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Research note:

Determination constructs validity of an agile organization model by using factor analysis

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Abstract: During 21st century, manufacturing success and survival are becoming more difficult to ensure this fact is originated in the emergency of new business era that has "change" as one of its major characteristics. Change in business environment and uncertainly have entered management study and research for the last two decades. Agility enhances the organization ability to provide high quality products and services, and is, therefore crucial to organization competitiveness. The paper briefly reviews the literature in this field and offers a model of agility based on leadership, human resource, organizational structure, organizational culture, process and system in the organization. This paper discusses the concept and the development of the methodology to achieve effective factors on organizational agility. An introduction of subject is given and followed by a detailed discussion of the proposed factor analysis methodology. One of the defining construct validity is using a factor analysis method. Factor analysis is a statistical method through which the number and nature of variables which measures the test are clarified. In factor analysis, this is done by combining various variables together as we have been making a few variables as a factor. This method defines the interrelations of analysis data and decreases variables to factors for simplicity. In the performed case study in Iranian industrial organization in order to define effective factors on organization agility, on the base of conceptual model, a questionnaire was compiled. The results of questionnaires were analysed by descriptive statistics and all variables were categorized in twelve factors through exploratory factor analysis. Using confirmatory factor analysis method, exploratory factors were surveyed whose result has a close adaptation with literature of organization agility and condition of studied Iranian industrial organization.

Keywords: *Agile organization; Construct validity; Confirmatory factor analysis; Agile drivers; Agile enablers, Agile capabilities*

1. Introduction

The concept of agile manufacturing was originally introduced in the report entitled ‘‘21st Century Manufacturing Enterprise Strategy’’ and published by the Iacocca Institute of Lehigh University as an option for managing firms in a dynamic world. Since then, it has been adopted by researchers, managers and consultants as the last stage in the evolution of organizational models or systems (Goldman and Nagel, 1991).

Competition basis, which used to be the product's price, has moved to quality, delivery time, and finally customer choice or in a more exact way, customer satisfaction. The prevailing strategy of economy of scales has been challenged by the new vision of economy of scope. Mass production systems are being seriously questioned for their viability in challenging the changing nature of the business environment. The new methods that have been used to cure the problems in productivity of traditional systems, such as flexible manufacturing and lean manufacturing and all techniques and tools associated to them, are found in sufficiently in the way they have been managed and utilized (Sharifi and Zhang, 1999).

By library and field researches for determining effective factors on organization agility, the proposed model was prepared and considered as an analysis base. Twelve factors including 25 indicators have been clarified as organization agility enablers due to this model. Meanwhile, organization agility capabilities were considered as a

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factor which has four indicators. This article classifies effective factors on agility by surveying construct validity of organization agility model through exploratory factor analysis method.

Reviewing the literature of agile organization, effective factors on organization agility was clarified in a conceptual model. This article clarifies the instruction of factors together and their effect on organization agility. Firstly, by survey the structural validity of questionnaires, effective factors on agility will be classified into factor analysis. Then, in order to achieve more comprehensive results, the studied achievement will be analyzed through the interaction of factors together and the proportion of relative effects on organization agility.

This survey studied the Iranian Industrial Organization. It is one of the largest producers of CNG cylinder and tower telecommunication in the Middle East.

2. Literature review

Agile manufacturing is a new and revolutionary way of manufacturing. Agile manufacturing organizations produce a high quality and defect- free product with short lead time. The product is able to be upgraded and reconfigured, rather than be replaced. The agile manufacturing organization integrates design, engineering, and manufacturing with marketing and sales in such a way that the products are customized to the exact needs of the consumer. Its goal is to produce products which completely satisfy consumer needs and wants (Nagel and Dove, 1991). Product lead time will be so short that they are virtually unheard of today (Blackburn, 1991; Youssef, 1992).

Agile organizations are flexible and quick to respond to fast moving market conditions. They increasingly leverage the intellectual power of the employees as opposed to their power. To increase the effectiveness of multifunctional product-development teams, companies may utilize goal setting techniques. Goal setting balances the autonomy of these teams with the goals of the company. Goals may include quality levels and timing. Management within these teams is flexible and prone to constant change (Hormozi, 2001).

Agile manufacturing organizations are finding it difficult to attain a sustainable competitive advantage or even ensure their survival due to the high levels of complexity, dynamism and uncertainty; they face (Va´zquez-Bustelo and Avella, 2004). This critical situation has forced firms to review their competitive priorities, triggering a transition process in which they are giving up traditional manufacturing models in favor of new organizational forms, new management practices and new strategies at all levels (Bartezzaghi, 1999). A transformation has been observed in ‘‘traditional’’ production models leading to a new production paradigm linked to agility.

With this move towards a new agility-based paradigm, the term ‘‘agile organization’’ has arisen, a concept that has been increasingly used in literature on Operations Management and Business Administration to denominate a model of flexible organization, capable of rapidly adapting to changes in the environment and of placing a large variety of products on the market to satisfy the needs of increasingly demanding and well-informed customers (Kidd, 1994; Goldman *et al.*, 1995; Gunasekaran, 1999; Sharifi and Zhang, 1999; Gunasekaran *et al.*, 2002). This emerging paradigm, the philosophy of which considers a new strategic positioning in organization and requires a global view of the firm (Roth, 1996), breaks with the guidelines of the traditional mass production model, placing special emphasis on the proactive adaptation to change (Yusuf *et al.*, 1999). It highlights the development of dynamic capabilities, the strategic use of new technologies, the integration of strategies and operations, customer satisfaction through new forms of inter-firm cooperation and knowledge management (Gunasekaran and Yusuf, 2002).

Despite the fact that agility has been defined in different ways and from different perspectives and fields of knowledge, a common element to all the definitions is that it is far removed from mass production. Sheridan (1993) argues that agility implies breaking with the moulds of mass production in order to manufacture more customized products at the time and place required by consumer demand. Thus, agile manufacturers represent a new form of industrial competition on a global scale for the 21st century that generates new operative and management forms designed to meet the challenges of the new competitive environment. As a concept, agility in manufacturing identifies a production model that is conditioned by changes in the environment and links innovation in manufacturing, information and communication technologies with a radical organizational redesign, new human resources practices and the application of new marketing strategies.

