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Just-In-Time (JIT) Manufacturing and its Effect on the Competence of Supply Chain and Organizational Performance in the Tile and Ceramic Industry in Yazd Province

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Abstract: *Just-In-Time manufacturing is defined as a comprehensive strategy for supply chain that combines the predefined elements of just-in-time manufacturing, purchase in just-in-time manufacturing and sale in just-in-time manufacturing, with new factor of information in just-in-time manufacturing that can be used in order to increase performance and improve competence of supply chain. This study aims at considering the relation between management strategy of supply chain and organizational performance. In this investigation, 219 managers and experts of tile and ceramic industry as well as technical and nontechnical of this industry have been considered, and the results indicate that strategy for supply chain management has positive effect on just-in-time manufacturing, competences of supply chain and desired organizational performances.*

Keywords*: Supply Chain Management Strategy, Just-in-time Manufacturing, Supply Chain Competence, Organizational Performance*

INTRODUCTION

In today's competitive world, previous methods for production management which pursued lower levels of integrity have lost their efficiency due to the new characteristics of the production environment and change in customers' nature which is affected by increasing capability, global commercial environment and development of production technologies. Thus, companies are required to establish an ordered integrity in their all production processes, from raw material to final consumer. On one hand, organizations are always using methods and techniques for improving their proper business management to achieve their goals and they want to develop new solutions (Ebrahimi & Namanian, 2015). Furthermore, increasing competition between factories and companies for producing products with high quality and in accordance to customers' taste has necessitated establishing new perspective between all manufacturers and producers.

In past, each production center tried to develop its market share through increasing the number of produced products. After some decades, production centers started to produce some products with higher qualities for absorbing customer. In recent decades, the main factor for achieving more market share in industry leaders' perspective is not fulfilling customer's needs (Jorge Luis et al., 2014). According to traditional approach, each company set some changes in its territory without having any information about conditions of other members of the chain. But in supply chain management approach, members of the chain set changes in company so that it has the most efficiency for the whole chain. Supply chain management is a key and strategic factor in increasing the effectiveness and achieving organizational

goals (Kootanaee et al., 2013). So, supply chain management should be called a vital field in organization management that, like other fields, needs observation, supervision, finding complainant, improvement and finally approaching toward excellence and is obligatory for achieving and reinforcing competitive advantages, performance evaluation, continuous improvement and efficient management.

Supply chain management, based on two principles of cooperation and coordination, coordinates the organizations of a chain through sharing and clearing information, and encourage them to cooperate with each other in a competitive environment in order to achieve more competitive advantages (Olfat & Gariz, 2014). (Claycomb et al. 1999) defined JIT "just-in-time manufacturing system" as includes three elements. Hence, this concept has been developed by the element and included information of just-in-time manufacturing and its name changed into total just-in-time manufacturing (T-JIT). New scale for clarifying effects of the information on supply chain and considering the effect of T-JIT on supply chain capacity and organizational performance was evaluated and then applied (Claycomb et al., 1999). Willing to have competitive environments in supply chain doesn't lead to adopt a strategy for supply chain management that leads to accept programs and tactics that establish integration and coordination of the business processes with customers (Kenneth et al., 2014). Supply chain management seeks for improving stockholders' performance through omitting spoilages and better usage of capacities of local and foreign technology suppliers. Adopting a strategy for supply chain management can lead to T-JIT processes. Strategy for supply chain management considered as in introduction for T-JIT. It is important to distinguish between strategy for supply chain management and supply chain management (Horri et al2015). Strategy for supply chain management is a fundamental strategy that makes an organization to focus on the importance of integration and coordination with customers and suppliers, rather than focusing on real process of integration and coordination (Mensah et al., 2015).

Total just-in-time manufacturing (T-JIT) is defined as a total strategy for supply chain that integrates predefined elements of production in just-in-time manufacturing, sale in just-in-time manufacturing, with the new factor of information in just-in-time manufacturing. Discovery of the effects of extensive concepts on supply chain capacity and organizational performance is interesting and informative. In this study, we consider T-JIT in the concept of a supply chain following the effect of a strategy and analyze a synthetic model of T-JIT as a main structure with a supply chain management strategy (SCMS) as an introduction and supply chain capacity (SCC) and operational performance as conclusions.

