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## Linking Risk Management Practices and Strategies to Performance Case Study: Ceramic and Tiles Industry

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### Abstract

The supply chain is a network of independent and linked organizations that cooperate in direction to controlling, managing and improving of material and information flow from suppliers to final consumers in order to meet satisfaction of client. Supply chain risk management (SCRM) is very important in industry especially that goes to long supply chains. SCRM process focus on recognition of existing risk and decrease of undesired effect in supply chains, it consists of recognition, assessment, control or management and tracking of risky occurrence. The effects of supply chain risk management on performance of a supply chain remain unexplored. In this research have assumed 4 hypotheses, that consider effect of SCRM on supply chain strategies (agility and robustness) so effect of these strategies on the supply chain's customer value and on business performance. We consider this research as a practical survey and empirical strategy. Research data was collected via questionnaire with Likert scale. To testing measures reliability use of Cronbach,s alpha so validity by Confirmatory Factor Analysis. Data were collected simple randomly. statistic society include 140 persons of tile and ceramic co's director managers, commercial mangers, logistic and sales experts that mainly were located in Yazd province. For hypotheses testing use of structural equation modeling so Lisrel software. Finally, result show that all hypotheses, except, the effect of robustness on supply chain's customer value so its effect on business performance, have been approved.

**Keywords:** Strategy, Risk management, Supply Chain Management, Agility, Robustness, Performance Management

### Introduction

Today Management's challenges have been formed of complex network of suppliers increasingly that it can threat business and creation of new opportunities for enterprise management. Understand of supply chain risks that companies are facing, makes it possible to business managers have a better ability to identify and deal with to unexpected events. Recognition of noted risks cause adaption ability in poor condition and uncertain competitive environment process and implement as lever strategic in the competitiveness of

organizations process. Supply chain Risks management can be considered as an activity of strategic management in companies that will affect the company's market, financial and operational performance (Narasimhan and Talluri, 2009). So in the business environment that associated with high uncertainty and complexity companies must manage the supply chain effectively to increase their efficiency and reactivity (Thun and Hoenig, 2009). A supply chain is a complex web of changes, coupled with the adaptive capability of organization to respond to such changes. Strategies to manage supply chains must incorporate these inherent properties. We argue that, due to this very nature of supply chains, both proactive (=preventive) and reactive strategies need to be implemented. A strategy to cope with changes reactively is agility. In contrast, robustness is a proactive strategy that can be defined as the ability of a supply chain to resist change without adapting its initial stable configuration. A robust supply chain remains effective for all plausible futures; it remains in the same situation before and after changes occur. Several authors have proposed model that helps to select the appropriate supply chain strategy with respect to internal or external context factors. While certain context factors. While certain context factors can affect the supply chain negatively, choosing appropriate strategies can help to overcome these effects. SCRM extends traditional risk management approaches by integrating risks of partners upstream and downstream the supply chain (Wieland and Marcus, 2012). SCRM can reduce vulnerabilities in both a reactive and a proactive manner: on the one hand, SCRM is reactive, because it helps to monitor changes in the supply chains, customer needs, technology, partner strategies, and competitors and to update the risk assessment correspondingly (Hallikas *et al.*, 2004). On the other hand, SCRM can also reduce vulnerabilities in a proactive manner; it helps identifying a potential risk and to assess its impact and probability before it can occur. Then, the decision maker can implement actions that prevent the risk or, at least, minimize the impact when occurring (Ergun *et al.*, 2010). While anecdotal evidence points to the fact that SCRM practices allows supply chains to react faster (increased agility) and to withstand adverse events (increased robustness), virtually there aren't many empirical research that reveals the underlying mechanisms. Our research is aimed at filling this gap by testing whether SCRM Influences both the agility and robustness of a supply chain. In addition, it is examining the impact of these two general supply chain strategies on different performance dimensions in order to understand the performance implications these strategies have. Based on this research, at first theoretical study has been reviewed. In the next section, marked the research methods and conceptual models and variables then provided statistical analysis and conclusions at final are discussed on suggestions and recommendations.

### **Supply Chain and Supply Chain Management**

The supply chain includes all the steps that meet customer demands directly or indirectly. Supply chain covers all areas related to logistics network including suppliers, manufacturing centers, warehouses, distribution centers and retails markets, raw materials of inventories are making and finished products. In the literature are expressed different definitions of supply chain: establish of companies in order to provide products or services to a market (Douglas *et al.*, 1998). Supply chain management is contained all activities using for connection between suppliers, producers, distributors and customers to produce and distribute goods in sufficient amount , correct place and in time in proposes of system costs decreasing and increasing in customer services (Tuncel and Alpan, 2012). Christopher and Taviil are described that risk and uncertainty are increasing in the supply chain (Lavastre *et al.*,

2012). Ritchie and Brindly (2007), also believed that global competition, changing in technology and constant search for competitive advantage, caused increasing in competition and challenges in supply chain management of organizations.