Implementation of this model, considered the latest in the stages of evolution of production systems (Esmail and Saggu, 1996), has been considered a solution for the problems arising from turbulent business environments (Sharifi and Zhang, 1999). Therefore, a positive relation is to be

expected between more turbulent environments, the application of agile organization, the factory results and the degree of competency. Following the review of several works (Goldman and Nagel, 1993; Burgess, 1994; Goldman *et al.*, 1995; Montgomery and Levine, 1996; Fliedner and Vokurka, 1997; Gunasekaran, 1998, 1999; Goranson, 1999; Meade and Sarkis, 1999; Sharifi and Zhang, 1999, 2001; Sharp *et al.*, 1999; Yusuf *et al.*, 1999; Dove, 2001; Coronado *et al.*, 2002; Gunasekaran and Yusuf, 2002; Gunasekaran *et al.*, 2002), three key elements in the implementation and development of agile organization have been identified: drivers (or motivators), enablers (facilitators, providers or pillars) and capabilities.

The business environment, as a source of change and generator of uncertainty, has been considered the main drivers. In fact, agile organization describes ''a comprehensive response to a new competitive environment shaped by forces that have undermined the dominance of the mass-production system'' (Gunasekaran *et al.*, 2001). So, agility is reflected in the ''capability to survive and prosper by reacting quickly and effectively to a continuously and unpredictably changing, customer-driven and competitive environment'' (Jain and Jain, 2001). Agile organization can be considered as a model that integrates technology, human resources through an information and communication infrastructure. It provides flexibility, speed, quality, service and efficiency and enables firms to react deliberately, effectively and in a coordinated manner to change in the environment.

3. The conceptual model and the methodology

Organizational agility effective factors consist of three main parts. First, the agility drivers which are the changes in the business environment that drives the company to a new position in running their business and searching for competitive advantage.

According to the literature survey eight agile driver factors (Table 1) were compiled and recognized.

The agility enablers are the second part that proposes the essential headlines of abilities that would provide the required strength for responding to the changes.

According to the literature survey twenty five agile enabler factors (Table 2) were compiled and recognized.

The capabilities of agile organization are the third part that providers are the means by which the so-called capabilities could be achieved. According to the literature survey nine agile capability factors (Table 3) were compiled and recognized. The conceptual model was derived from literature is shown in Figure 1. Based on this model and the empirical work performed in the research programmed, a methodology has been developed to provide the industrial organization with a realistic tool for better understanding of the total concept of agility, determining their agility needs, assessing their current position, determining the capabilities required in order to become agile.

The main objective of this paper is to explore the application, causes and consequences of agile organization factors in Iranian Industrial Organization. By library research for recognition of effective factors on organization agility, according to Table 4, twelve factors including twenty five indicators were clarified as enablers of organization agility (independent variables).

Twelve enabler factors of organization agility according to literature are:

1) Organizational Structure (Formality, Complexity, Centrality),
2) Virtual Organization (Process, Participation),
3) Information Technology(Application, Integration),
4) Organizational Culture (Participation, Risk Taking),
5) Leadership (Transactional / Transformational, Future /Goal Centered),
6) Supply Chain (Cooperation with Suppliers and Customers) ,
7) Progressive Design Technology (Simulation Technology, Engineering Analysis Technology),

Table 1: Agile drivers are derived from literature.

Row	Factors	References
1	Change in competition	Christian *et al.* (2001), Lin *et al.* (2005)
2	Change in environment	Christian *et al.* (2001)
3	Change in social factor	Christian *et al.* (2001), Lin *et al.* (2005)
4	Change in technology	Christian *et al.* (2001), Lin *et al.* (2005)
5	Change in market	Christian *et al.* (2001)
6	Change in politics	Christian *et al.* (2001)
7	Change in customer desire	Christian *et al.* (2001), Lin *et al.* (2005)
8	Change in supply chain	Christian *et al.* (2001)

Table 2: Agile enablers are derived from literature.

Row	Factors	References
1	Virtual enterprise	Sharp *et al.* (1999),Kidd (1999),Yusuf (1999)
2	Electronic commerce	Sharp *et al.* (1999),Kidd (1999),Yusuf (1999)
3	Rapid prototyping	Sharp *et al.* (1999),Kidd (1999),Yusuf (1999)
4	Improvement	Sharp *et al.* (1999),Kidd (1999),Yusuf (1999)
5	Multi-skill and flexible people	Sharp *et al.* (1999), Bustlo *et al.* (2006), Kidd (1999),Gunasekaran (1999), Kidd (1999), Sharifi & Zhang (1999), Bessant (2001), Crocitto & Youssef (2003)
6	Team working	Sharp *et al.* (1999),Kidd (1999)
7	Concurrent engineering	Sharp *et al.* (1999),Kidd (1999), Bustlo *et al.* (2006)
8	Change and risk management	Sharp *et al.* (1999),Kidd (1999), Bustlo *et al.* (2006)
9	Integrated information system	Sharp *et al.* (1999),Kidd (1999), Bustlo *et al.* (2006), Bessant (2001), Crocitto & Youssef (2003)
10	Continues Improvement	Sharp *et al.* (1999),Kidd (1999), Bustlo *et al.* (2006)
11	Flexible infrastructure	Gunasekaran (1999), Hoyat (1996)
12	Supply chain	Hoyat (1996) Crocitto & Youssef (2003),Bustlo *et al.* (2006)
13	Improved manufacturing technology	Bustlo *et al.* (2006), Gunasekaran (1999), Kidd (1999), Sharifi & Zhang(1999)
14	Core competency	Sharp *et al.* (1999),Yusuf(1999)
15	Capability for reconfiguration	Yusuf(1999)
16	Knowledge management	Yusuf (1999) Bustlo *et al.* (2006),
17	Innovation	Gunasekaran (1999), Bessant (2001)
18	Agile strategy	Bessant (2001)
19	Agile process	Bessant (2001)
20	Reward system	Crocitto & Youssef (2003)
21	Culture	Crocitto & Youssef (2003)
22	Reengineering	Crocitto & Youssef (2003)
23	Leadership	Crocitto & Youssef (2003)
24	Collaborative relationships	Lin *et al.* (2005)
25	People leverage and information technology	Lin *et al.* (2005)

Table 3: Agile capabilities are derived from literature.

Row	Factors	References
1	Responsiveness	Sharifi & Zhang (1999), Christian, Crocitto, Youssef, Lin *et al.* (2005)
2	Competency	Sharifi & Zhang (1999), Lin *et al.* (2005)
3	Flexibility	Sharifi & Zhang (1999), Christian, Crocitto, Youssef, Bessant (2001) Lin *et al.* (2005)
4	Quickness(speed)	Sharifi & Zhang (1999) Bessant(2001) Crocitto, Lin *et al.* (2005)
5	Variety of products	Bessant (2001)
6	Time to market	Bessant (2001)
7	Varity of product innovations	Bessant (2001)
8	Quality	Crocitto & Youssef (2003)
9	Cost	Crocitto & Youssef (2003)

8) Progressive Manufacturing Technology (Flexible Facility, Rapid Prototyping),

9) Team Working (Efficiency, Trust and Support Members),

10) Empowerment & Improvement (Job Enrichment, Accept of Job Change),

11) Motivation System (Job Satisfaction, Organizational Commitment),

12) Planning & Evaluation Performance (Efficiency, Integration).