2- Literature review

(Horri et al.2015) in a study titled "total just-in-time manufacturing and its effects on supply chain capacities and organizational performance (case study: Zarab company in Arak)" investigated the relation between supply chain strategies, T-JIT, organizational performance and supply chain competences. Their method was descriptive-correlational and a questionnaire was distributed among employees of Zarab Company of Arak with more than 2000 employees and total technicians of 60 people. DEMATEL technique based on pair comparison and distribution of questionnaire among experts was used in this study. Results show that there is a positive and significant relation between supply chain management strategies and T-JIT. Furthermore, there is appositive relation between supply chain management strategies and organizational performance and supply chain capacities. The positive relation between T-JIT and organizational performance and supply chain capacity was confirmed.

(Ebrahimi et al.2015) in an investigation titled "just-in-time manufacturing just-in-time manufacturing and its effects on supply chain capacities and organizational performance", considered the relation between supply chain strategies, T-JIT, organizational performance and supply chain competences. Data collection tool is a questionnaire. Total number of managers, technical and non-technical experts from west cement factory is 508 people. To determine the sample capacity, Cochran formula was applied upon which the sample capacity was 219 people. To consider data normality, Kolmogorov-Smirnov test was used. Hypotheses were considered using correlation test and multivariable regression with multi-structure equations. Results of the study show that there is a positive and significant relation between supply chain management strategy and T-JIT. In addition, there is a positive relation between supply

chain management strategies and organizational performance and supply chain capacity. The positive relation between T-JIT and organizational performance and supply chain capacity was confirmed.
(Lee,2015) in a study titled "effect of the green supply chain management on the supplier's performance through aggregation of social asset" investigated the effects of green supply chain management (GSCM) on environmental and operational function through a perspective about aggregation of social asset. This study was performed using distribution of questionnaire among companies in South Korea and the sample size involved 207 cases. Analysis was performed using factor-discovery analysis and structural equations. Results show that GSCM leads to improvements in environmental and functional performances of supply chain through aggregation of social asset. So, all the hypotheses are confirmed (Su-Yol Lee et al., 2015).
(Chen et al., 2015) in a study titled "relations between JIT, TQM, operation performance and production" investigated the relations between just-in-time manufacturing (JIT), total quality management (TQM) and the operation for producing performance. The investigation model is made of components including JIT implementation, production functional performance and implementing TQM. The investigation was performed through distribution of questionnaire among Chinese production companies and the sample size involved 173 cases. Data analysis was performed using model of structural equations and SPSS and AMOS software. Results show that there isn't a positive relation between production functional performance and TQM while there is positive relation between production functional performance and JIT. In addition, complementary relation between JIT and TQM was confirmed (Chen et al., 2015).
(Kenneth et al., 2014) in a study titled "total just-in-time manufacturing and its effect on supply chain competence and organizational performance" investigated the effect of total just in time index on the fields relevant to supply chain. This study is made of some variables including supply chain management strategies, total just-in-time manufacturing, organizational performance and supply chain competences. The sample size involved 1600 cases from production managers and factory managers who are working for large industries in The Unites States. Data analysis was performed using procedural structural equations and covariance structural modeling. Results show that supply chain management strategy has positive effect on just-in-time manufacturing, supply chain competences and desired organizational performances and so, all the hypotheses were confirmed (Kenneth et al., 2014).
(Pamela et al. 2012) in an investigation titled "just-in-time manufacturing, supplying JIT and performance: review on the effects of moderation" investigated the positive relation between just-in-time manufacturing and supply and performance. The sample size involved 207 cases from Italian production factories. Data analysis was performed using hierarchical regression analysis. Results show that just-in-time manufacturing and supply has positive effect on performance effectiveness and delivery performance, but the moderating role of supply between just-in-time manufacturing and delivery performance and performance effectiveness was not confirmed (Pamela et al., 2012).

