

The impact of supply chain ambidexterity on supply chain flexibility with the mediating role of information technology capability (Case study: Qom Province Gas Company)

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ABSTRACT:

One of the most important factors that affect the flexibility of the supply chain is the ambidexterity of the supply chain. The simultaneous ability to use the opportunities available in the exploration departments, and to exploit and create a balance between these two organizational aspects at the same time, has an effective role in achieving ambidextrous management and leadership. This article has a descriptive-correlational approach and was done with a quantitative-qualitative method with an applied purpose. The statistical population of the research is the group of managers of the gas company of Qom province. In this research, due to the limited statistical population, the census method was used instead of the sampling method, and the questionnaire was distributed among all the statistical population of 43 people. The questionnaire includes questions related to three variables of supply chain ambidexterity, flexibility of the supply chain and information technology capability, which is taken from the questionnaire of Galgo Burin et al. (2020). Modeling based on the structural equation model and analyzes at the $\alpha=0.05$ have been done with the SmartPLS3 software. The findings indicate that the supply chain ambidexterity does not directly have a positive and significant effect on the supply chain flexibility, but this effect exists through the mediation role of information technology capability. The relationship between supply chain ambidexterity and information technology capability is positive and significant. Also, the relationship between information technology capability and supply chain flexibility is significant. Therefore, by raising the level of information technology in the organization, it is possible to provide the basis for using the ambidexterity of the supply chain in order to improve the flexibility of

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1. Introduction and Theoretical Background

Supply chain flexibility refers to the ability of a supply chain to quickly and efficiently adapt to changes in demand, market conditions, and other external factors. A flexible supply chain is characterized by its ability to respond quickly to changes, and its ability to alter its operations, processes, and structures in response to changing conditions. Supply chain ambidexterity, on the other hand, refers to the ability of a supply chain to simultaneously pursue both exploration (innovation, creativity) and exploitation (efficiency, effectiveness) goals. In other words, it is the ability of a supply chain to balance the need for short-term efficiency and cost-effectiveness with the need for long-term innovation and growth. Both supply chain flexibility and ambidexterity are important components of effective supply chain management, and they are often interdependent. A flexible supply chain can be better equipped to adapt to changes in the market, while a supply chain with strong ambidexterity is better able to pursue both short-term and long-term goals, and can be better equipped to thrive in uncertain and rapidly changing environments (Song & Bennett, 2016).

The current business environment, characterized by uncertain demand and a high degree of volatility, has created a challenge for supply chain management, so organizations are required to have a flexible supply chain in case of disruptions and sudden changes in demand, to make them able to adapt quickly without disrupting customer service. Due to the development and diversity of the companies' products and also the intense competition between them, the companies are subject to transformation and the final success and survival of the organization depends on the use of organizational ambidexterity to create a competitive advantage for the organization (YingWang et al., 2021). With the intensification of competition and the acceleration of the pace of changes, organizations need to become ambidexter (including exploiting existing capabilities and discovering new ways). If organizations reach the state of ambivalence, they will perform better in dynamic environments and achieve the best level of performance, competitiveness and long-term survival (Gallego Burin et al., 2020). Ambidexterity is of particular importance as a sustainable competitive advantage (Tat-Dat Bui et al., 2017). The ability to simultaneously exploit and explore leads to long-term sustainability and direction of the company through better financial performance, learning and innovation (Jeong Hugh Han et al., 2017).

IT capabilities are a type of organizational capability that supports business processes by organizing and bringing together other important resources; And it is effective for identifying resources (and capabilities) and applying them using information technology. It enables firms to

acquire the necessary knowledge to explore and exploit supply chain resources (Liu et al., 2016). Flexible information links (sharing) between companies allow a central company to exploit existing operations within its own company, such as online purchase order and supplier management system to simplify purchasing processes (in order to facilitate procurement processes), thereby increasing productivity. This approach improves information transfer and processing capabilities, and companies can quickly deal with unforeseen events and compete successfully in a changing environment (Minhao Gu et al., 2021).

While previous research focuses on the positive outcomes of supply chain flexibility, few empirical studies have studied moderators (facilitators). In the case study of gas company of Qom province, the main issue is to investigate the relationship and significant effect of supply chain duality on supply chain flexibility directly or through the mediating variable of information technology capability.

