

Investigating the impact of product innovation and standardization on delivery speed with the mediating role of customized mass production capacity (Case Study: Isfahan Steel Toka)

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Abstract

The purpose of this study was to investigate the effect of product innovation and standardization on delivery speed with the mediating role of the customized mass production capacity. This research is practical in terms of its purpose and in terms of the method is a descriptive - survey research. The statistical population of the research is all employees of Isfahan TokaFoulad Company included 741 people. Cochran formula is used to determine the sample size, that sample size required according to the population is 253 people. The instrument for collecting data in this study was a standard questionnaire based on Wang et al. (2017). The reliability of this questionnaire was confirmed using Cronbach's alpha coefficient of 0.921. To analyze the collected data, the Amos structural equation modeling software was used. The results showed that product innovation has a significant effect on delivery speed. But the impact of standardization on delivery speed was not confirmed. The mediating role of customized mass production capacity was also confirmed by the impact of product innovation on delivery speed .

Keywords: Customized mass production capacity, product innovation, standardization, delivery speed

1 .Introduction

Environmental dynamics and changes have affected various industries and caused major changes (Wang et al., 2015) In order to continuously improve their competitive advantage, organizations need to respond more quickly to changing needs. In the market for the sale of some commodities, the company's ability to deliver faster products to customers is crucial to its competitors. (ZandHesami and colleagues, 1392) In the meantime, standardization through economies of scale leads to increased productivity and market share of companies (Wang et al., 2017). Standardization emphasizes the similarity, uniformity, and continuity of behavior and encourages bureaucracy, which may lead to a reduction in new ideas in the organization and the use of products and technologies in the company. (Funk et al., 2015) Recently, some scholars argue that standardization enables employees to develop common languages and ways to facilitate knowledge, such as product development, and the production process, to adapt to new technologies. (Rite et al., 2012)

Also, product innovation today is very important for the company to maintain its competitive advantage (Yuan et al., 2010: 302) Organizations today need to be innovative to respond to the changing demand and lifestyle of customers, as well as to exploit the opportunities created by technology and market changes. (Rowley2011: 54) Globalization and increased competition in the market will drive companies to increase their innovation in operations in order to gain sustainable competitive advantage. (Vorma and Mozhizma, 2014: 105) In the near future, creativity and innovation capabilities are critical factors for the company to build and maintain a competitive advantage, especially for companies that are in a changing market environment (Olimpia, 2014: 17) In addition, creativity and innovation capabilities enable decision makers of company to better address social change and technology. (Nelson et al., 2006: 47) From the organizational aspect, they see innovation in performance and growth through improvements in efficiency, productivity, quality, competitive position, and market share (Tidd, 2005: 69.)

One of the most important operational capabilities of the organization to manage environmental turbulence and increase customer expectations is the mass customization capability. The manufacturing and marketing phases, which are as complex as computing and information technology, have increased competition in the business world. The advantages of mass customization capabilities include flexible production technology, timely production systems, reduced production times, and the creation of a timeframe for competition. (Pine, 1993: 54) With the development of mass customization capabilities, the company can achieve with the minimum amount of inventory, maximize productivity and meet customer orders in the shortest time possible. (Piller et al., 2013: 644)

Customized mass production is mass production of customized goods and services for each individual. The goal is to customized mass production of goods and services with a sufficient variety, in which case each customer can purchase a custom product that cost of it close to the cost of mass production products. (Duray& Milligan, 1999: 121) Therefore, cost saving for companies and lower costs for customers, and simultaneously providing a huge variety of products, is the essence of the purpose of the mass custom production. Bulk customization capability is associated with higher operational efficiency (Piller et al., 2004: 437; You et al, 2001: 150). The bulk customization capability not only reduces production costs, but also shortens the delivery time of the product (Tu et al., 2001: 151)

All organizations are looking for competitiveness, discovering strategies that are effective in this area, and strategies that can provide solutions for access to environmental accountability, improvement of processes and organization performance, are a major step in the competitive advantage of the

organization. As mentioned above, standardization has a special significance, and on the other hand innovation is also one of the most important factors in creating competitiveness for companies. Due to the fact that one of the main features of the contemporary world is the dynamism and competitive nature of the environment, it is therefore important to research and study in this regard. Considering the necessity of research and since the research has not been done in the country, the main question of this research is:

Does product innovation and standardization effect on delivery speed with the mediating role of bulk custom production capacity?