3- Theoretical framework

Just-In-Time strategy is defined as a combination of accomplished activities in an organization that includes just-in-time manufacturing, just-in-time purchase, just in time sell and just in time information that the aim of all these components is omitting wastage in an organization and better usage of the resources all over supply chain. Total just in time is adopted with the aim of operating out the manufacturing organizations in total supply chain management…. both in a direct and indirect way, through competences relevant to accomplishable chain (Hunt et al., 1999).
Using just-in-time manufacturing systems for effecting on supply chain involves developing just in time purchases and sales. Those activities are concentrated at developing and reinforcing these integrated mechanisms, have defined direct supply chain as a central organization that is in relation to first grade communications between supplier and customer. In this regard, Kenneth et al. started to review the relation between supply chain management strategies and total just-in-time manufacturing and found that there are positive and significant relations between them (Kenneth et al., 2014). In addition, (Horriet al.,2015) discovered positive and significant relations between supply chain management strategies and

just-in-time manufacturing and the results of their study were acknowledged by the investigation by (Ebrahimian et al., 2015). The conceptual model for the study will be as follows:

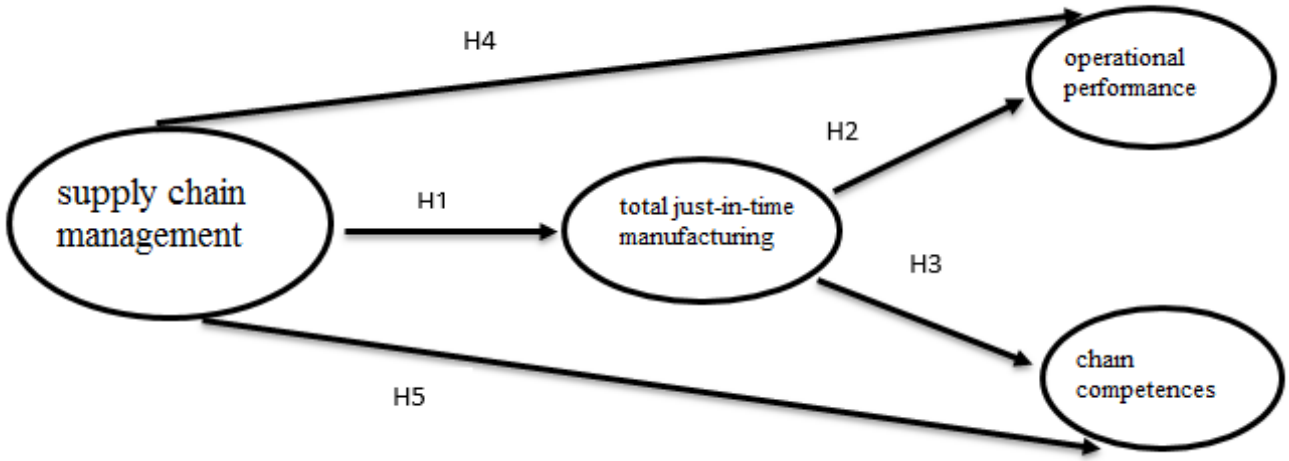

Figure 1- conceptual model

(Supply chain management strategies, total just-in-time manufacturing, operational performance, chain competences)

3- Methodology

The main purpose of this study is about Just-In-Time (JIT) manufacturing and its effect on the competence of supply chain and organizational performance in the tile and ceramic industry in Yazd province. Statistical population of this research is all the managers and experts of tile and ceramic industry as well as technical and non-technical experts in this industry. Accordingly, a sample size involving 219 people is achieved using Cochran formula. To review variable of supply chain management strategies, the questionnaire from (Winser, 2003), to review functional performance, questionnaire from (Bowersox et al. 2000) and (Inman et al. 2011), to review supply chain competences, the questionnaire from (Kohli et al., 2010) and to review total just in time, a questionnaire from (Inman et al. 2011) were used.

For data analysis in modeling structural equation method with the minimum minor squares, two stages should be performed: 1. Review of model fitness: this stage involves 3 parts: review of measurement model fitness, review of structural model fitness and review of total model fitness and 2. Hypotheses testing. To review measurement model fitness, three scales are used: stability (assessment of factor weights, combined stability), convergent justifiability (assessment of average index of variance extracted or AVE) and divergent justifiability (diagnostic justifiability and factor-discovery analysis). The scale for reviewing structural model fitness of a research includes: R^2 values and Q^2 scale. Furthermore, to review total model practice which controls, both parts of measurement and structural models, GoF scale is used.

4- Results

4-1- Review of measurement model fitness

Stability

Stability is reviewed through evaluating factor weights and synthetic stability. Paradigm 1 shows that all factor weights of indices are higher than 0.4. So, there is no need to omit any index and therefore it has appropriate stability.