### **Supply Chain Risk Management**

Risks in the supply chain are a Potential event that prevents of the normal flow of materials and information in chain and therefore lead to disturb in the chain. Supply chain is the flow of raw material from suppliers up to the final customer (Ghafouri *et al.*, 2012). Supply chain risk management begins with risk proper identification and assessment, and continues with appropriate so in just response to risks. In fact, effective risk management, reduce network vulnerabilities by building a flexible supply chain against to the variations (Bogataja and Bogataj, 2007). Companies traditionally used to accept strategies that protect themselves against the risk by using several sources for strategic items and inventory for that. Since this additional cost makes an inefficient firm, these stores will often limit performance and reduce competitive advantage. Competitive advantage cannot obtain through inefficiency associated with traditional strategies using of stocks. It is expected from Supply management to reduce risks and at the same time, to control costs and provide continuity. The most challenges that companies encountered are supply chain risk reducing or delete it without losing profits. While saving inventory may protect the company against the delay delivery of suppliers, generate of resources in disproportionate form make costs and impact to final result. When the companies identify its supply chain risk clearly, so can select an appropriate general approach to decreasing risk so select suitable and indistinct strategy for that approach (Bayat *et al.*, 1386).

### **Supply Chain Risk Management Steps**

Supply chain risk management involves identifying and calculating the possible risks and potential impact on operation in the supply chain process after identifying the direct risks respect to the operation, considering to the potential causes of risks in each stage of the chain is a priority. The next goal is to identify potential sources of risk and doing of appropriate measures to prevent the chain of vulnerability. According to Juttner *et al* (2003), supply chain Risk Management is composed of four main steps. 1 - Risk Resources Assessment 2 - concepts Identify 3 - tracking of actuator 4 - Reducing risks. Kleindorfer and Saad 2005 provide three elements as the supply chain risk management steps 1 - identify sources of risk and vulnerability 2 - Risk Assessment 3 - reductions Risk. These steps are close to Waters 2007 view (Mir Ghafouri *et al.*, 2013).

### **Performance**

Given that the performance is nothing less than the amount spent in reaching the target with minimal resources (resource consumption), so perhaps it could equal efficiency although, indicators and standards of productivity for any organization considering what kind of organization it is different (profit or non-profit, private or public). Usually measure a company's business performance, is profit rate of investment, market share, quality and quantity of goods and services and other economic measures (Naebzadeh, 2011). Institutions and organizations and executive agencies with every mission, goals, outlook; eventually works in a national or international scope and required to respond to customers and stakeholders. Performance results are considered a strategically important process. Numerous products and services providing and funding from sources, make sensitive enough to check the

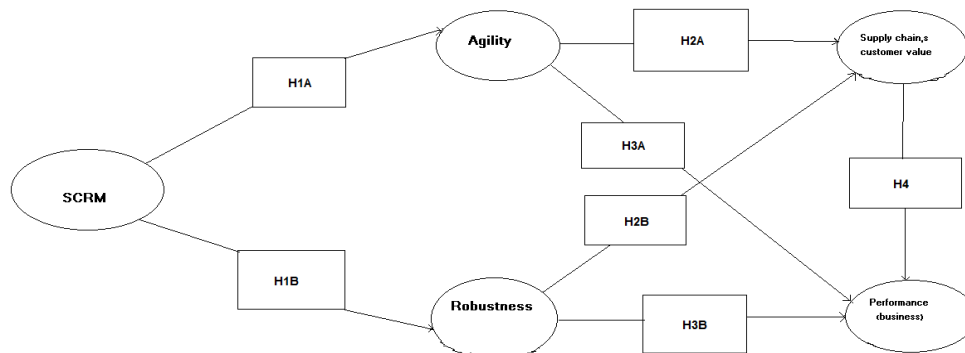
fulfillment of the objectives, continuous quality improvement, improve customer and citizen satisfaction, organizational performance management and staff. If the performance assessment is done with process viewpoint correctly and consistently, in public sector cause promote executive accountability and public confidence respect to organizational performance and efficiency of government. In the private sector, improve resource management, customer satisfaction, contributing to national development; create new capabilities, sustainability and promotion of companies and institutions world class. Continuous improvement of organizational performance provides force synergy (Synergy) that these forces can support the development programs and making excellence opportunities to companies (Rahimi, 2006).