Meanwhile, capabilities of organization agility (depended variables) were considered as a factor which is included four indicators in designing questionnaire. Four capabilities factors of organization agility according to literature are:

1) Competency

2) Responsibility

3) Flexibility

4) Speed

4. Survey normal and linearity variables assumption

In parametric analysis including path analysis which is used in the research, there are pre-assumptions about measurable variables distribution in societies which a sample is obtained.

One of the pre-assumptions normalization of variables distribution or other assumption is linear assumption among surveyed variables and homogeneity of variance in model.

In order to analyse the research data through descriptive statistics including frequency, cumulative percentage, median, standard deviation and median standard errors and in order to survey the variables linearity through kolmograph - semirnov test and in order to control the linearity relation between variables, distribution diagrams will be observed prior to deductive analysis, meanwhile, missing data will be deleted from the analysis.

In the case of deviating variable distribution from normal distribution, one of the following four methods from Figure 2, is used for transforming considerable variable to normal distribution. (Tabechnick and Fidell, 1989).

At first, distribution of variables abundance was surveyed for testing the assumption of research variable normalization. The research was done on all 150 variables which were used in exploratory factor analysis.

The executive method was that abundance distribution. Drown with normal curve for each research variables and on the basis of distribution deviation, transformation was done.

In this research, it was clarified that the fifth organizational culture's variable (orcu-e), third supply chain variable (scc), third progressive manufacturing technology variable (tmc), third team work variable (twc) and eighth team work variable (twh), don't have normal distribution and with the required techniques according to Table 5, each of them was transformed according to the following table, then new transformed variable replaced pre-variable. By re-controlling, transformed variables with other variables have normal distribution.

As it is clarified through 94 independent variables (agile enablers) only 5 variables need to be normalized which shows the normal distribution of other questions. Meanwhile; all 56 depended variables (Agile capabilities) has normal distribution, and it is not required to be transformed.

For controlling the linear assumption, all the present among research variables in the path model of distribution diagram were surveyed through point's distributions along variables pair axis, and the confirmation was verified.

Table 4: Agility enabler and capability factors.

Factor	Indicator	Question code (variables)	Quantity of question	Resource
Organizational structure	Formality	stora, storb, storc	3	Stephen P. Robbins
	Complexity	stord, store, storf, storg, storh	5	
	Centrality	stori, storj, stork, storl, storm, storn	6	
Virtual organization	Process	vea, veb	2	H. T. Goranson
	Participation	vec, ved	2	
Information technology	Application	ita, itb, itc, itd	4	Alvin O. Gunnson
	Integration	ite, itf, itg	3	
Organizational Cultural	Participation	orcua, orcub, orcuc	3	John R. Schermerborn
	Risk taking	orcud, orcue	2	
Leadership	Transformational/ Transactional	lsa, lsb, lsc, lsd, lse, lsf, lsg	7	John R. Schermerborn
	Future/Goal Centered	lsh, lsi, lsj, lsk, lsl, lsm, lsn	7	
Supply Chain	Cooperation with Customers	sca, scc	2	Rick Dove
	Cooperation with Suppliers	scb, scd	2	
Improved Design Technology	Simulation technology	Tda	1	Paul T. Kidd
	Engineering Analysis technology	Tdb	1	
Improved Manufacturing Technology	Flexible Facility	Tmc	1	Paul T. Kidd
	Rapid Prototyping	tmd, tme	2	
Team Working	Efficiency	twa, twb, twc, twd, twe, twf, twg	7	Paul G. Friedman & Elaine A. Yarbrough
	Trust & support members	twh, twi, twj, twk, twl, twm, twn, two, twp	9	
Empowerment & Improvement	Job enrichment	eia, eib, eic	3	Judith R. Gordon John M. Ivancevich & Micheal T. Matteson
	Accept of Job Change	eid, eie, eif, eig, eih, eii	6	
Motivation System	Job Satisfaction	msa, msb, msc, msd	4	Martin J. Gannon Fred Luthans
	Organizational Commitment	mse, msf, msg, msh, msi, msj, msk	7	
Planning & Evaluation Performance	Efficiency	pepa, pepb	2	John R. Schermerborn
	Integration	pepc, pepd, pepe	3	
Organization agility	Competency	orag1-11, orag14-15, orag19-27	22	Sharifi & Zhang
	Responsibility	orag12-13, orag28-42	17	
	Flexibility	orag16-17, orag43-52	12	
	Speed	orag18, orag53-56	5	
Total: 13	29	150	150	---

Table 5: The list of variable transformation for normalization.

Row	Variable name before normalization	Code	Transformation method	Variable name after normalization	Code
1	fifth organizational culture's variable	Orcue	Reverse then second stem	5- Organization culture reverse second stem	SQRTRorcue
2	third supply chain variable	Scc	second stem	3- Supply chain second stem	SQRTscc
3	third progressive manufacturing technology variable	Tmc	Logarithm on the base of 10	3- Progressive manufacturing and design logarithm	LOGtmc
4	third team work variable	Twc	second stem	3- Team working second stem	SQRTtwc
5	third team work variable	Twh	second stem	8- Team working second stem	SQRTtwh