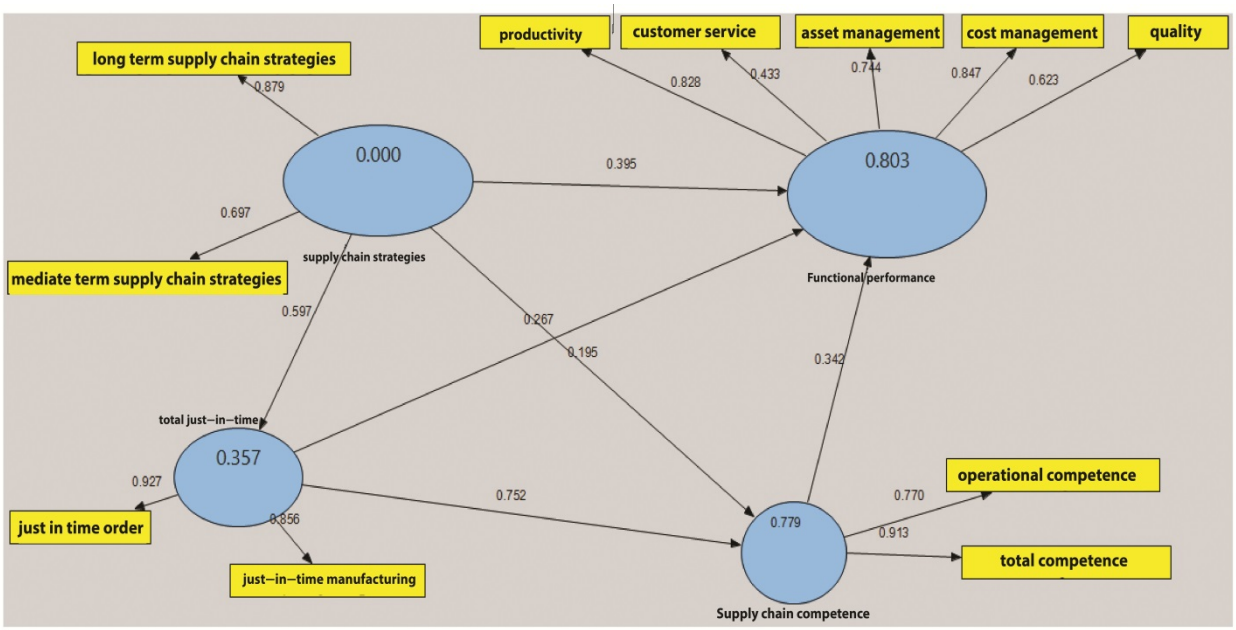

Figure 2- Research model in standard approximation mood

Significance of factor weights of indices is shown in Chart 2:

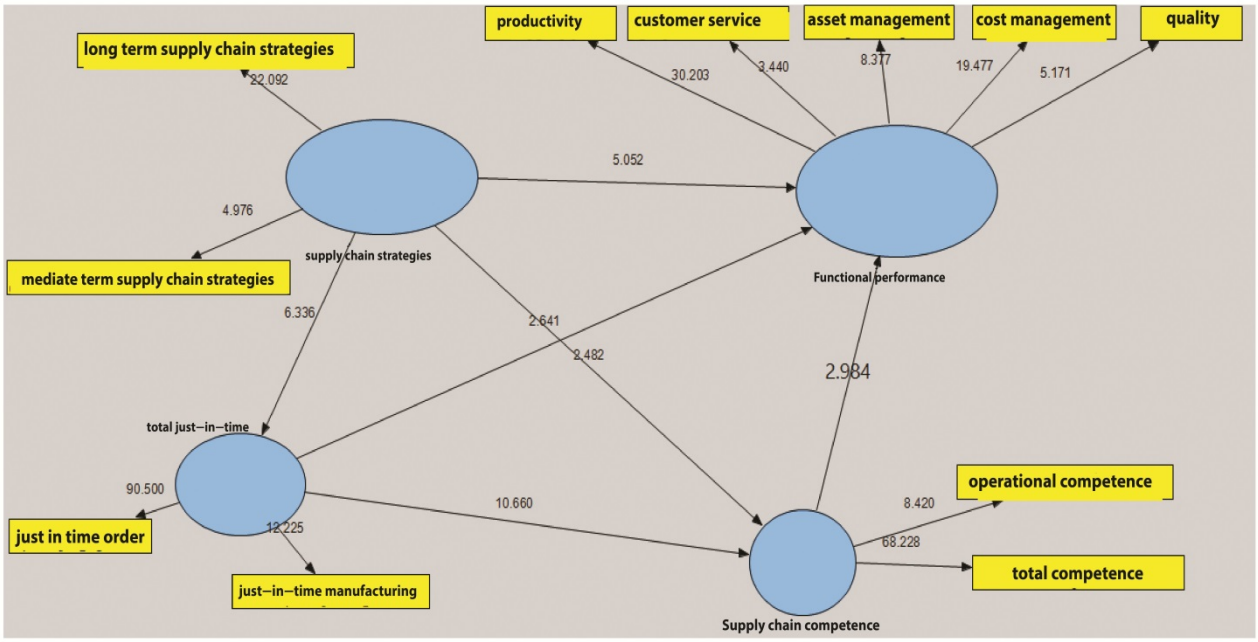

Figure 3- Research model in significance factor mood

Furthermore, table 1 shows the synthetic stability of main variables in the study:

Table 1- synthetic stability of the main variable in the study

variable	Stability
Total just in time	0.886
Functional performance	0.830
Supply chain strategy	0.771
Supply chain competence	0.832

Results of table 1 shows that values of synthetic stability of main variables in the study indicate appropriate stability and acceptable practice of the measurement model.

Convergent justifiability

Convergent justifiability is evaluated using average variance extracted index or AVE. values of average variance extracted of the variables in this study are shown in table 2:

Table 2- Values of AVE

Variable	AVE
Total just in time	0.796
Functional performance	0.506
Supply chain strategy	0.621
Supply chain competence	0.713

As it is shown in table 2, values of average variance extracted of variable in this study are higher than 0.5 and it indicates on the fact that there is an appropriate justifiability in these two variables.

Divergent justifiability

Divergent justifiability uses two methods to consider practice:

a- Diagnostic justifiability: Fourner and Locker method

(Fourner et al., 1981) state divergent justifiability is in acceptable level when AVE value in each component is higher than component's square correlation with other components. The AVE value of all 4 variables in table 3 is higher than their square correlation with each other and this shows that there is an appropriate divergent justifiability and good practice in measurement model. Table 3 shows the divergent justifiability assessment matrix using Fourner and Locker method:

Table 3- Divergent justifiability assessment matrix using Fourner and Locker method

Component	Value of correlation factor with:				Average variance extracted	Establishing the condition for divergent justifiability
	A	B	C	D		
Total just in time (A)	1	0.655	0.527	0.338	0.796	☑
Functional performance (B)	0.655	1	0.411	0.209	0.506	☑
Supply chain strategy ©	0.527	0.411	1	0.533	0.621	☑
Supply chain competence (D)	0.338	0.209	0.533	1	0.713	☑

b- Comparing correlation between indices of a component with that component against correlation of those indices with other organizations (factor-discovery analysis)

Table 4 shows the results of factor-discovery analysis:

Table 4- factor-discovery analysis

	Total just in time	Functional performance	Supply chain strategies	Supply chain competences
Just in time order	0.758	Under 0.6		
just-in-time manufacturing	0.813	Under 0.6		
Customer service		0.814		
Cost management	Under 0.6	0.795	Under 0.6	
Quality	Under 0.6	0.876	Under 0.6	
Productivity	Under 0.6	0.722	Under 0.6	
Asset management	Under 0.6	0.811	Under 0.60	
Supply chain	Under 0.6		0.779	Under 0.6
Supply chain long term factors	Under 0.6		0.744	Under 0.60
Operational competences	Under 0.60			0.863
Total competences	Under 0.6			0.844

As it is shown in table 4, all indices share more factor weight with their own relevant components rather than other components and this indicates an appropriate divergent justifiability of the investigation model.

4-2- Structural model fitness

4-2-1 R^2 index

Chin (1998) introduces three values of 0.19, 0.33 and 0.67 as scale value for weak, mediate and strong values of R^2. As it's shown in figure 4-1T the R^2 value for total just in time variable, functional performance and supply chain competence are in turn 0.357, 0.803 and 0.799. Therefore, the R^2 value of these variables is at the level of mediate, very strong and very strong.

4-2-2 Q^2 scale

Q^2 index determines the predictability of the model and if its value reaches to 0.02, 0.15 and 0.35 in an endogenous component, they indicate on weak, mediate and strong predictability of the endogenous component, respectively. This value in total just in time, functional performance and supply chain competence equals to 0.239, 0.376 and 0.5457 respectively that shows the mediate, very strong and very strong predictability of the desired practice of structural model.