2 -Theoretical framework of research

Customization

In the 1970s, the debate about "standardization" versus "adjustment or adaptation", in the 1980s and 1990s, "global integration in response to indigenous conditions" was raised in the theme of "globalization versus indigenization". (Najafizadeh et al., 2008) Standardization is the creation of criteria for dealing with actual or potential issues and seeking to achieve an optimal order in the subject matter for general and continuous use. (Rhee et a, 2009) Standardization refers to the use of common parts, components and platforms for R & D, production and purchasing of raw materials (Wang et al., 2017) Organizations implementing standards can improve their performance by raising awareness of the needs of the product and the market, thereby can increase their share in the market. Consumers use standardized products with better quality and price and greater assurance of the various components that have application for them. Not only is the standard quality of the product itself, but its maintenance and after sales services are also of great importance to the consumer. Also, reducing the risk of product misunderstanding is one of the other benefits of standardization. Maintaining community health, optimal use, effectiveness and efficiency is another of the standardization impacts that benefit the community. Environmental considerations and pollution prevention are the categories that can be found in any product-related standard (Riahi, 2009)

Innovation

Innovation refers to the new application of knowledge, methods and skills that can provide new products and processes to meet the needs of customers. (Wang et al., 2017) Innovation also means the successful use of creative ideas in the organization. (Rhee et al., 2006: 505) Innovation brings about long-term benefits, resulting in large displacements in the competitive environment of organizations. (Hamel, 2006: 50) Innovation is a major factor in the excellence of the technology of companies and organizations, and this excellence has a significant impact on the growth and performance of organizations. Technology innovation is vital for economic development, and the lack of attention to it, has destroyed many organizations and organizations (Jansen et al., 2014) Managers found that in order to survive in a competitive world today, they should create innovative goods and services. (MacCarthy , 2011: 558) Innovation leads to a variety of products. (Jansen et al., 2006: 1662) Creativity and innovation capabilities help companies develop their unique marketing strategies and other distinct organizational processes.

Mass customization capability

Mass customization capability is the ability to produce customized products in large volumes at cost, quality, and delivery equal to mass production. (MacCarthy et al., 2003: 292; Huang et al., 2008: 716) The mass custom production was predicted by Ellen Toffler in the 1970s as a future shock, and was outlined by Stan Davis in 1987 as a complete future. (Huang et al., 2010: 515) A mass custom

manufacturing is a new way for business competition and is a way to identify and fulfill the demands of the most important individual customers without sacrificing of the efficiency, the effectiveness and the low cost for the customization. (Pine, 1993: 51) And in the full future book, it describes the idea of mass custom manufacturing as follows: the production of customized products and services designed to the needs of individual customers on a mass scale. He also states that the new information technology enables manufacturers to track the individual customers' needs and wishes, and by automating flexibility, the product can be customized during the assembly phase. (Hvam, 2006: 410)

More importantly, by automating the custom manufacturing process, custom-made products can be produced at a price that is as high as the price of mass-produced goods (Davis, 1987: 45). According to the said articles, the general definition of custom-made mass production is :

Ideal definition: The ability to produce any product that the customer desires and deliver the product whenever, wherever and whenever he / she expects. This definition is perfectly ideal and rarely achieved by an organization in the best of integrity and rigor; it is not possible even by corporations that have committed their own corporate heart and soul to a custom manufacturer. Companies should do their utmost to get close to this definition. (Pine &Maskel, 1998: 55)

Realistic definition: Mass production customization is an organization structure and flexible procedures for the production of custom and often unique products and services, at a price that is equivalent to the monotone production of a mass production system. More precisely, products and services have been customized to cover a predetermined variety, and the purpose is to determine the extent to which the range of the customer's products or services can be significantly customized, or that there is a possibility for each customer to be distinguished, and The selection of the customer from within that range will be facilitated. (Pine, 1993: 51)