### Literature Review

Fakhr al-Din *et al* (2012) , used of Multi-criteria decision making techniques in order to assess the risk factors of supply chain in the field of information technology of small and medium firms. In this study was used of the electric technique, tops is and taxonomy to ranking of supply chain risk factors and ultimately were obtained final ranking of supply chain risk factors by using the average (Dehnavi *et al.*, 2012). In another study, has been investigated supply chain risk management literature and published articles in this field. Sherafati (2010) is discussed the risks subject in one of the engineering and construction of power plant equipment Mapna (Tuga) companies. In this study, suggest a 5-step approach to managing the risks from area suppliers and finally offered the ways to reduce the risks. Hendi (2008) also explained some of the concepts of risk and supply chain, so investigated and identified supply chain risks and strategies to decrease it (Bayat and Alhan, 2008). In another study presented, a conceptual model for the application of supply chains risk management in developing of strategies to reduce the organization risk. Thun & Hoenig (2009) are discussed in a field study of the empirical analysis of the German car industry supply chain risk management. Although supply chain risk management in recent years has attracted the attention of investigators, There are some shortcomings in this field of study, an empirical study is needed about supply chain risk management to analyze major supply chain risks and effective tools to supply chain risk management and the purpose of this study is to analyze current practices and supply chain risk management used in the Germany with investigating of automotive industry in this country. The analysis is done based on a study of sixty- seven manufacturing plants operating in the automotive industry in Germany (Juttner, 2005; Zsidisin & Ritchie, 2008), have done comprehensive study about the concepts and models provided in order to effective management of supply chain risk (Giannakis and Louis, 2011). Harland *et al* (2003), presented complete overview of the assessment and management of risk management, provided Conceptual tools was described in four studies in the electronics sector. In this paper, is presented a conceptual model for using the results of the supply chain risk to develop strategies to reduce organization risks. This model can lead to risk reduction strategy in the course of a logical process.



## Methods



Hypotheses are formed, based on studies and observations (can see in the above model) as follows:

*Hypothesis 1: SCRM has a positive effect on agility and robustness.*

*Hypothesis 2: Agility and Robustness has a positive effect on the supply chain's customer value.*

*Hypothesis 3: Agility and Robustness has a positive effect on the business performance.*

*Hypothesis 4: Business performance is positively influenced by the supply chain's customer value.*

Researchers in Quantitative strategies select a sample of a population and generalize its results to the population. The population of this research are included, general managers, sales, marketing, logistics staff and ceramic and tile industry experts (mainly located in Yazd province, Iran), which are informative in this regard. Data were collected simple randomly. Depending on the information and data necessary to carry out this research Two methods were used to collect data A: Library sources (secondary sources) that refer to books, documents, papers and dissertations for the more familiar with the topic and the research literature also use the Internet to research and review articles and relevant literature B - field method: data is collected with development and completion of a questionnaire from the sample of society. After identifying the data collection instruments to measure the variables in this study used a standard questionnaire of closed questions which twenty questions, and seven-item answer puts in front of respondents and they have showed the rate of agreement or disagreement (pretty Worse competitors, worse competitors, relatively worse, same, better, better than competitors, so much better than competitors), (very slow, slow, moderately slow, moderate, moderately rapid ,rapid, very rapid) and (strongly disagree, disagree, slightly disagree, I don't view, a fairly consistent , agree, strongly agree) then responses are summarized. This scale has been developed by Likert. The population size is 220 that by using Cochran formula sample's size was determined 140 persons. By the number of total 140 questionnaires were completed by 113 pcs. In the following are discussed brief description of the variables and the corresponding items in the questionnaire.

### Supply Chain Risk Management

1. Systematic identification of sources for such disruptions.
2. Assessment of both own risks and risks of important suppliers and customers.
3. Assigned persons responsible for the management of such risks.

4. Continuous monitoring of developments that might promote such disruptions.

### Supply Chain Agility

1. Adopt manufacturing lead-times
2. Adapt level of customer service
3. Adapt delivery reliability
4. Adapt responsiveness to changing market needs.

### Supply Chain Robustness

1. For a long time, our supply chain retains the same stable situation as it had before changes occur.
2. When changes occur, our supply chain grants us much time to consider a reasonable reaction
3. Without adaptations being necessary, our supply chain performs well over a wide variety of possible scenarios
4. For a long time, our supply chain is able to carry out its functions despite some damage done to it.