4-3- total model fitness

To review total model fitness which controls both parts of measurement model and structural model, GOF scale is used:

$$GoF = \sqrt{\overline{Communalities}} \times \sqrt[2]{\overline{R^2}}$$

$\overline{Communalities}$ is deduced from average common values of latent variables in first stage, that is component indices of the research. With respect to output of SmartPLS software, these values include:

Table 5- calculating total model fitness index

component	communalities	$\overline{Communalities}$	R^2	$\overline{R^2}$	GOF
Total just in time	0.796	0.659	0.357	0.646	0.652
Functional	0.506		0.803		

performance					
Supply chain strategy	0.621		----		
Supply chain competence	0.713		0.799		

(Wetzels et al. 2009, p 187) introduce three values of 0.01, 0.25 and 0.36 as scale value for weak, mediate and strong values of GOF. Therefore, achieving value of 0.652 for GOF indicates on very strong total fitness for research model.

4-4- examining the main hypothesis of the research

Paradigm 3 shows the research model in standard approximation mood:

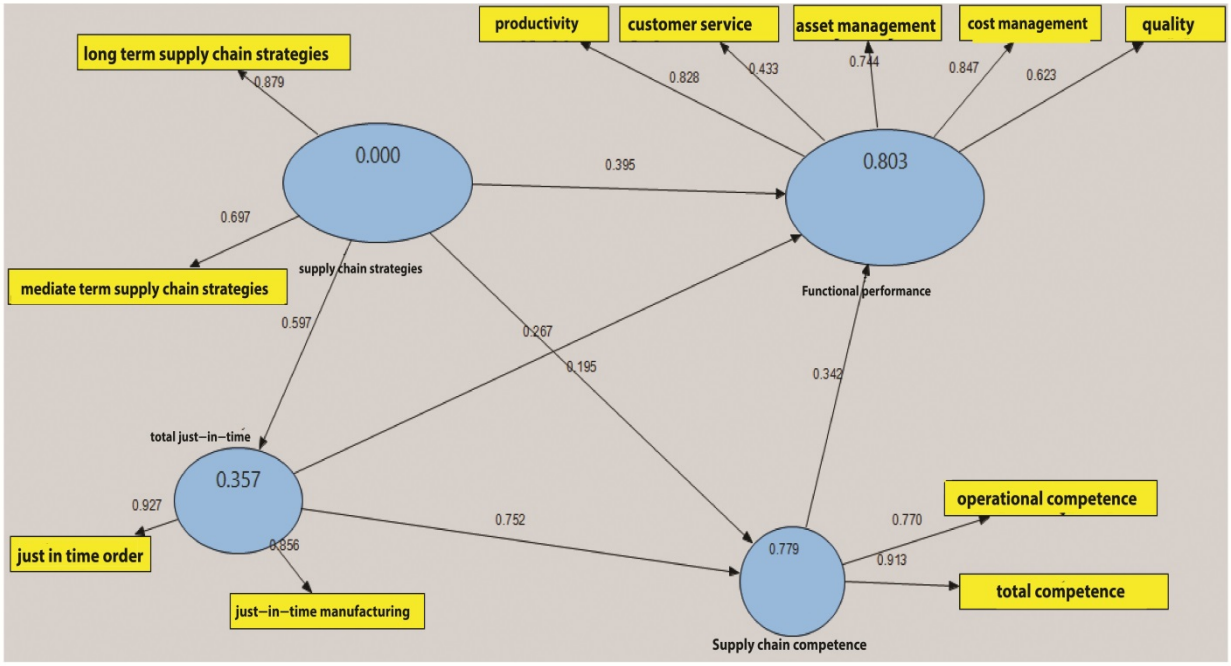

Figure 4- Research model in standard approximation mood

Chart 3 (model in standard approximation mood) and 4 (model in significance factor mood) show the impact and significance of the relations between main variables in the research.