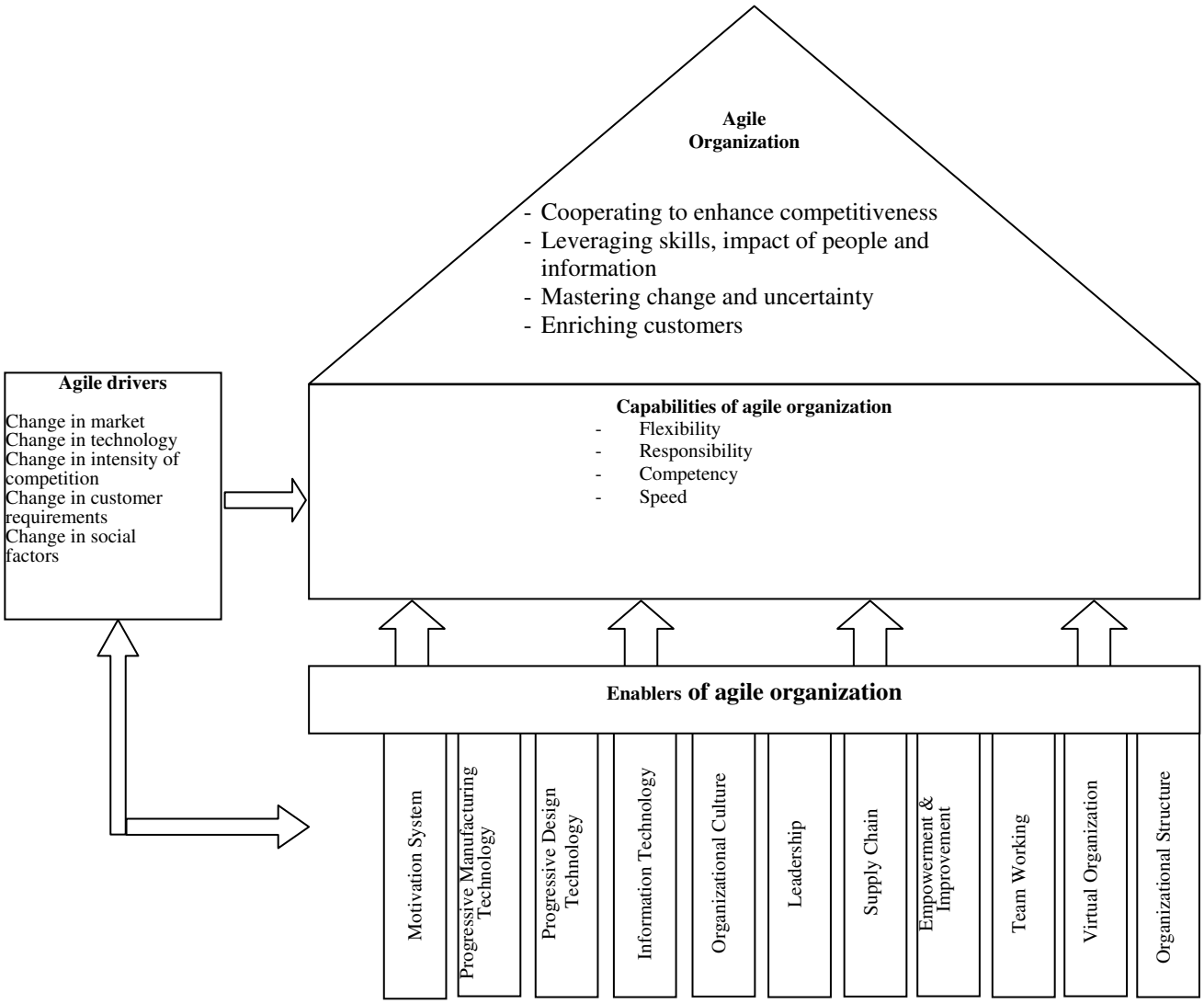

Figure 1: The conceptual model.

5. The survey reliability of questionnaire

Since Cronbach's alpha is usually suitable indicator for measuring reliability of measurement tool and inter cooperation among its elements. Therefore, questionnaire reliability used in the research has been evaluated by alpha Cronbach. By using SPSS software by Cronbach test, total validity of questionnaire and sets of depended and independent variables were obtained in Table 6.

As it is shown in Table 6, the amount of alpha Cronbach is excellent for agility enablers factors (%98.0), agility capabilities factors (%98.3) and for all questionnaires. At the end, after control the normal and linear of variables and reliability, factor analysis is done for construct validity measurement.

6. The survey constructs validity of the model

Validity is expression which refers to a target which the test is created for improving it. As it was told, a test has validity which is enough and

suitable for measurement. In this research, exploratory factor analysis method is used for construct validity. Factor analysis is one of the multi-variable method and one of the depended methods which all depended variables are considered and it tried to a lot of variables summarized in several factors. The main target of factor analysis is the summarization a lot of variables in a limited number of factors. As though from this process there will be least amount of decreasing information. One of the correlation methods for selecting suitable variables for factor analysis is using matrix. Since the basis of factor analysis method is related to correlation among variables but non-casual variable;s therefore, in using this method, correlation matrix should be calculated. These correlation matrixes show the relation between variables and lack of relations with others. This sample in factor analysis causes the formation of clusters which variables inside cluster has correlation together, and doesn't have correlation with other clusters of variables. It is justified that variables which does not have any correlation with no variables are deleted from analysis which in this research, one variable was not omitted out of 150 variables. KMO method can be used suitable determination and recognition outputs for factor analysis which its quantity is fluctuated between 0 and 1.

If KMO is less than 0.5, data will not be suitable for factor analysis, and if it is between 0.5 to 0.69, it can be analyzed more cautiously. However, if it is more than 0.7 present correlations will be suitable for factor analysis among data. KMO has been more than 0.95 in this research.

In this research by using SPSS software, all estimated methods including "principal component analysis", "common factor analysis", "generalized least squares", "unweighed least square", "maximum likelihood", "principal factoring", "alpha factoring", and "image factoring" were used and results compared together. Due to the cumulative sums of squared loading in total variance table, principal components analysis method because of maximum cumulative sums of squared loading was selected in comparison to other estimated methods. Firstly "special amount" equals to one and the results were compared together. All the mentioned manners have been done by choosing factor relation and results will be surveyed separately. It is necessary to mention that factor relation different methods like Varimax, Oblimin, Quartimax, Equamax and Promax have been used in this factor analysis and because of lacking meaningful difference of these methods and more application of variance method, these methods were used. Finally, because of better agreement with theoretical structure and factor load in the final factor analysis table, principal components analysis estimation method and definition 12 factors, and Varimax factor rotation, and KMO method (suitable recognition and determination of data output), factor analysis was done and the following results obtained. As it is observed in Table 7, KMO is equal to 0.861 and this factor shows the verification of samples volume. Bartlett's test of sphericity examine observed correlation matrix which belongs to depended variable society.

By observing Table 7 and meaningful level of Bartlett's test, we understand that there is meaningful relation among variables in correlation matrix.

By finalizing estimation and factor rotation method, final matrix of organization agility independent variables was created as Table 8.

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization. A Rotation converged in 9 iterations.

According to Table 9, clusters of each factor are classified based on factor loading. Twelve independent variables factors were selected in this cluster classification which according to Table 9, most of them agreed with factors explode from literature.

Table 6: Cronbach's alpha for questionnaire and set of depended and independent variables.

Scale title	Quality of questions	alpha Cronbach
Agility enablers factors (independent variables)	94	98.0
Agility capabilities factors (independent variables)	56	98.3
All questionnaires	150	98.8

Table 7: Bartlett and KMO test.

