1961 by Forrester while designing a three-part system of factory, distributor and retailer (Brarati 2013, quoting Werst and Biolens 1999). He showed that a small disruption in a part of this system can increase quickly and impact the whole system (Forrester effect or Bullwhip effect). Remko and Van Hook in 1998 described supply chain management as integrating key procedures of the business from the consumer to the main supplier who provides products, services and information and create added value for customers and other beneficiaries. Simchi and others in 2000 defined supply chain management as a combination of methods that effectively integrate suppliers, producers, warehouses and stores to reduce the costs of the system to the least possible amount and provide the necessities of service level. Balo and others in 2000 stated that supply chain management is integrating activities related to transfer and flow of goods and services, including information, from the raw material supplier to the final consumer (Moradi Bastani, 2011). Gwen and others, also described supply chain management as a series of methods to manage and coordinate the whole chain, from suppliers to consumers. Varman and

Deshmakh in 2006 described supply chain management as integrating activities by improving the relationship between members of the chain in order to obtain the final goal of competitive advantage.

Barney and Hanson in 1997 said that trust is the mutual certainty that in a business interaction, none of the participants would sustain losses. Cook and Wall in 1980 defined trust as the belief in another person's talks and actions. McAlister in 1995 stated that trust is the level of one's belief in another's word and is determined by how much one's actions are influenced by another's opinions and decisions. Bone and Holmes in 1991 said that the ones who trust, put themselves at risk intentionally because they have positive beliefs about others' motives. This can cause loss or disadvantage for them (Rezaeian 2003, Hall 1996). Madhook in 1995 described trust as the belief that others won't act selfishly. In a general definition, trust-based cooperation is performing by collaborating with each other (Otarkhani 2010). In other words trust-based cooperation is the procedure of reaching goals that cannot be gained individually -at least efficiently (Alvani and Danaiifard 1997). Trust-based cooperation is an agreement between a group of participants in order to reach shared goals and results in a shared procedure (Donald, 2001). In recent years many researches have been done about inter-organizational relationships, buyer- supplier relationships, how to choose suppliers and basically about cooperation. Some of these previous researches are mentioned in table 1.

Research methodology: Population and sample

The first population is "experts", whose guidelines were used to prepare the research proposal and the basic model in both steps of the research. In the first step (exploration), 5 academic and industrial experts who were members of scientific boards of universities were asked to aid with identifying and extracting elements and variables of cooperation, building the analytical structure, making the basic conceptual model and screening measures relating to it. In the second step, after identifying and selecting the latent variables, the primary questionnaire was designed and 9 academic experts of the automobile industry were asked to present their advice and suggestions to evaluate the validity of the questions related to variables of the supply chain relationships and the links between them and to approve the conceptual model.

The second population, "companies", was used to describe

and define the variables and their relationships and to execute the structural equation modeling and assess the performance of the companies of the supply chain and also to measure validation and fitness of the model. In order to know this population, a list of companies that are members of the supply chain of the automobile industry was made by referring to Sapco and Sazeh Gostar Saipa companies and after omitting the recurring companies, 600 names were left. Bentler and Cho (1998) have proposed an innovative method where in normal conditions, 5 items per each parameter and in abnormal conditions, 10 items per parameter are estimated (Chen and others, 2003).

Considering the fact that the population is limited, Cochran formula was used to calculate the size of the sample. The results of the calculations show that a sample of 164 companies of the supply chain was needed. Therefore, in order to collect at least 164 questionnaires and based on the usual rates of return, 400 paper questionnaires were distributed among the companies related to this research and 196 were collected. The return rate was 48%.

Research tools

The measuring tool in this research is questionnaire. The questionnaire was designed in 2 steps. The first step was done after studying the research literature and choosing the indicators, in order to acquire opinions of experts and modify the indexes that impact trust-based cooperation in supply chain. The second one included 72 questions, 68 of which were based on Likert scale and the other four were 3-option or 4-option questions, in order to gather data to test the research model.

Content Validity

Content validity is the type of validity that assesses the components of a measuring tool. Content validity in this research has to do with the questionnaire. If the questions in this research tool in fact measure the features that the research aims to measure, one can say that the research has content validity. Content validity is usually judged by experts of the research subject (Sarmad and others, 2010). In order to assess the validity of the primary questionnaire, it was presented to the first population of the research, "experts".