Fast delivery

The speed of delivery refers to the delivery time of the product to customers, so the less the delivery time is, the more customer satisfaction will be. (Jahanshahi et al., 1392) The concept of timely delivery with a competitive approach involves a quick and reliable act of delivering the promise. (Rothet al., 1989; Douth et al., 1990) Skinner (1985) and Hill (1994) called the delivery promise of produce as "delivery reliability" and the ability to deliver faster than competitors as "delivery speed." (Skinner, 1985; Hill, 1994) Many companies, especially service companies, have a competitive priority to provide appropriate delivery as a criterion for the creation and development of an appropriate competitive position in the market. Choosing this priority means that the company decides to deliver its products faster and more reliable than other competitors to its customers.

Background research

Here are some internal and external research in the field of research:

Zahhassami et al. (1392) are looking to answer this question. How do quality management dimensions affect the ability to mass customize? In this paper, while describing the concepts of mass customization and comprehensive quality management, six different dimensions of quality management are identified and with the help of the software, the relationship between these dimensions has been tested with mass and bulk customization. In this regard, a conceptual model has been presented and tested, and finally the results have been analyzed and the impact of each dimension has been determined. In fact, the results of the research presented in the form of a conceptual model, confirm the relationship between the

dimensions of comprehensive quality management and mass customization. Also, Najafizadeh et al. (2008) in his research answer the question of how product dimensions and external influences influence the range of standardization and adjustment strategy choices and how do they lead international marketers in choose one strategy that suits the foreign or destination market? By conducting this research in five international foreign companies in Iran and collecting and analyzing the required data, we tried to test the validity of our assumptions. Findings of the research indicate that factors related to product dimensions and influential external factors have a significant relationship with the standardization and modification strategies. And product labeling factors from product dimensions and socio-cultural factors, and legal-political factors from external influential factors are among the factors that encourage international decision makers of the research companies toward an adaptive strategy.

Abroad, in this context, Kasiri et al. (2017) analyzed the direct and indirect consequences of standardization and customization on customer satisfaction and loyalty through quality of service. Quality of service has two dimensions: technical quality and quality of service. A framework has been developed with the expansion of the Grohnoosh Service Model, using a history of service quality. A questionnaire based survey of 315 customers from three service industries including health care, hospitality and education has been gathered. The data were analyzed and the model was confirmed using PLS-SEM. The findings show that: (1) the combination of standardization and customization of service delivery for service quality is very necessary; (2) standardization has a greater impact on service quality than customization; (3) performance quality has a greater impact on Customer satisfaction in comparison with technical quality; and (4) customer satisfaction has a significant impact on customer loyalty. Wang et al. (2017) also examined the relationship between innovation, standardization, mass customization and delivery speed. Data were collected from 204 manufacturing companies in China. The results show that standardization has a positive impact on innovation. Innovation and standardization positively affect the mass customization capability and are complementary to the development of mass customization capabilities. Innovation significantly increases the speed of delivery. However, the direct effect of standardization on delivery speed is not meaningful. In addition, innovation and standardization indirectly affect delivery speed.

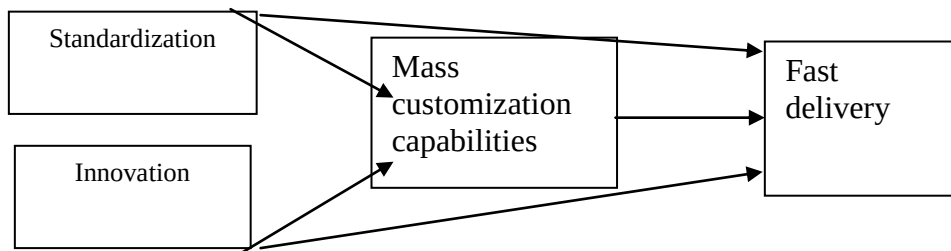


Figure 1 - Conceptual model of research (Wang et al., 2017)

Conceptual model of research

After reviewing the documentary on internationally valid papers and treatises and some internal ones, in relation to the background of the present research, the model presented below was used.