Sample volume verification by KMO test		,861
Bartlet test	Approx. Chi-Square	14543,336
	df	4371
	Sig.	,000

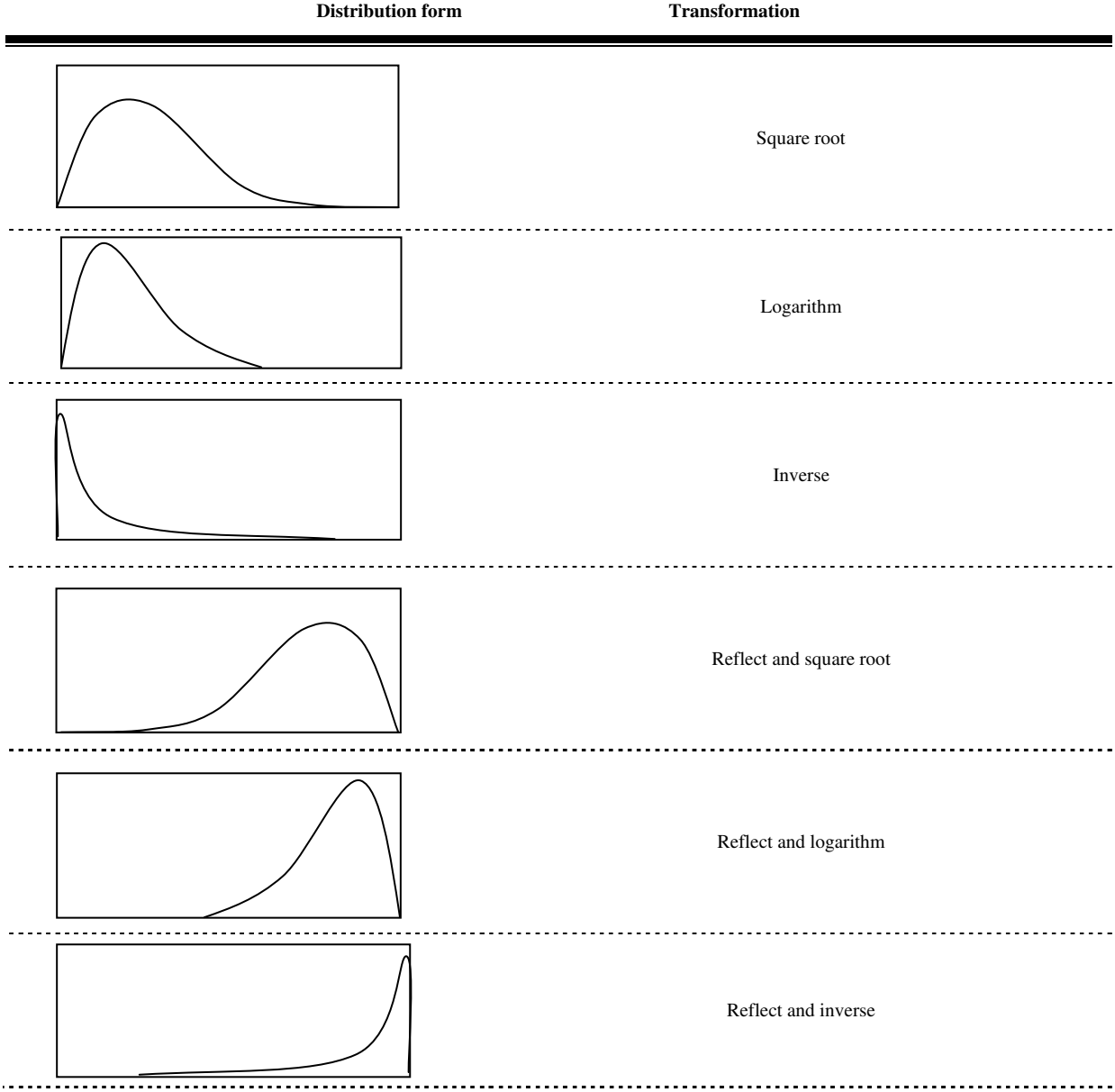

Figure 2: Distribution and common transformations to produce normality.

Table 8: Rotational factors matrix.

Variables	Factors											
	1	2	3	4	5	6	7	8	9	10	11	12
Orsta	,269	,058	,114	,091	***,732***	,137	,081	,077	,208	,087	,034	,077
Orstb	,316	,058	,232	,237	***,696***	,136	,063	,217	,109	,060	,030	,030
Orstc	,340	,179	,193	,212	***,722***	,182	,084	,162	,106	,100	,059	,016
Orstd	,263	,134	,023	,092	***,745***	,039	,027	,016	-,069	,036	-,050	,212
Orste	,243	,054	,130	,247	***,715***	,102	,096	,255	,011	,165	,140	,095
Orstf	,181	,058	,121	,039	***,271***	,030	,158	,439	,061	,085	,196	,128
Orstg	,357	,209	,097	,114	***,612***	,092	,163	,308	,166	,035	,059	-,047
Orsth	,221	,246	,229	,183	***,517***	,123	,209	,331	,033	,035	,190	-,143
Orsti	,304	,110	,211	,033	,397	,148	,150	***,565***	,095	,108	-,002	-,018
Orstj	,387	,220	,167	,063	,499	,116	-,013	***,457***	,087	,068	-,039	,163
Orstk	,327	,096	,200	-,005	,332	,085	,098	***,606***	-,047	,104	,073	,021
Orstl	,437	,107	,221	,150	,367	,122	,165	***,578***	-,059	,011	,017	,079
Orstm	,437	,045	,290	,047	,264	,170	,091	***,538***	,101	,026	-,075	,152

Table 8: Rotational factors matrix (continued).