Coefficient of variation:

One of the criteria that is used to compare 2 or several samples or

populations and simultaneously compares the means and variances is coefficient of variation. This criterion that is usually expressed by percentage and has no scale, is measured as follows:

Relationship 1:

$$cv = \frac{S}{\bar{x}} * 100$$

In relationship 1, S = Standard deviation and $\bar{x}$ = sample mean

Coefficient of variation is used to compare heterogeneous observations in 2 or more samples. Sometimes means of 2 samples are the same but the variances are different. Obviously, standard deviation alone cannot show the variation of the population. Comparing the variation of 2 populations only has a meaning when it is measured based on their means. A population with lower coefficient of variation is a better one (Bameni, 2011). After studying the research literature and designing the model, the researcher designed the first questionnaire and sent it to 9 academic scholars who were also experts in automobile industry and they gave all questions a score between 1 and 5. Then in order to measure the credibility of the questions, the researcher calculated the coefficient of variation using Excel software, and omitted those whose coefficient of variation was lower than 30% which came to 4

questions in the mentioned questionnaire.

Reliability
Reliability is one of the technical characteristics of measuring instruments. Reliability is whether the measuring means show stability and compatibility within the measured concept which is to what extent a questionnaire gives the same results under similar conditions. (Sarmad *et al.*, 1389) Cronbach's alpha was used for the second phase to test the reliability of the questionnaire statistically. In order to validate reliability, this index needs to be higher than the 7.0. Results are shown in Table 1.

Table1. Cronbach's alpha coefficient for each structure

Variables	Number of questions	Cronbach's alpha
Performance	13	0.833
Integrates	3	.716
Supplier selection	15	0.784
Win-win approach	11	0.707
Justice	14	0.758
Integration	15	0.745

Method of Analysis
In this study, to ensure the accuracy of independent and dependent variables of the measurement models regarding the "SEM-approved" and

particularly the path analysis techniques, the researchers used the third version of Smart PLS version. Factor analysis allows the researcher to first, validate the conceptual structures and diagnose the relation between the agent and principal dimensions of the constituent components with structures and measures defined in the structure. Secondly, this type of analysis assesses the reliability of the questionnaire designed as a useful and reliable tool that can measure the variable in space and time.

Research Findings

First through the study of literature the most important factors and elements of a confidence-based cooperation in the automotive supply chain were determined. Then, through surveys and interviews with experts, four latent variables of "supplier selection, integration, win-

win strategy and justice" were selected as the main variables of cooperation based on trust and were used in this study. To measure the performance according to existing methods of measuring performance in this study, the balanced scorecard method "BSC" (Kaplan and Norton) was used. In this method, the performance of member companies is examined from four perspectives: from the perspective of internal processes, from the financial perspective, from the perspective of learning and innovation, and from the

customer perspective. Table 2 presents the final variables of the model of cooperation based on trust in the automotive supply chain and prior research about each variable. The researcher designed the initial research model according to the above-mentioned criteria as follows.

Variables	References
Cooperation	Harland, (1996) Syaav et al., (2002) and Muller et al., (2003) Thakkar et al., (2003) Vlvdv et al., (2004) and Su Kun, (2005) Fiennes et al., (2005) Sabrtv on and et al., (2005) Grinit et al., (2006), and your Cannan (2006) Qureshi et al., (2007), Chang and Chen, (2008) Thakkar et al., (2008) Jytsh Dakar et al., (2008) and Nyaga et al., (2010) Kirsten et al., (2011) ancient Moradi, (1390) Barati, (1392).
Supplier selection	Asvby, (2001) Bhagat, (2002) Fvszv Pedersen (2002), Wu and Choi, (2005), and your Cannan (2006) Russell Kyngshat, (2006), Chang and Chen, (2009) Moradi Bastani, (1390) Barati , (1392).
Win-win approach	Gupta and Govinda Raja, (2000) Faye and Birkinshaw, (2001), Fernandez and Sabral, (2001) Malvra and Sgarz, (2001) Dehghani Firoozabadi, (1384) Otarkhany, (1389).
Integration	Levy, (1994), Remy (1996) Hndfyld and Nichols (1999) Simchi et al., (2000) Maloney and Benton (2000), Chu (2004) and Tan Canaan, (2006) Thakkar et al., (2008) Kim, (2009) Young, (2009) Flynn, (2010).
Justice	Marco, (1996) Krytnr and the Universe Yuki, (2001) Queiroz and Paul, (2001) Jewelry (2002) Mark and Trnhyl, (2003) Motahari, (1374) Ghaninejad, (1379) Rezaeian, (1391)