Research hypotheses

1. Product innovation affects delivery speed.
2. Standardization affects delivery speed.
3. Product innovation affects the delivery speed with the mediating role of mass custom production capacity.
4. Standardization on the delivery speed with the mediating role affects the mass custom production capacity.
5. Standardization affects product innovation
6. Methodology of research

The present research is in the field of applied research. If the classification of types of research is based on the nature and method, the present research method is essentially a descriptive survey research. The statistical population of the research is all employees of Isfahan TokaFoulad Company included 741 people. Cochran formula is used to determine the sample size, that sample size required according to the population is 253 people. The method of selecting statistical samples in this research is simple random sampling according to its theme and its nature. Library studies and field studies have been used to collect the required data. We also use the Amos Structural Equation Modeling Model 23 to analyze the data.

Data collection tool

Data collection will be done using a standard questionnaire. The first part of the questionnaire includes demographic variables (sex, education level), and the second part contains questions related to the variables of the research, which was prepared based on Likert scale. To prove the validity of the research tools, there are several ways in which there are different content, content validity, formal validity and construct validity (convergent, divergent, and internal consistency and factor validity). There are several ways to collect evidence of the validity of the research tool: content validity, formal validity, and construct validity (convergent, divergent, and internal consistency and factor validity). In the first stage of the study, the questionnaire was available to the supervisor and other experts to assess the validity of the questionnaire and emphasized that in the qualitative assessment of content validity must be considered the grammar, the use of proper words, the importance of questions, the placement of questions in the right place and time to complete the designed tool. Finally, their comments were slightly modified in the questionnaire.

In the second stage of a narrative study, the experts' view regarding the level of coordination of the content of the instrument and the purpose of the research was used to evaluate the content validity. The questionnaire was then handed out to 15 field administrators and they were asked to answer questions as useful and not useful. Responses were calculated based on the CVR formula and were adapted to the Lowsheh table. Numbers above 0.49 were accepted. After validation, the internal consistency method (Cronbach's Alpha coefficient) was used to assess the reliability of the research tool in order analysis the reliability of the questionnaire. In the present study, after a pilot study in a sample of 20 people, and returning the questionnaires, the data were collected into Spss 21 software and computed their Cronbach's alpha. Finally, after performing four steps: 1. Content validation. 2. Two-half. 3. Cronbach's (Reliability) 4. retest , the research tool was prepared .

Distribution of the questionnaire and Cronbach's alpha coefficient is expressed in the following table.

Table 1. Relationship between variables and questionnaire questions

Cronbach's alpha	Source	Variable	Row
0.941	Wang et al. (2017)	Mass customization capabilities	1
0.953		Innovation	2
0.911		Standardization	3
0.926		Delivery speed	4

4 .Statistical analysis

Quantitative description of research variables based on research objectives

In Table 4, descriptive indexes related to the research variables have been calculated. The average index of importance of variables is shown by the respondents and the standard deviation index shows the distribution of responses. Given that the highest number for the mean of the independent and dependent variables is 5 (the 5th spectrum: totally disagreeing, disagreeing, fairly opposed, agreeing, totally agreeing) The interval (2-33) represents the low score of the subjects, the interval (66 / 3-34 / 2) represents the mean score and the interval (67.6%) represents the high score of the subjects.

Table 2. descriptive indexes of research variables

Skiddin	Elongation	The standard deviation	Average	Index name g
0.452	-0.526	1.11	3.512	Mass customization capabilities
0.358	-0.552	1.02	3.284	Innovation
0.464	- 0.862	1.25	3.641	Standardization
0.557	-0.756	1.31	3.254	Delivery speed

The results of the above table show that the mean of all variables is in the range (2.34-3.66), which can be claimed that the status of the variables is moderate. Also, the slope and elongation of the variable are in the range (2.2), which indicates that the variables have a normal distribution.