1-1- Supply chain management:

Supply chain management includes various approaches that are aimed at effective coordination of suppliers, manufacturers and distributors in carrying out the activities of procurement of raw materials, converting these materials into intermediate or final products and distributing these products to customers in the right quantities, to the right places and at the right time. It is used to provide the required level of service with minimum cost (Chandra & Grabis, 2007). One of the key points in supply chain management is that the supply chain should be considered as a coherent whole; Therefore, when company managers try to make an individual decision in each of the parts of the supply chain; are procurement, production or distribution, they should note that the chosen solution optimizes the entire supply chain (Bastas & Liyanage, 2019).

1-2- Ambidexterity:

The term duality was first proposed by Doncan (1976) and developed by March (1991), who introduced the two terms exploitation and exploration. Exploitation is related to organizational focus, experience and variability. Finally, compared to exploration, exploitation is considered more certain, especially in the short term. Manufacturing companies with a common vision, recruitment and selection, training and professionalism of managers can facilitate the achievement of duality. Ambidexter organizations for exploitation and exploration can improve and improve their position and adapt to the uncertain environment more quickly through resource integration, which leads to competitive advantage (Suzuki, 2018).

1-3- Supply Chain Ambidexterity:

In some cases, the term ambidextrous has been used to indicate the ambidextrous ability of a company to communicate with suppliers and customers. In addition, the conceptual definitions of exploration and exploitation in the supply chain are similar to the definitions presented in the articles written about business strategies (Abebe and Angriawan, 2014). Supply chain exploitation focuses on maintaining relationships with current suppliers, finding solutions to supply chain problems using existing resources, and using current supply chain technologies, while supply chain exploration includes Searching for solutions to solve supply chain problems is based on innovative approaches and creative search to respond to customers' needs. Competitive advantage is achieved through ambidexterity (Lacerda et al., 2014). "Discovery" in supply chain includes searching for solutions to solve supply chain problems based on new approaches and creative search to respond to customers' needs.

1-4- Supply chain flexibility:

When a company can easily and quickly establish the necessary communication with other organizations in the supply chain, it leads to the flexibility of the supply chain (Zhu et al., 2020). Supply chain flexibility includes four dimensions. The first dimension is in resources, which refers to the availability of appropriate materials and services, and the ability to purchase them effectively in changing environment. The second dimension is the flexibility of the operating system; which is the ability to use opportunities and resources to effectively produce a range of products and services to meet different customer demands. The third dimension is distribution flexibility; which refers to the ability of companies to control: movements, storage of materials, parts and finished goods. The fourth dimension is the flexibility of the information system; which includes the ability of the organization's information system to adapt to changes, especially in a chaotic and unpredictable situation (Moon et al., 2012).

1-5- Information technology capabilities:

IT capability has 3 dimensions: *flexibility* of IT infrastructure, Which refers to the extent to which a company's IT infrastructure is scalable, modular, and compatible with systems; *Integration* is the shared use of two or more users of the same information with the same storage resource, and the link between different and balanced sectors, which includes strategic orientations, focus on the market, resources, skills and culture, and creates a mutual relationship between internal groups and existing tasks; and *Information technology management*, which refers to the organization's ability to effectively implement activities such as information technology project management, development of information technology assessment and control

systems (Chen et al., 2015). During COVID19, the uncertainties caused by upstream suppliers and downstream consumers and markets were very high, and many companies failed to make correct and effective decisions and faced failure. While it is important that they collect, process and analyze the available information (Yang et al., 2021). In other words, this pandemic has further exposed the reliance of supply chain operations on information processing capabilities.