Operation	Deming (1939) Zhvran, (1988), Norton (1996) Syaav et al., (2002) Gvnaskaran et al., (2004), Canaan and Tan (2006) Grace Morgan, (2007), Chang and Chen, (2008) Qi et al., (2009) Chia et al., (2009) Tan et al., (2010) Wong and Wong, (2011) Kvrstn et al., (2011

After identifying the variables of the model, and designing a model for model validation and establishing relationships between variables, structural-confirmatory equation modeling and in particular path analysis method was applied using the third version of Smart-PLS Software. In this section due to space constraints, only the results of the analysis are presented in tables 3 and 4.

Figure 1, the final research model

As Table 3 shows, in terms of relations "path analysis" all the metrics used to measure latent variables of trust-based partnership model, regarding the path coefficients and t-value, significant coefficients are approved

	Indicator	Path coefficient	T-statistic	Result
Supplier selection construct	Reasonable price	0.682	23.635	Confirmed
	Provider work process	0.794	12.703	Confirmed
	Quality	0.767	10.909	Confirmed
	Continuous improvement	0.755	18.449	Confirmed
	Timely delivery	0.661	46.977	Confirmed
	Knowledge and technical expertise	0.788	26.659	Confirmed
Integration	Common culture	0.816	15.205	Confirmed
	Common goals	0.887	34.43	Confirmed
	Joint Working	0.663	11.802	Confirmed

	Process			
Justice	Procedural justice	0.920	31.800	Confirmed
	Interactional justice	0.695	7.646	Confirmed
	Distributive justice	0.406	6.524	Confirmed
Win-win approach	Sharing knowledge	0.428	6.724	Confirmed
	Sharing resources	0.967	46.977	Confirmed

As shown in Table 4 in terms of relations of "path analysis" except for the win-win approach variable, all variables show significant t-coefficient and path coefficient.

Table 4. shows the path coefficients, t-statistic and the coefficient of determination

The dependent variable	Latent variables	Path coefficient	T-statistic	Result
Performance	Supplier selection	0.653	8.822	Confirmed
	Integration	0.403	4.586	Confirmed
	Win-win approach	0.022	0.269	Disproved
	Justice	0.205	2.815	Confirmed

Discussion and conclusion

To achieve the study goals, comprehensive study of literature took place and a series of variables of cooperation were identified in previous studies. Then experts were asked to choose some of the suggested models. Regarding the content validity, the most important variables in the automotive supply chain relationships were chosen to provide basic model. To establish relationships between variables, model validation and structural-verification equation, modeling techniques and in particular path analysis were used to statistically

test the relationships between variables.

The first hypothesis: there is a significant relationship between the criteria for selecting the supplier in the automotive supply chain and the performance of companies in the supply chain. According to the path coefficient of 0.653 and t-statistic of 8.822, it can be said that in the confidence level of 99% between supplier selection criteria in the performance of companies in the automotive supply chain and supply chain there is a significant positive relationship, so the first research hypothesis is confirmed.

The second hypothesis: between integration in the supply chain and

performance in the automotive supply chain companies there is a significant relationship.
According to the path coefficient of 0.403 and t-statistic of 4.586 it can be said that in the confidence level of 99% there's a significant relationship between automotive supply chain integration level and performance of companies in the supply chain. Thus the second hypothesis is confirmed.
The third hypothesis: there is a significant relationship between collaboration based on a win - win approach in the automotive supply chain and the performance of companies in the supply chain.

According to the path coefficient of 0.022 and t-statistic of 0.269 it can be said that in the confidence level of 99% between cooperation based on a win - win approach in the automotive supply chain companies and the supply chain performance of the country, there is no significant relationship. Therefore the third hypothesis is not confirmed. The fourth hypothesis: there is a significant relationship between the administration of justice in the performance of companies in the automotive supply chain and supply chain.

The fourth hypothesis: there is a significant relationship between the administration of justice in the performance of companies in the automotive supply chain and supply chain.
According to the path coefficient of 0.205 and t-statistic of 2.815 it can be said that there is a significant positive relationship in the confidence level of 99% between the administration of justice in the country and the performance of the automotive supply chain companies. Therefore the fourth research hypothesis is confirmed.