Variables	Factors											
	1	2	3	4	5	6	7	8	9	10	11	12
Orstn	,415	,125	,244	,113	,168	,240	,022	***,574***	,089	,112	-,031	-,013
Vea	,114	-,104	***,698***	,103	,196	,167	,183	,235	-,061	,103	,099	,075
Veb	,092	-,089	***,760***	,121	,163	,141	,149	,164	-,038	,117	,071	,035
Vec	,149	,016	***,774***	,031	,167	,155	,129	,160	-,012	,067	,091	,113
Ved	,134	-,019	***,734***	,023	,118	,196	,182	,132	,106	-,003	,098	,204
Ita	,147	,174	***,825***	,171	,073	,100	,092	,049	,087	,059	,008	,033
Itb	,197	,188	***,825***	,093	,063	,141	,068	,093	,111	,032	,017	-,052
Itc	,148	,160	***,845***	,140	,036	,060	,021	,169	,065	,143	,040	-,063
Itd	,140	,155	***,733***	,108	-,008	,024	,121	,133	,091	,122	,020	-,001
Ite	,176	,104	***,803***	,229	,123	,159	,110	-,061	,037	,005	-,027	,086
Itf	,184	,081	***,770***	,203	,072	,185	,137	,009	,138	-,033	,010	,133
Itg	,111	,198	***,723***	,189	,005	,156	,019	-,224	-,009	,000	,020	,010
Orcua	,308	,164	,274	,143	,146	,043	***,714***	,237	-,010	,199	,064	,035
Orcub	,298	,187	,280	,085	,142	,075	***,709***	,155	,060	,229	,010	-,015
Orcuc	,186	,126	,261	,091	,087	,204	***,805***	,095	,094	,073	,047	,026
Orcud	,361	,177	,268	,117	,181	,156	***,696***	,049	,028	,089	,051	,028
SQRTREF Orcue	,348	,078	,214	,044	,058	,123	***,705***	,030	,162	,084	,051	,097
Lsa	***,660***	,158	,160	,273	,320	,138	,272	,021	,056	,155	-,025	,025
Lsb	***,643***	,128	,164	,163	,401	,164	,212	-,024	,101	,186	,032	,013
Lsc	***,711***	,147	,201	,132	,262	,189	,139	,100	,113	,194	,037	-,041
Lsd	***,730***	,213	,219	,199	,207	,187	,124	,057	,022	,112	,071	-,014
Lse	***,755***	,216	,236	,181	,238	,207	,101	,089	,012	,117	,045	-,039
Lsf	***,716***	,308	,129	,093	,090	,212	,021	,173	-,092	,071	,075	,115
Lsg	***,760***	,206	,153	,207	,189	,045	,222	,161	,052	,065	,059	,125
Lah	***,680***	,171	,183	,250	,280	,217	,233	,049	,138	-,081	,029	,017
Lsi	***,736***	,160	,204	,185	,156	,230	,145	,077	,132	,116	,106	-,016
Lsj	***,764***	,161	,208	,161	,220	,259	,096	,081	,094	,103	,081	,010
Lsk	***,713***	,188	,191	,277	,253	,240	,076	,165	,073	,096	,106	,067
Lsl	***,748***	,206	,157	,133	,123	,252	,120	,107	,166	,193	,153	,110
Lsm	***,622***	,035	,026	-,012	,039	,087	,167	,220	,075	,059	,042	,147
Lsn	***,731***	,085	,104	,259	,140	,154	,127	,270	,094	,071	,145	,089
Sca	,329	,258	,209	,291	-,018	,144	,212	,250	-,046	-,007	-,015	***,543***
Scb	,033	,327	,073	-,028	,124	,005	,100	,053	,037	,030	,064	***,720***
SQRTscc	,097	,393	,227	,005	,067	,027	-,081	,167	,115	,180	,169	***,581***
Sce	,089	,372	,110	,034	,162	-,013	-,042	-,013	,189	,194	,179	***,626***
Tdma	,215	,166	,055	,089	,165	-,018	,136	-,118	-,317	,071	***,399***	,283
Tdmb	,168	,279	,021	,001	,111	,163	,125	,081	,071	-,023	***,399***	,043
LOGtdmc	-,041	,081	,091	-,125	-,012	,021	,090	-,006	-,143	,061	***,767***	,068
Tdmd	,035	,057	,050	-,052	,099	,049	-,152	,012	,201	,142	***,617***	,289
Tdme	,318	,098	,108	,041	-,033	,163	,026	,101	-,146	-,032	***,687***	-,138
Twa	,040	***,580***	,119	,352	,015	-,016	,027	,400	-,002	,100	,125	,197
Twb	,051	***,606***	-,021	-,014	-,058	-,028	-,055	,261	,020	,119	,207	-,027
SQRTtwc	,152	***,728***	,094	,209	-,039	,048	,015	,276	,128	,153	,157	,096
Twd	-,022	***,747***	,111	-,025	,026	,018	-,024	,191	,315	,133	,110	-,053
Twe	,027	***,692***	,043	,130	,124	,136	,084	,047	,430	,006	,175	-,032
Twf	,069	***,623***	-,067	,051	,123	-,042	-,096	,249	,197	,036	,021	,127
Twg	,310	***,608***	,090	,123	,032	,053	-,030	,094	-,064	,084	,173	-,066
SQRTtwh	,116	***,731***	,034	,164	,103	,270	,083	,060	-,146	,095	-,026	,073

Table 8: Rotational factors matrix (continued).

Variables	Factors											
	1	2	3	4	5	6	7	8	9	10	11	12
Twi	,235	***,659***	,107	,080	,116	,286	,169	,002	,072	-,054	-,124	,082
Twj	,307	***,690***	,065	,120	,119	,291	,178	-,028	,031	-,062	-,031	,150
Twk	,124	***,743***	,075	,036	,046	,171	,231	-,136	,106	-,131	,044	,211
Twl	,206	***,590***	,111	-,035	,079	,100	,124	-,002	-,015	-,075	-,079	,180
Twm	,250	***,660***	,062	-,119	,014	,021	,073	-,182	,112	,006	-,010	,165
Twn	,184	***,608***	,201	,015	,186	,162	,083	-,111	-,044	,216	,130	,185
Two	,129	***,619***	,227	,134	,283	,247	,258	-,116	,021	,159	,049	,187
Twp	-,016	***,556***	,118	-,002	,251	,278	,152	-,240	-,124	,269	,130	-,053
Eia	,235	,343	,282	,123	,204	***,569***	,215	,075	,081	,224	,139	-,027
Eib	,105	,335	,347	,043	,203	***,568***	,159	,017	,063	,065	,172	,152
Eic	,264	,238	,241	,007	,181	***,613***	,074	,101	,116	,105	,069	,135
Eid	,164	,282	,160	,028	,049	***,454***	,308	,092	,108	,281	,158	-,089
Eie	,291	,166	,219	,161	,028	***,763***	,023	,039	,060	,095	,051	-,037
Eif	,294	,288	,249	,110	,060	***,644***	,089	-,029	,079	,000	,025	,022
Eig	,272	,025	,216	,229	,130	***,686***	,038	,104	-,097	,080	,058	,021
Eih	,320	,083	,149	,214	,059	***,724***	,067	,115	,051	,039	,045	-,014
Eii	,301	,205	,196	,232	,172	***,663***	,138	,173	,112	,040	,064	,012
Msa	,220	,276	,179	,195	,184	,071	,059	-,058	***,678***	,129	-,113	,029
Msb	,177	,203	,205	,343	,147	,139	,095	,029	***,706***	,104	-,005	,120
Msc	,197	,132	,135	,535	,134	,133	,156	,116	***,569***	-,061	-,019	,101
Msd	,204	,232	,076	,348	,086	,046	,173	,120	***,670***	-,009	-,080	,138
Mse	,174	,129	,157	***,715***	,213	,030	,075	,169	,188	,118	-,032	,017
Msf	,317	,017	,167	***,728***	,164	,100	-,092	-,016	,129	,148	-,116	-,029
Msg	,178	,063	,221	***,723***	,224	,117	,032	,058	,114	,042	,007	-,003
Msh	,128	,086	,099	***,805***	,054	,064	,009	-,060	-,032	,074	-,094	-,031
Msi	,143	,105	,205	***,780***	,179	,186	,128	,063	,022	,111	-,043	,065
Msj	,277	,086	,248	***,647***	,029	,209	,150	,041	,200	,150	,091	-,053
Msk	,221	-,049	,179	***,579***	-,015	,174	,103	,023	,215	,016	,112	,098
Pepa	,395	,162	,245	,358	,123	,192	,150	,152	,097	***,590***	,000	,093
Pepb	,449	,117	,166	,294	,190	,228	,074	,105	,010	***,618***	-,018	,188
Pepc	,328	,171	,238	,255	,219	,121	,166	,092	,100	***,666***	,183	,085
Pepd	,418	,196	,186	,271	,143	,154	,144	,113	-,038	***,681***	,015	,138
Pepe	,328	,284	,075	,094	,156	,207	,164	,196	,187	***,516***	,252	,181