### Supply Chain's Customer Value

1. Missing/wrong/damaged/defective product shipped
2. Warranty/returns processing costs
3. Conformance to customer specifications
4. Customer satisfaction

### Business Performance

1. Profit margin
2. Return on sales
3. Return on total assets
4. Sales over assets

### Validity and Reliability of Questionnaire

Validity is a term that refers to fulfill the purpose of the test is made for it (Houman, 2005). Questionnaire, s validity of this study is by confirmatory factor analysis. The most common test to internal logic coordination reliability is the coefficient of Cronbach's Alpha which is used for multiple choice questions (Danaii Fard *et al.*, 2011). Therefore, the reliability of the questionnaire in current study was assessed using Cronbach's Alpha that should be above 70%. Table 1 indicated the reliability of the variables.

Table 1  
*Validity of variables by Cronbach's Alpha*

results	variables
.823	SCRM
.844	Agility
.862	Robustness
.795	Business
.819	General model

**Exploratory and Confirmatory Factor Analysis**

Factor validation is a form of construct validity is obtained through factor analysis. In fact, the use of factor analysis is necessary in the directory in which tests and questionnaires are used. Factor analysis can be either exploratory or confirmatory. Which of these two analyzes should be used in the factor analysis is based on the objective of data analyze. In an exploratory analysis, the researchers sought to examine empirical data to detect and identify specific indexes and relationships between them, and do so without imposing any definite model on the data. In other words, exploratory analyze in addition to have the investigation or suggested value so can be made structure, model, hypothesis or to formulate hypotheses that have more objective testing than the other methods of multivariate. The researcher in Confirmatory factor analyze expects to test a certain plan of hidden factors beyond variables. In this type, variables it is expected to have a certain layout. The purpose of this analysis is to verify the especial factor structures that are expressed hypothesis about the number of factors clearly. To conduct a confirmatory factor analysis is using Lisrel or Amos (Zand Hesami *et al.*, 1388). Exploratory factor analysis of current research variables are expressed in Table 2.

Table 2  
*Variables exploratory factor analysis*

VARIABLES	KMO	CHI-SQUARE	BARTLETT,S test	SIG.
SCRM	.670	58.738	6	.000
AGILITY	.782	189.315	6	.000
ROBUSTNESS	.692	71.799	6	.000
SUPPLY CHAIN,S CUSTOMER VALUE	.593	110.169	6	.000
PERFORMANCE	.782	130.627	6	.0000

Contribution of each factor in the questionnaire is 4 questions. The amount higher than. /5 for KMO confirm the adequacy of the sampling confidence. Level of Sig with less than. /05 as well as is shown the suitability of the invoked factor model.

Table 3  
*Variables commons*

	Initial	Extraction
scrm1	1.000	.514
scrm2	1.000	.539
scrm3	1.000	.593
scrm4	1.000	.618
ag1	1.000	.722
ag2	1.000	.704
ag3	1.000	.724
ag4	1.000	.613
rob1	1.000	.678
rob2	1.000	.527
rob3	1.000	.627
rob4	1.000	.592
sup1	1.000	.544
sup2	1.000	.522
sup3	1.000	.528
sup4	1.000	.579
per1	1.000	.633
per2	1.000	.623
per3	1.000	.702
per4	1.000	.533



In this section, are examined the correlation's amount between the purposed variable variance respect to the variance in the other variables. The first column of table 3 (initial), are the extracted from the initial data that when be high (maximum 1) to express using factor analysis is appropriate. In the second column expressed the extracting commons values of factors. Here the value is greater than . /5 confirm to fit the data in factor analysis. If this value is low for the variable, relevant question should be excluded from the analysis.

Table 4

*The total variance explained by the variables*

Component	Initial Eigen values			Extraction Sums of Squared Loadings		
	Total	%of Variance	Cumulative%	Total	%of variance	Cumulative%
Scrm1	1.963	49.078	49.078	1.963	49.078	49.078
2	.813	20.332	69.410			
3	.708	17.691	87.101			
4	.516	12.899	100.000			
agil1	2.763	69.071	69.071	2.763	69.071	69.071
2	.536	13.397	82.468			
3	.417	10.413	92.881			
4	.285	7.119	100.000			
Rob1	2.058	51.446	51.446	2.058	51.446	51.446
2	.804	20.098	71.544			
3	.676	16.895	88.439			
4	.462	11.561	100.000			
Sup1	2.172	54.309	54.309	2.172	54.309	54.309
2	.989	24.714	79.024			
3	.502	12.548	91.572			
4	.337	8.428	100.000			
Per1	2.492	62.301	62.301	2.492	62.301	62.301
2	.632	15.797	78.097			
3	.464	11.594	89.691			
4	.412	10.309	100.000			

Table 4 shows the number of extracted factors from the data (primary variables). In this part factors are known effective that special value be greater than 1 in column's sum. Last columns show all the factors together how percent of the variability of the original variables. In the following table 5 is presented the factor rotated matrix.