Table 6- The results of examining the main hypothesis of the research

Independent variable	Dependent variable	Direct effect	Total effect	t>1.96	Test result
Supply chain management strategies	Total just in time	0.597	0.597	√	approving H_1
Total just in time	Functional performance	0.267	0.524	√	approving H_1
Total just-in-time manufacturing	Supply chain competence	0.752	0.752	√	approving H_1
SCM strategies	Functional performance	0.395	0.775	√	approving H_1
SCM strategies	Supply chain competences	0.195	0.644	√	approving H_1

Supply chain competences	Functional performance	0.342	0.342	√	approving H_1

As it is shown by the result of table 6, all hypotheses of the research are confirmed.
Values of p and t are calculated in turn less than 0.05 and higher than 1.96. according to the p values (less than 0.05) and t values (higher than 1.96), it can be said by 95% assurance that independent variables have positive, direct and significant effect on dependent variables. Paradigm 4 for significance shows the effect of independent variables on dependent variables:

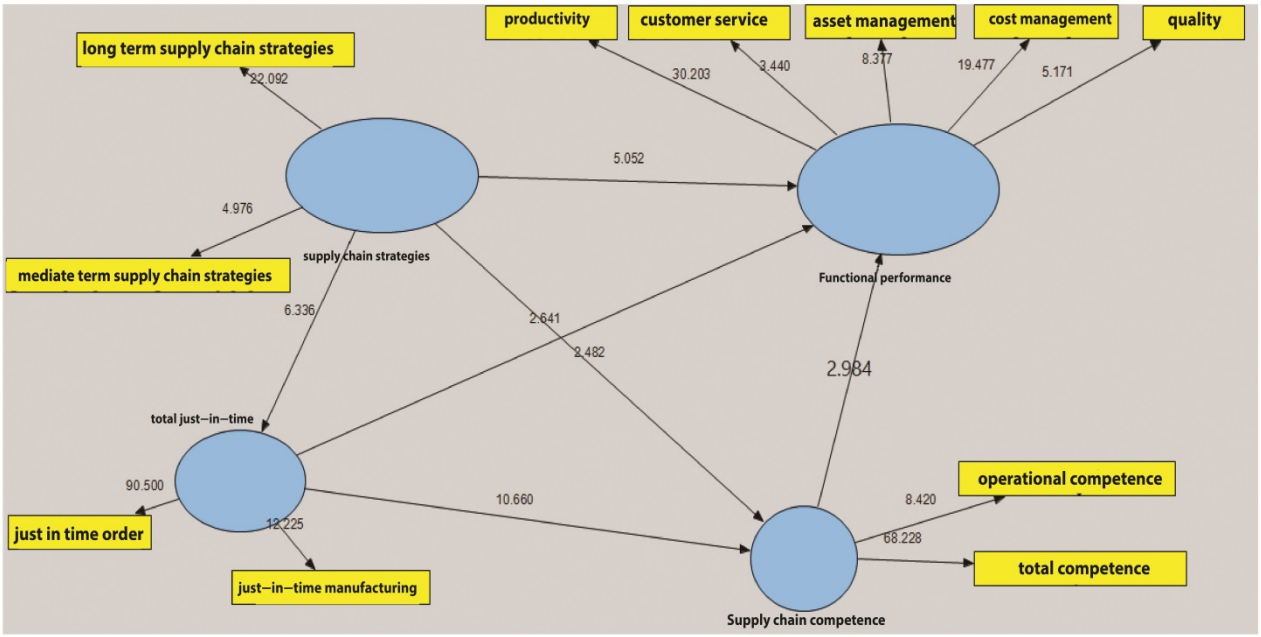

Figure 5- Model of main hypothesis of the research in significance factor mood

5- Discussion and Conclusion

H1: there is a positive and significant relation between supply chain management strategies and total just-in-time manufacturing.
In his studies, (Claycomb et al. 1999) found that a just in time communication with customers, improves total performance of the organization. Furthermore, Kenneth et al found that T-JIT has positive effect on organizational performance (Kenneth et al., 2014). Local investigators including (Horri et al.,2015) and (Ebrahimian et al., 2015) have also found that there is a positive and significant relation between total just-in-time manufacturing and organizational performance. In assessing the impact of key factors for the success of agility in supply chain on strategic performance of electronic industries, (Karami et al. 2015) found that there is a positive relation between agility of supply chain and organizational performance. (Inman et al. 2011) divided organizational performance into three categories of financial performance, market performance and operational performance and considered the relation between JIT and agility with different kinds of performances. In reviews, it was recognized that JIT has positive impact on different kinds of organizational performance (Inman et al., 2011). According to the results of previous research, second hypothesis is as follows:
H2: Total just-in-time manufacturing has positive and significant relation with operational performance.
As it was explained in previous sections, total just in time emphasizes on omitting wastages and optimizing resource usage all over the supply chain. Total just in time integrates the whole supply, production and provision processes all over the supply chain. These integrated processes should lead to the lowest levels of inventory in the organization and make some improvements in different domains including provision speed, reliability, responsibility and flexibility (Kenneth et al., 2014). (Karami et al.