Test (KMO)

To do the factor analysis, we need to make sure that we can use existing data for analysis and are the number of data desirable for factor analysis? For this purpose, the KMO index and the Bartlett test are used. Qualitative sampling method is statistic to examine the adequacy of the data (sampling) and shows the ratio of the common variance in variance of variables that may be caused by important factors. This index is in the range of 0 to 1. The higher values for this statistic (close to 1) indicate that factor analysis can be done using these data. If this value is less than 0.6, the results of the factor analysis will not be very useful. The relation below is the sampling rate (KMO) criterion (Momeni and Active, 1391: 193).

$$KMO = \frac{\sum_i \sum_j r_{ij}^2}{\sum_i \sum_j r_{ij}^2 + \sum_i \sum_j a_{ij}^2}$$

Where :

r_{ij} = A simple correlation coefficient between variables i and j

a_{ij} = The partial correlation coefficient between variables i and j

Bartlett's spherical test tests the hypothesis that the matrix of correlation is an identity matrix or not. If the matrix of correlation is the identity, then the variables are not related to each other, and thus there is no possibility of identifying new factors based on the correlation between the variables. But if it is not the identity matrix then the variables are related, so that it is possible to identify new factors based on the correlation between the variables. This test examines the relevance and relevance of variables for the discovery of the structure. Small values (less than 0.05) for the significant level indicate that the correlation matrix between variables is not identity and factor analysis for existing data will be useful.

Table 3. KMO test results

Result	KMO	Index name
The strength of the sample and the suitability of the sample are verified	0.866	Mass customization capabilities
The strength of the sample and the suitability of the sample are verified	0.875	Innovation
The strength of the sample and the suitability of the sample are verified	0.855	Standardization
The strength of the sample and the suitability of the sample are verified	0.863	Delivery speed

The result of the KMO test in the table above shows that the KMO value for all scales is greater than 0.6. Therefore, the sample size is good for performing factor analysis.

Measurement model

In the first step, we seek to answer the question of whether each of the developed measurement models for structures has the minimum scientific criteria defined, whether it is necessary to analyze each of the measurement models separately. The comparative model of this study has two variables. In this step, we examine the factor load obtained from the confirmatory factor analysis that factors with factor load greater than 0.4 are considered for the final model. Results are shown in the table below.

Table 4. The Factor Loads Table

Significance level	Index		
	Critical ratio	Factor load	
q18 <--- Standardization	.767		
q17 <--- Standardization	.817	14.006	***
q16 <--- Standardization	.831	14.298	***
q15 <--- Standardization	.797	13.592	***
q14 <--- Standardization	.826	14.196	***
q13 <--- Standardization	.845	14.599	***
q12 <--- Innovation	.838		
q11 <--- Innovation	.747	14.005	***
q10 <--- Innovation	.888	18.485	***
q9 <--- Innovation	.882	18.269	***
q8 <--- Innovation	.870	17.820	***
q7 <--- Innovation	.813	15.948	***
q6 <--- Mass customization capabilities	.828		
q5 <--- Mass customization capabilities	.859	17.268	***
q4 <--- Mass customization capabilities	.887	18.251	***

Significance level			Index	
			Critical ratio	Factor load
q3	<---	Mass customization capabilities	.925	19.648 ***
q2	<---	Mass customization capabilities	.945	20.443 ***
q1	<---	Mass customization capabilities	.934	20.008 ***
q19	<---	Delivery speed	.893	
q20	<---	Delivery speed	.926	20.418 ***

As shown in the table above, factor loadings are above 0.4 and significant at 99% confidence level, indicate that the indicators (marker variables) explain the conceptual variables well .

Structural Equation Modeling (SEM)

In this research, structural equation and Amos software have been used to examine and test the conceptual model provided by the researcher. Modeling the structural equation helps the researcher to test and review the theoretical model that consists of various and different components, both in general and in a minor way. With the implementation of Structural Equation Modeling Test in software, fitness indexes are presented that indicate that the conceptual model is partially fitted with empirical data. Unlike conventional statistical tests that are approved or rejected by a statistic, a number of indicators are introduced in the modeling of structural equations. The status of fitness indicators for the conceptual model of research is presented in the following table.

The fitting pattern of the present research model based on the data obtained from the results of the Amos software application is as follows.