Table 5

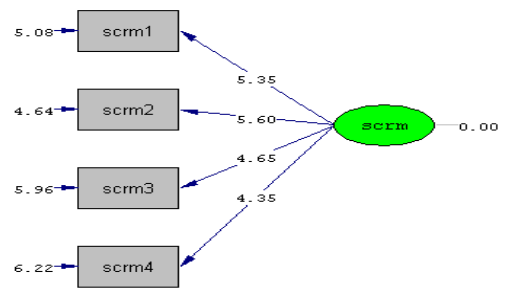
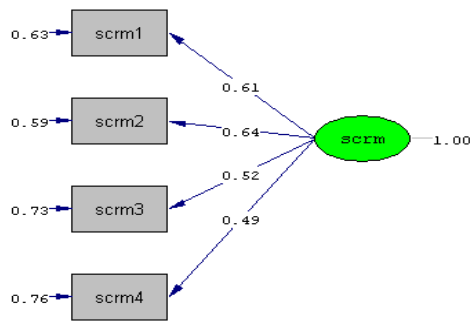
*Variables Factor Rotated Matrix*

	Component
	1
scrm1	.717
scrm2	.734
scrm3	.685
scrm4	.663
ag1	.850
ag2	.839
ag3	.851
ag4	.783
rob1	.823
rob2	.686
rob3	.684
rob4	.664
sub1	.737
sub2	.722
sub3	.727
sub4	.761
per1	.796
per2	.789
per3	.838
per4	.730

The factor final structure is presented in the rotated factor matrix which includes the share of variables explained variance by factors. The results contained in this matrix are the basis for the grouping variables and each factor is connected to the number of variables that have high factor loading (minimum 4/0). It should be noted that the rotation matrix will be only with variables is focused on more than one factor Therefore in the all models of present research because all variables is measured one particular factor, so there aren't rotation matrix and only presented a table such above to show only focused load on the each factor. After Factor analysis test of the model's variables and determining of related variables it is turn to considering the connection method of each question with its relevant variable. This test is confirmatory factor analysis and takes place with LISREL software. Oval shape represents each of the factors separately, and rectangular shapes represent variables are related to each factor.

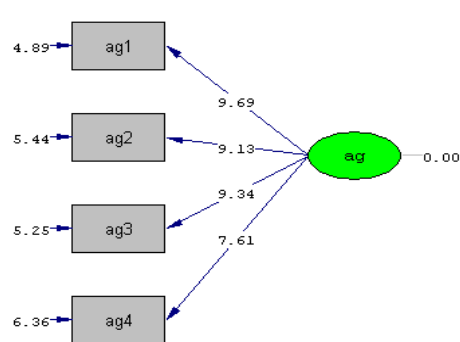
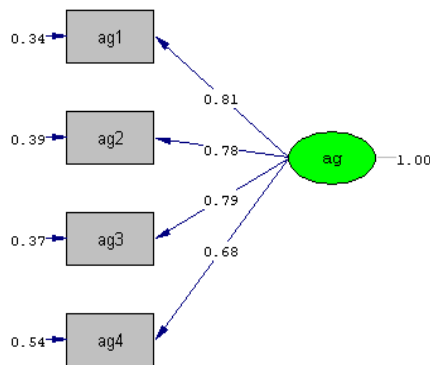
***Confirmatory factor analysis of the Supply Chain Risk Management variable in the Standard estimated and in t-value models***

The low shapes indicates general model in the Standard estimated and in t-value numbers models .to fitting a model according to the Lisrel's output amount of  $\chi^2$  respect to freedom degree should be less than 3. When this index be less shows little difference between research conceptual models with research observed data. So RMSEA should be less than .08 that indicate the model fitting every this index be lesser the fitting of model is more. GFI should be more than .9 so NFI and NNFI and CFI be more than .9.

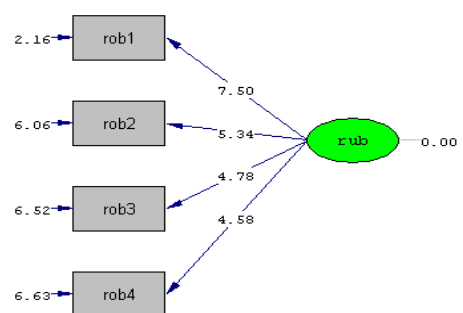
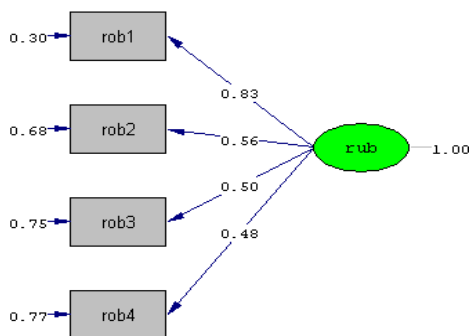


The numbers on the path indicate t-value for each path. If this value be greater than 1.96 is verified measured variable for latent variable.