2015) concluded that those companies that have performed just in time strategies in a suitable way at the company level will be able to convey the problems to management in a simpler way. (Horri et al., 2015) in a study named "just-in-time manufacturing and its effects on supply chain ability and organizational performance (case study: Arak Zarab company)" investigated the relation between supply chain strategies, T-JIT, organizational performance and competences of supply chain and found that just-in-time manufacturing has positive effect on supply chain competences. (Kenneth et al., 2014) in a study titled "total just in time and its impact on supply chain competence and organizational performance", investigated about effect of total just in time index on field that are related to supply chain and found that total just-in-time manufacturing has positive effect on supply chain competence.

H3: Total just-in-time manufacturing has positive effect on supply chain competence.

(Lee, 2015) in a study titled "effects on green supply chain management on the supplier performance through aggregation of social asset" found that supply chain management has positive effect on organizational performance. Wanto et al. (2014) found that green supply chain management has positive effect on organizational performance. Kenneth et al. (2014) in their studies concluded that for improving chain performance, supply chain strategies should be improved. (Yazdi et al. 2014) in a study titled "an investigation about cognitive mapping of causal relations between supply chain management activities, enablers and supply chain performances with phased approach", considered relations between supply chain management activities with enablers and supply chain performances and have acknowledged the positive relation between supply chain management strategies and performance.

H4: There is a positive relation between supply chain management strategies and operational performance.

Implementing the strategies should increase the created value for customers and their satisfaction which in turn it will improve competitive advantage of the supply chain (Kenneth et al., 2014). The aim of supply chain management is to create value for the customer. This added value should represent itself in indices like cost, quality, flexibility and components relevant to supply chain performance. (Yazdi et al. 2014) investigated about the relation between supply chain management and supply chain competence and confirmed the positive relation between them. (Radfar et al. 2012) considered supply chain competence and agility and found that supply chain agility leads to increasing its competence.

H5: supply chain strategy has positive and significant relation with supply chain competence.

Managers traditionally focus on improving organizational input performances which are directly responsible for them. Nevertheless, it is possible that efforts to improve organizational performance have invert effect on the supply chain performance and hence this can damage organizational competitive advantage (Kenneth et al., 2014). So, supply chain management should implement external concentration in which managers have to consider the effect of organizational strategies on participants in supply chain. Supply chain performance is optimized when a local organizational and an applied strategic approach are accepted by all members of supply chain. Such an approach maximizes a surplus supply chain to be shared with all members of supply chain (Kenneth et al., 2014). Organizational strategies which support strategies relevant to supply chain, should improve organization's competitive position and in turn, improve the performance of each present member of the chain. (Horri et al.,2015) in a study titled "total just-in-time manufacturing and its effects on supply chain capacity and organizational performance" have confirmed the positive relation between supply chain competences and organizational performance. (Ebrahimi et al., 2015) also believe that there is a positive relation between supply chain competences and organizational performance. (Kenneth et al. 2014) in a study titled "total just-in-time manufacturing and its effect on supply chain competence and organizational performance" reviewed the effect of total just in time index on the fields that are relevant to supply chain, and believe that supply chain competence can be effective for its performance.

6- Conclusion

Nowadays, previous methods for production management in which there were less integrity, have lost their efficiency and supply chain, as an integrated approach for proper management of goods and material

flows, information and finance, is capable of responding to different situation… there is a close relationship between design and managing supply chain flows (materials, information, finance) and chain's success, in a way that electronic commerce failures are mostly related to problems in designing and managing supply chain flows. Complexities in organizations in financial and social aspects and empowerment of supplier's chain, forced organizations to share their information with other organizations that were mainly suppliers of goods and services, in order to facilitate reciprocate relations. Increasing development of information trade created new attitude named total just-in-time manufacturing.

Results of this study show that supply chain success requires supply chain management strategies and supply chain capacities. In addition, it was found that total just-in-time is an appropriate strategy for supply chain management. Hence, it is recommended to supply chain activist to be just in time and knowledgeable manufacturers, purchaser and sellers that a total just in time strategy can help them to do so.

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