Table 9: The results of independent variable analysis.

Obtained factors of exploratory factor analysis	Literature factors
Leadership (ls)	Leadership (ls)
Team working (tw)	Team working (tw)
empowerment and improvement (ei)	empowerment and improvement (ei)
motivation system-job satisfaction (ms-js)	motivation system (ms)
motivation system-organizational commitment (ms-oc)	planning and evaluating performance (pep)
planning and evaluating performance (pep)	Organizational Structure (orst)
Organizational Structure-Formality& Complexity(orst-fc)	Information technology (it)
Organizational Structure-Centrality(orst-ce)	Virtual organization (ve)
Information Technology-Virtual organization(itve)	Organizational Cultural (orcu)
Organizational Cultural (orcu)	Improved Design Technology (tda)
Improved Design and Manufacturing Technology(tdm)	Improved Manufacturing Technology(tma)
Supply chain (sc)	Supply chain (sc)

According to the above method, exploratory factor analysis was done for depended variables (agility capabilities) 56 depended variables were surveyed in this analysis.

According to Table 10 KMO equals to 0.932 calculated which shows the sample volume verification. Meanwhile; Bartlett's test clarified that there is meaningful correlation among variables. Due to Table 11, and using Pre-told techniques, three factors were created by factor analysis method. According to the obtained results, exploratory factors are: competency, responsibility, and third factor are flexibility and speed.

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

A Rotation converged in 6 iterations.

Due to variables factor load, it was clarified that questions 12, 13, 16, 17, 43 have low factor loading and they were deleted in this process. Finally, by depended variable factor analysis, responsibility and competency indicators were verified, but speed and flexibility indicators were emerged in one indicator that is shown in Table 12. The reason is a few number of speed indicator questions, and close concept of speed and flexibility, in this exploratory division, exploratory factor analysis became the next basis of calculation.

7. Confirmatory factor analysis in organization agility model indicators

For survey whether suitable indicators are used for measuring latent variables of organization agility analytic model, confirmatory factor analysis was used by LISREL Software.

As it is shown in Figure 1 and Table 10, confirmatory factor analytic results show that all organization agility analytic model indicators have meaningful relation with organization agility analytic model latent variables more than 99% ensuring.

By helping the above confirmatory factor analysis, organization agility analytic model latent variables were created as follows:

1) Leadership / organizational structure including: leadership, centrality, formality and complexity indicators.
2) Sub-structure / human resource including: teamwork, virtual organization / information technology, improvement and empowerment, organizational culture.
3) Technology/Process including: planning and evaluating performance, progressive manufacturing and design technology / supply chain.
4) Systems including: job satisfaction and organizational commitment.
5) agility including: flexibility - speed, responsibility, competency.

Table 10: Bartlet and KMO test.

Sample volume verification by KMO test		***.932***
Bartlet test	Approx. Chi-Square	7310.246
	df	1128
	Sig.	***.000***

Table 11: Rotation factors matrix.

Variables	Factors		
	1	2	3
orag1	***.728***	.302	.115
orag2	***.760***	.301	.201
orag3	***.705***	.374	.208
orag4	***.712***	.336	.099
orag5	***.783***	.232	.187
orag6	***.821***	.246	.138
orag7	***.717***	.329	.307
orag8	***.745***	.239	.377
orag9	***.713***	.263	.390
orag10	***.740***	.244	.282
orag11	***.704***	.269	.259
orag14	***.679***	.297	.309
orag15	***.664***	.207	.278
orag18	***.638***	.251	.321
orag19	***.584***	.091	.431
orag20	***.564***	.077	.334
orag21	***.648***	.151	.427
orag22	***.479***	.170	.447
orag23	***.592***	.273	.443
orag24	***.572***	.270	.293
orag25	***.485***	.394	.219
orag29	.350	.411	***.485***
orag30	.358	.356	***.549***
orag31	.345	.231	***.485***

Table 11: Rotation factors matrix (continued).

Variables	Factors		
	1	2	3
orag32	.426	.349	***.592***
orag33	.467	.343	***.553***
orag34	.374	.472	***.581***
orag35	.398	.417	***.608***
orag36	.362	.266	***.700***
orag37	.302	.339	***.710***
orag38	.301	.307	***.753***
orag39	.186	.283	***.819***
orag40	.171	.323	***.789***
orag41	.224	.307	***.767***
orag42	.354	.306	***.655***
orag44	.307	***.699***	.221
orag45	.361	***.661***	.258
orag46	.365	***.691***	.149
orag47	.441	***.588***	.301
orag48	.430	***.648***	.253
orag49	.198	***.680***	.309
orag50	.173	***.801***	.210
orag51	.077	***.660***	.362
orag52	.170	***.705***	.270
orag53	.312	***.679***	.283
orag54	.323	***.653***	.240
orag55	.286	***.773***	.344
orag56	.268	***.738***	.310

Table 12: The results of depended variable analysis.

Obtained factors of exploratory factor analysis	Literature factors
Competency	Competency
Responsibility	Responsibility
Flexibility-Speed	Flexibility
	Speed

Table 13: Confirmatory factor analytic value.