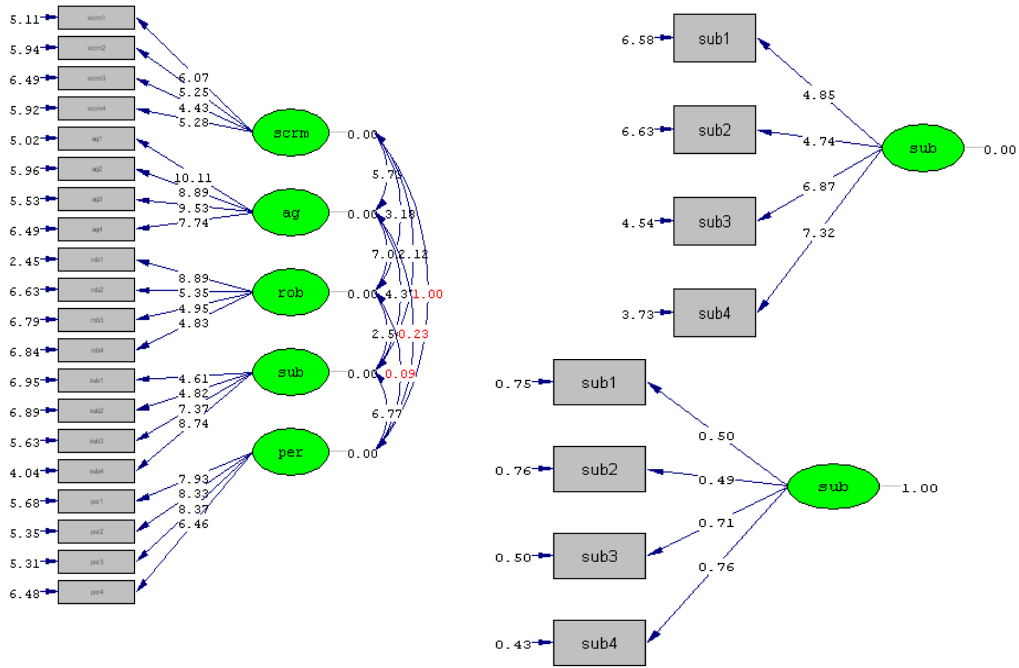
**Confirmatory factor analysis of agility variable in the standard estimated and the t- value models**



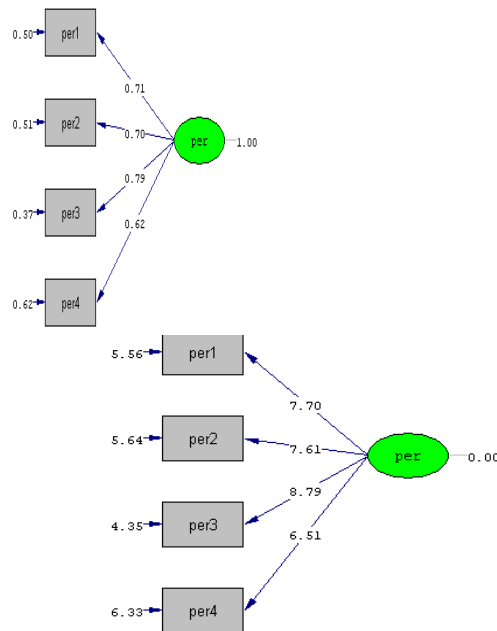
**Confirmatory factor analysis of robustness variable in the standard estimated and the t- value models**