Table 5. Model fitting indices

RMSEA	PRATIO	PNFI	PCFI	IFI	TLI	NFI	CFI	GFI	AGFI	X2/df	index
<0.08	>0.5	>0.5	>0.5	>0.9	>0.9	>0.9	>0.9	>0.9	>0.8	>3	Recommended criteria
0.072	0.863	0.785	0.808	0.926	0.937	0.910	0.936	0.926	0.877	2.123	Structural model

As shown in the table, all fitting model indicators are in a good position. For example, the significance level of the chi-square model is more than 5 percent, indicating that the experimental data adequately support the conceptual model of the research. Also, the root mean square error estimate is less than 10% and this index confirms the fitness of the model. Another model's acceptability is also seen in software outputs. In order to test the research hypotheses, Structural Equation Modeling (SEM) was applied using the maximum likelihood method in Amos software. During the analysis process, the covariance matrix was used. The following figure shows the structural relationships of the research model.

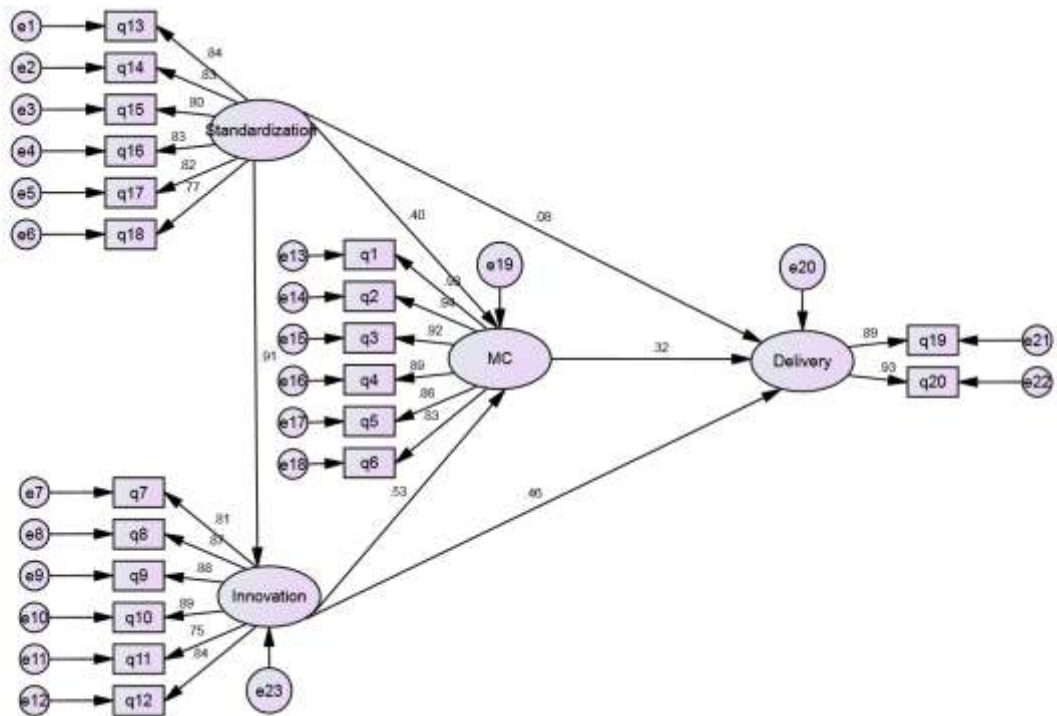


Figure 2. conceptual model of research with factor loads

Table 6. The path coefficient of assumptions

The result of the hypothesis	Significance level	Critical ratio CR	Standard coefficient	Hypothesis
Confirmation	0.001	3.230	0.46	Product innovation affects delivery speed.
Reject	0.539	0.617	0.08	Standardization affects delivery speed.
Confirmation	-	-	0.169	Product innovation affects the delivery speed with the mediating role of mass custom production capacity.
Confirmation	-	-	0.128	Standardization on the delivery speed with the mediating role affects the mass custom production capacity.
Confirmation	0.000	13.173	0.91	Standardization affects product innovation.

The product innovation variable has a significant effect on delivery speed at 95% confidence level (critical ratio is 3.230, more than 1.96). Given that this relationship is positive (the standard coefficient is 0.46), so the product innovation variable has a moderate impact on delivery speed .