Latent variable	Indicator title	Estimated value	Standardized value (Lambda)	Standard error	t-value	Indicator determination coefficient by latent variable.	Significant	Result
Structure/ Leadership (st_lst)	Leadership (ls)	226.19	0.91	0.17	13.58	0.83	P < 0.01	Model confirmation
	complexity and formality (orst_fc)	105.67	0.79	0.37	10.99	0.63	P < 0.01	Model confirmation
	centrality (orst_com)	84.79	0.78	0.39	10.78	0.61	P < 0.01	Model confirmation
Infrastructurel/ Human resource (inst_hur)	team working (tw)	121.64	0.64	0.59	8.17	0.41	P < 0.01	Model confirmation
	information technology/virtual organization (itve)	145.13	0.64	0.59	8.13	0.41	P < 0.01	Model confirmation
	empowerment and improvement (ei)	118.39	0.80	0.36	10.97	0.64	P < 0.01	Model confirmation
	organizational culture (cuor)	53.72	0.70	0.51	9.17	0.49	P < 0.01	Model confirmation
Technology/ Process (te_pr)	planning and evaluating performance (pep)	48.69	0.50	0.31	4.52	0.69	P < 0.01	Model confirmation
	progressive design and manufacturing (tdm)	26.21	0.54	0.71	6.08	0.29	P < 0.01	Model confirmation
	supply chain (sc)	25.61	0.58	0.66	6.58	0.34	P < 0.01	Model confirmation

Table 13: Confirmatory factor analytic value (continued).

Latent variable	Indicator title	Estimated value	Standardized value (Lambda)	Standard error	t-value	Indicator determination coefficient by latent variable.	Significant	Result
System (sy)	job satisfaction (ms_js)	43.61	0.68	0.54	8.56	0.46	P < 0.01	Model confirmation
	organizational commitment (ms_oc)	115.36	1.73	-0.04	3.02	0.86	P < 0.01	Model confirmation
Organization agility (orag)	Flexibility-Speed (flexsp)	147.49	0.56	0.27	12.27	0.82	P < 0.01	Model confirmation
	Responsibility (resp)	180.21	0.88	0.22	8.23	0.78	P < 0.01	Model confirmation
	Competency (comp)	197.96	0.64	0.18	12.89	0.73	P < 0.01	Model confirmation

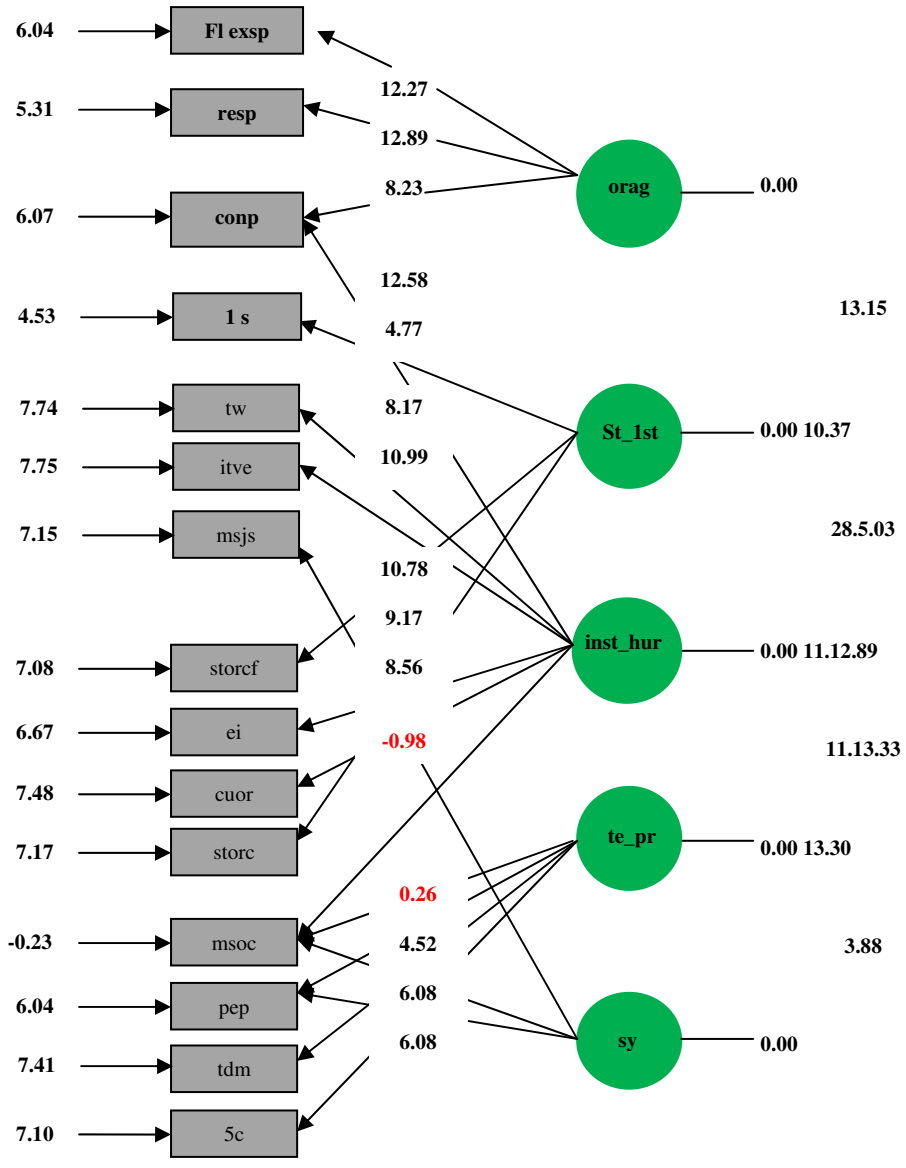

Figure 3: Initial modal of path analysis with t-value.

8. Conclusion

After gathering questionnaires, following results for the studied Iranian Industrial Organization according to the conceptual model, enablers and capability factors are acquired.

As it is observed in Table 9, factor analysis has integrated some of the literature independent factors like information technology, virtual organization and also progressive design technology, progressive manufacturing technology and in return, some of the literature factors are divided including centrality of organizational structure in one hand and formality and complexity of organizational structure on the other hand, or motivation system divided to job satisfaction factors, and organizational commitment.

According to Table 11, clusters of each literature dependent factors are classified based on factor loading. Three factors were selected in this cluster classification which according to Table 12 and most of them agreed with factors explode from literature.

The main conclusion of this study was that by using factor analysis, inner effective factors (enablers) and agile capability factors were clarified to some extent so that these factors agreed with literature and researchers experiences.

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