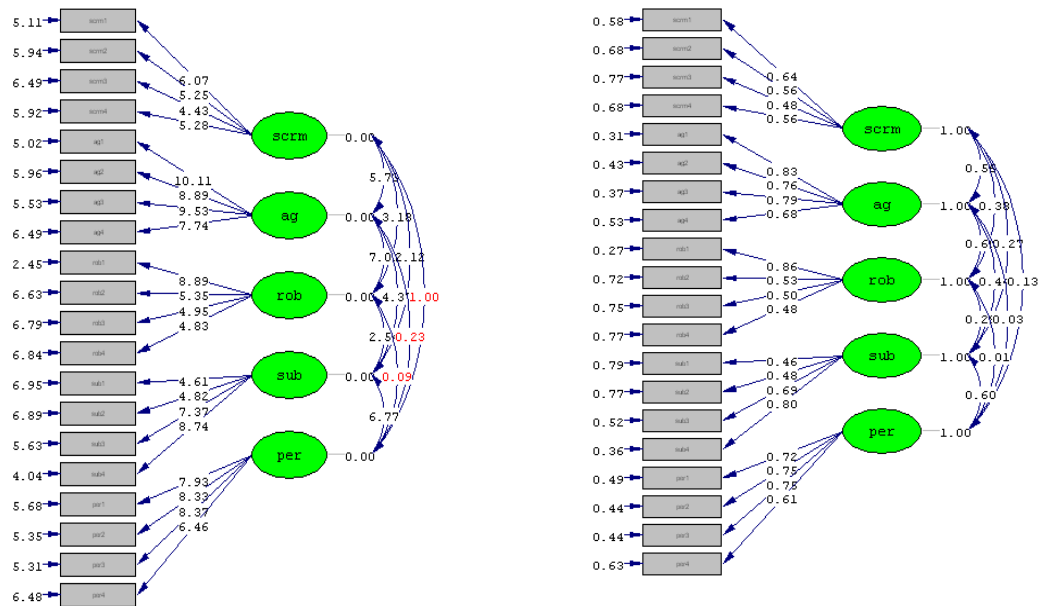
**Confirmatory factor analysis of the Supply Chain's Customer Value Variable in the standard estimated and the t- value models**



**Confirmatory factor analysis of the business performance in the standard estimated and the t- value models**



**Confirmatory factor analysis of the general model in the standard estimated and the t- value models**

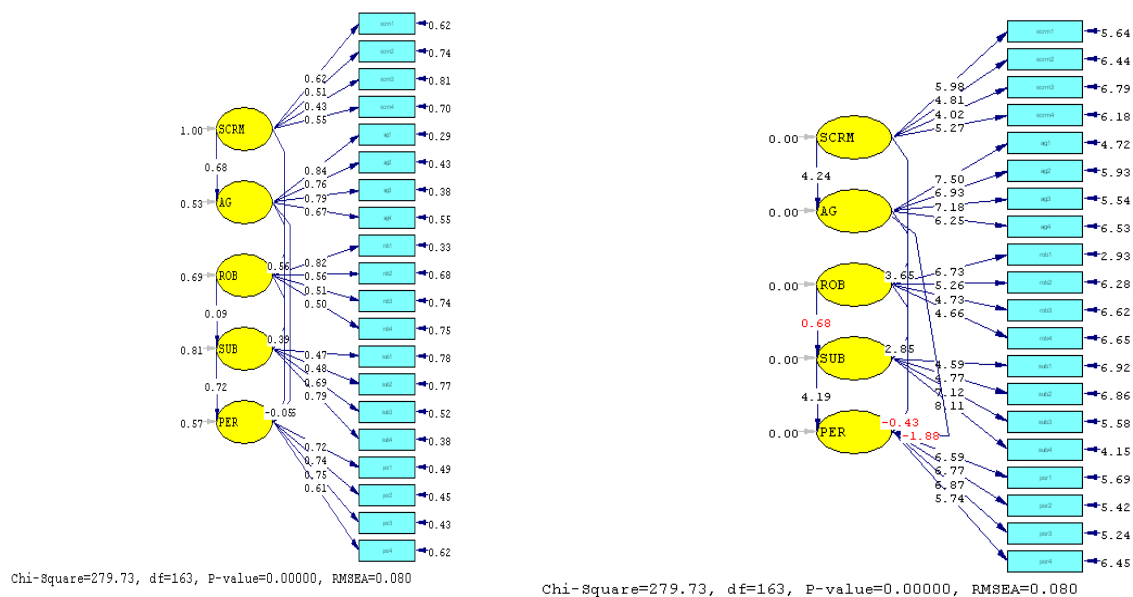


As you can see in all above models t-value's output is in standard level (higher than 1/96). So in standard estimate of general model among the variables belong to SCRM factor scrm1 has highest correlation with SCRM latent variables, this amounts is . /64. Among the observer variables related to the Agility, Agil1 has the highest correlation with agility latent variable whose value is . /83, among the robustness observer variables Rob1 with the value . /86 and between Supply Chain's Customer Value observer variables Sup4 with . /80 so between performance observer variables per1 and per3 with . /75, have highest correlation with the its latent variables. Table 6 shows fitting indexes for all the variables that are presented whole are in acceptable level.