The standardization variable does not have a significant effect on the delivery speed at 95% confidence level (the critical ratio is 0.617, which is less than 1.96) .

The standardization variable has a significant impact on product innovation at the 95% confidence level (critical ratio is 13.173, more than 1.96). Given that this relationship is positive (the standard coefficient is 0.91), so the standardization variable has a strong impact on product innovation.

Also, due to the change in the path coefficient between product innovation and delivery speed from 0.46 to 0.169, we conclude that product innovation affects the delivery speed with the mediating role of a mass custom production capacity. It has a mediating effect .

Also, due to the change in the path coefficient between standardization on the delivery speed from 0.08 to 0.128, we conclude that standardization on the delivery speed with the mediating role affects the mass production custom capacity. It has a mediating effect.

Under these conditions, organizations have begun an ambitious effort to institutionalize these issues at all organizational levels, with a new look at concepts such as strategic flexibility, innovation, and adopting a strategy for innovation in processes to maintain and enhance its competitive position. The results showed that product innovation has a significant effect on delivery speed, but the impact of standardization on delivery speed was not confirmed. The mediating role of custom manufacturing capacity was also confirmed by the impact of product innovation on delivery speed .

In sum, most of the research hypotheses have been confirmed. In this regard, the research results of Wang et al. (2017) show that standardization has a positive impact on innovation. Innovation and standardization positively affect the mass customization capability and are complementary to the development of mass customization capabilities. Innovation significantly increases the speed of delivery. However, the direct effect of standardization on delivery speed is not meaningful. In addition, innovation and standardization indirectly affect the delivery speed. These results are consistent with the findings of the present study.

Of course, this result is specific to the statistical society defined in the present study and can not be extended to other communities. It should be acknowledged that standardization is one of the cornerstones of progress in various industries. Modified standardization, as an official mechanism, provides a basis for significant convergence with the level of progress of industry and technology in different parts of the world. Therefore, in order to achieve the major economic goals and industrial progress, the standard and standardization categories and active participation in the formulation of international and national standards should be considered.

The findings of this study by providing feedback can be used by the officials and staff of the relevant organizationby , and can also increase to the scientific and literary richness of the study area. Finally, the researcher has been able to test the claims presented in the research in a desirable way through research and analysis of extracted data and to achieve a definite result in this regard. Regarding the results of the analysis of the research data, given the hypotheses that were approved, suggestions are presented as possible as.

Using innovative techniques, they will focus on providing service delivery models and customer satisfaction.

It is suggested that we increase operational efficiency by employing flexible processes, agile manufacturing systems, supply chain structure capabilities, and specific organization structures from mass customization to deliver custom products .

According to the results of the research, by using the innovative processes in the company can be achieved time efficiency. Therefore, managers must support innovative processes in the company, and encourage employees to think and to develop their ability to provide new ideas in the organization to reduce the processes time .

Companies can reduce the cost of processes by focusing on customer individual differentials in mass custom manufacturing.

Managers can reduce service delivery time by searching for new distribution channels, new processes and new services for customers .

Research constraints

In this research, the researcher has encountered some limitations, which are referred the most important ones in here:

- boring of some respondents when completing the questionnaire
- Lack of proper knowledge of the morale of some of the respondents and lack of proper communication
- Unwillingness of some respondents to complete the questionnaire
- The time limit for conducting research and the short duration of sampling is one of the limitations of any academic research that reduces the accuracy of the study, and the present study is no exception.
- Restricted access to foreign scientific resources
- Limited knowledge of some respondents regarding issues related to research variables.
- The accuracy and accuracy of responses provided by respondents
- The questionnaire's long questionnaire was a source of reluctance to respond to respondents.
- Suggestions for future researchers
- The role of standardization and innovation in increasing market share in future research should be considered.
- The role of the mediator of two-way innovation in future research should be explored.

- In the field of functionality, mass customization should be designed and implemented longitudinally and over time.
- This research should be done on other companies and products and its results should be compared with the results of this research.
- It is suggested that a comparative study be conducted between two different statistical societies.

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