Multiple coefficient of determination (R^2) is 0.692. Accordingly independent variables of supplier selection criteria, integrity and justice altogether have

been able to predict the yield changes of about 69.2%.

According to the path coefficient of 0.205 and t-statistic of 2.815 it can be said that there is a significant positive relationship at 99% confidence level between the administration of justice in the country and the performance of the automotive supply chain companies in the supply chain. Thus the fourth research hypothesis is confirmed.

Multiple coefficient of determination (R2) is equal to 0.692. Accordingly the independent variables of supplier selection criteria, integrity and justice altogether have been able to predict the yield of about 69.2%. But the independent variable based on the win-win cooperation approach, has no significant role in predicting changes in the performance of variables. The researcher believes that the results of this research is applicable only in the automotive industry but not in other industries. Due to the limited internal market, trust-based cooperation model can be applied to improve the performance and competitive model of domestic products against foreign products. And will increase market share of domestic products in the global market. Cooperation between variables of trust-based cooperation in the automotive industry supplier selection has the greatest impact on

supply chain performance. Among the measures of work processes of the supplier selection, technical expertise and commitment to quality have the highest impact which must be considered in the supply chain relationships. Considering that the study was conducted in a specific statistical population it is recommended to test the statistical model to confirm the initial findings in order to increase the validity of the model.

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شناسایی عوامل و مولفه‌های موثر بر همکاری مبتنی بر اعتماد در زنجیره تأمین صنعت خودرو و تأثیر آنها بر عملکرد شرکت‌ها ی عضو زنجیره

محسن رفیع پور[1]، جهانیار بامداد صوفی[2]، مقصود امیری[3]، جمشید صالحی صدقیانی[4]

هدف از این تحقیق، شناسایی عوامل و مولفه‌هایی است که بر ایجاد یک همکاری مبتنی بر اعتماد در زنجیره تأمین صنعت خودرو موثر باشند و تأثیر این عوامل و مولفه‌ها بر عملکرد شرکت‌های عضو زنجیره تأمین. این پژوهش در دو مرحله انجام می‌گیرد، در مرحله نخست با مطالعه پیشینه تحقیق و ادبیات موضوع و مصاحبه و نظر سنجی از صاحب نظران و خبرگان دانشگاهی و صنعت، چهار متغیر مکنون همکاری مبتنی بر اعتماد در صنعت خودرو شناسایی و مدل اولیه تحقیق طراحی شده است. مرحله دوم تحقیق، با رویکرد معادلات ساختاری تأییدی و تحلیل مسیر به تأثیر این متغیرها بر همکاری مبتنی بر اعتماد، و تأثیر همکاری مبتنی بر اعتماد بر عملکرد شرکت‌ های عضو زنجیره تأمین صنعت خودرو مورد بررسی قرار گرفته است. جامعه پژوهش شرکت‌های عضو زنجیره تأمین ایران خودرو و سایپا اعم از (قطعه سازان، تولید کنندگان اصلی خودرو و توزیع کنندگان) بوده است. شیوه گردآوری اطلاعات پرسشنامه بوده که در اختیار ۴۰۰ شرکت قرار داده شد"به هر شرکت یک پرسشنامه" از این میان ۱۹۶ پرسشنامه قابل استفاده بازگشت داده شد که مورد تحلیل قرار گرفت. در این مرحله، نخست با تحلیل عاملی تأییدی و تحلیل مسیر، پایایی شاخص‌های استخراج شده مدل در مرحله نخست تحقیق آزمون شد که همگی مورد تأیید قرار گرفتند. بر اساس مدل مفهومی تحقیق چهار فرضیه تدوین گردید و از طریق تحلیل مسیر مورد آزمون قرار گرفتند بر اساس یافته‌های تحقیق سه فرضیه تأیید شدند و یک فرضیه نیز رد شد. با توجه به نتایج بدست آمده از تحقیق پیشنهادهایی برای بهبود عملکرد شرکت‌های عضو زنجیره تأمین صنعت خودرو و برای پژوهش‌های آتی ارائه شده است.

واژگان کلیدی: اعتماد، زنجیره تأمین، مدیریت زنجیره تأمین ،همکاری، صنعت خودروسازی، مدل سازی معادلات ساختاری.

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