Table 6  
Fitting Indexes

NFI	CFI	IFI	RMR	GFI	RMSEA	P VALUE	$\chi^2/df$	variables indexes
.93	.95	.96	.076	.98	.009	.015	2.35	SCRM
.97	.98	.98	.060	.97	.154	.030	2.84	AGILITY
.98	1.00	1.00	.052	.99	.035	.000	1.41	ROBUSTNESS
.98	1.00	1.00	.052	.99	.035	.000	1.41	SUPPLY CHAIN, SCUSTOMER VALUE
.99	1.00	1.00	.030	.99	.000	.037	.97	PERFORMANCE
.99	.94	.96	.028	.99	.076	.000	1.65	FINAL

**The research final model results in standard estimates and T-value models**



- Normed Fit Index (NFI) = 0.78
- Comparative Fit Index (CFI) = 0.89
- Incremental Fit Index (IFI) = 0.89
- Root Mean Square Residual (RMR) = 0.015
- Standardized RMR = 0.092
- Goodness of Fit Index (GFI) = 0.80

**Conclusion**

*Hypothesis 1:* SCRM has a positive effect on agility and robustness. Regarding to the significance level was calculated in the above model is higher 1.96, so the null hypothesis is rejected. The supply chain risk management has a significant effect on agility and robustness. So the first research hypothesis is confirmed in 95%.

*Hypothesis 2:* Agility and Robustness has a positive effect on the supply chain's customer value. Based on the results of significant level of agility is calculated in the above model greater than 1.96, therefore the null hypothesis is rejected. The agility has a significant effect on the supply chain's customer value. But regarding to the software output (./68) the effect of robustness on SCCV is not approved.

*Hypothesis 3:* Agility and Robustness has a positive effect on the business performance. Based on the results of the output due to the significant level of agility calculated in the model is very close to 1.96 therefore assumption is confirmed in the 90%.with respect to the significant computing for Robustness, this factor has no significant effect on firm performance.

*Hypothesis 4:* Business performance is positively influenced by the supply chain's customer value. Regarding to the significance level was calculated in the above model is higher 1.96, so the null hypothesis is rejected. Therefore SCCV has positive effect on business performance.

Departing from a somewhat heterogeneous literature base on agility and robustness and the expectation that both strategies may be important in improving the supply chain's



customer value and business performance, our research provide more considering for this assumption. Being agile has a positive effect on the supply chain's customer value, while its impact on business performance is mediated by the supply chain's customer value and thus can say indirect somewhat. Our hypotheses that SCRM is important for agility and robustness of a supply chain are supported. Thus, the implementation of SCRM, which entails the identification, assessment, and controlling of risks, allows companies to better cope with changes both proactively and reactively. Besides other possible facilitators of agility and robustness, such as cooperation, insurance, and postponement, it turns out that SCRM is a strong driver of realizing these two strategies. This is an important argument for managers who consider the introduction of SCRM. Most importantly companies. Who are searching for a means to improve agility and robustness of their supply chains, find that the introduction of SCRM can be powerful supplement to more traditional means such as excess capacities and safety stocks.

### **Research Proposition**

1. Establishment of agile and robustness supply chain and making use of supply chain risk management in companies and Business institutions.
2. Understanding and education on the topic of supply chain risk management cause increasing performance and speed up customer service and communication with suppliers.
3. Teaching and learning this system to managers and corporate employees.
4. Focused on the implementation Business activities are in network structures with regard to sufficient agility level for response to changes in proactive way, organization is able to predict changes to search the new opportunities.
5. Applying agility in supply chain, will enable the companies to access a higher level of agility across the organization subsequently, agility in supply chain causes to react an organization to market's turbulence and uncertainty effectively and quickly react; The result will allow organizations to gain the better and particular competitive situation.
6. With the implementation of agile supply chain and more sensitive to market, create greater ability to synchronize supply and demand, will lead the organization to select the shorter cycle for providing product This will directly affect the ability to produce innovative products (new products), and deliver better to customer that lead to customer satisfaction and the better performance of company.

### **Suggestions for Future Research**

1. Suggest doing the data of current study through phase hierarchical technique and other or compound of these methods using ELECTERE or TOPSIS, decisions methods as simultaneous technique. Compare them results with the presented results in this paper will be a valuable research.
2. Designing, developing and instituting other models of impact the supply chain strategies, including efficiency, cost reduction and on supply chain performance and company's performance.
3. Conduct research related to supply chain agility required in organizations and related industries.
4. To implement the conceptual model presented in this study with other organizations and the comparison of research findings.
5. Similar studies with interfering variables such as IT infrastructure, organizational structure, business environment.

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