2- Conceptual model architecture and Hypotheses

Using what was stated in the above section, the relationship between the main variables of the research was established, which we denote by H. Also, for each main variable, components were developed using the literature review. In this research, the effect of supply chain ambiguity on supply chain flexibility with the mediating role of information technology capability is investigated. The following figure shows the conceptual model of the research:

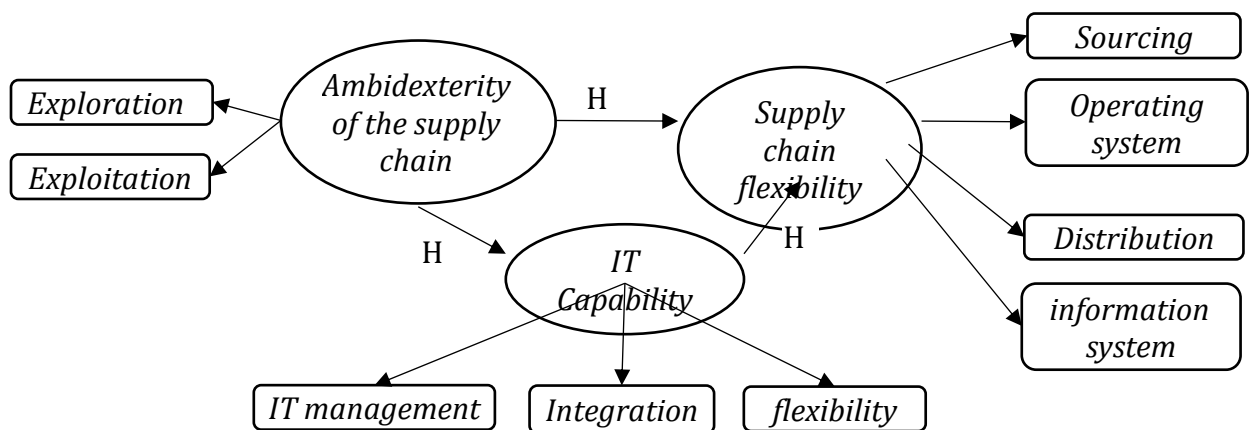


Figure 1: Conceptual model of the research

The hypothesis of the research based on the conceptual model of the research are as follows:

H₁: There is a significant relationship between supply chain ambidexterity and supply chain flexibility.

H₂: There is a significant relationship between information technology capability and supply chain flexibility.

H₃: There is a significant relationship between supply chain ambidexterity and supply chain flexibility with the mediating role of information technology capability.

3- Research Methodology

Since the effect or relationship of the variables is the subject of the research, therefore, this research is of a causal type. Since the results of this research will be used in the gas company, then it is applied research. Considering that the existing situation is measured and reported,

therefore, the research is descriptive. The modeling and analysis framework is based on structural equation modeling. The statistical population of the research was formed by the managers of the gas company of Qom province. The size of the statistical population is 43 people. Due to the limited availability of the community, the census method was used to collect data. Documentary and library methods were used to collect data in the theoretical framework section. A questionnaire was used to collect conceptual model information. The research questionnaire was designed based on Galgo Burin (2020) questionnaire. Two pillars of the supply chain including 2 sub-variables and 6 questions, flexibility of the supply chain including 4 sub-variables and 9 questions, and information technology capability including 3 sub-variables and 13 questions are included in the questionnaire. Cronbach's alpha was used to measure the reliability of the questionnaire. For the above variables, it was calculated as 0.915, 0.817 and 0.914 respectively. Other validity and reliability measurement methods in SEM analysis have also been added to these analyses. To test the relationships between the variables, the confirmatory factor analysis method SmartPLS3 software were used. To check the normality, the Kolmogorov-Smirnov test was used with a significance level of 0.05.

4- Analyses and Findings

The results of the Kolmogorov-Smirnov test showed that the distribution of most of the data is not normal. The reason for this is that, first, a 5-point Likert scale was used in data collection (from very high to very low, equivalent to 1 to 5), and this range measures qualitative data that usually do not have a normal distribution. Secondly, the number of the statistical sample is 46, which is not enough for the central limit theorem to fully occur. Since software such as Amos and Lisrel emphasize the normality of data for modeling structural equations, they cannot be used in this situation. Therefore, partial least squares method and SmartPLS software were used, which do not require normality of the data. In this software, Bootstrapping and PLS Algorithm methods were used for data analysis. The results of these analyzes are shown in the following figure:

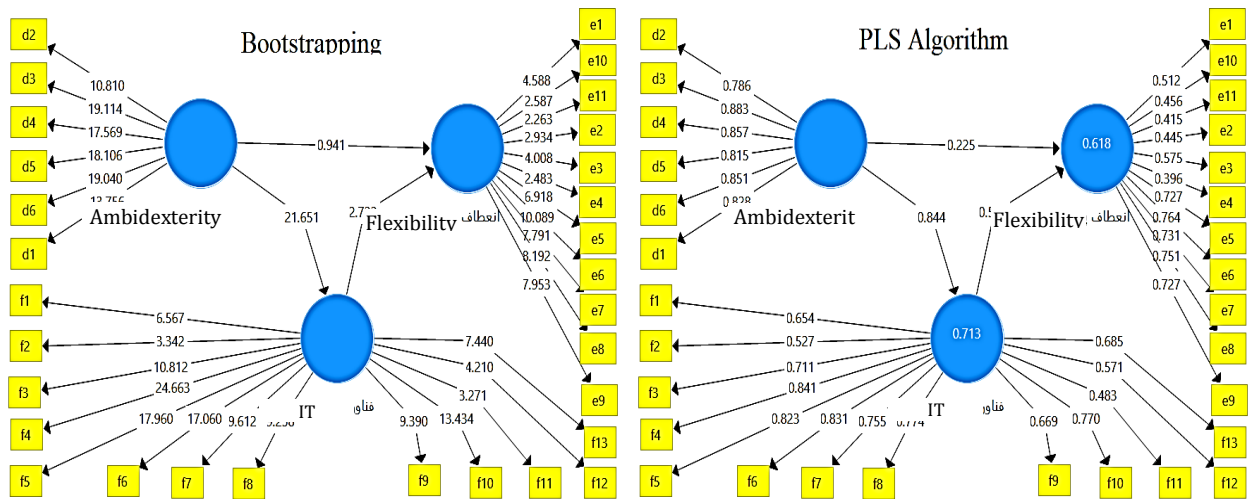


Figure 2: The results of conceptual model analysis using the SEM method

The figure on the right shows the factor loadings and the figure on the left shows the t-test values. Factor loadings greater than 0.4 with $|t| > 1.96$ indicate that there is a significant relationship. As can be seen, this issue can be seen in all items. Only for e4 question, the factor loading value is 0.396, which has been proved to be significant (according to the t value), and therefore, it has been remained in the model.

In order to check reliability, Cronbach's alpha and composite reliability were used. The results of Table 1 show Cronbach's alpha coefficient and composite reliability for all research variables above 0.7, which confirms the reliability of the model.

Table 1: Calculation of Cronbach's alpha and composite reliability

Research variables	Cronbach's alpha	Composite reliability
Ambidexterity of the supply chain	0.915	0.934
Supply chain flexibility	0.817	0.859
IT Capability	0.914	0.927

Diagnostic validity was used to check the validity of the model. Diagnostic validity is the most valid test of divergent validity. This test examines the divergence of the items (questions) of each variable in relation to the items of other variables. In diagnostic validity at the indicator level (observable variables), if the factor loading of each observable variable on its related hidden variable is at least 0.1 higher than the factor loading of the same observable variable on other hidden variables, the relevant test has diagnostic validity at the level of its constructs. The following table shows the results of this test:

Table 2: Calculation of diagnostic validity at the representative level (observable variables)

Q	Ambidexterity	flexibility	Capability	Q	Ambidexterity	flexibility	Capability
d1	0.828	0.574	0.72	e10	0.169	0.456	0.331
d2	0.786	0.502	0.625	e11	0.264	0.415	0.37
d3	0.883	0.599	0.744	f1	0.46	0.432	0.654
d4	0.857	0.525	0.703	f2	0.363	0.403	0.527
d5	0.815	0.718	0.698	f3	0.628	0.514	0.711
d6	0.851	0.672	0.739	f4	0.794	0.688	0.841
e1	0.274	0.512	0.418	f5	0.715	0.663	0.823
e2	0.335	0.445	0.304	f6	0.674	0.666	0.831
e3	0.413	0.575	0.452	f7	0.674	0.612	0.755
e4	0.435	0.567	0.423	f8	0.667	0.565	0.774
e5	0.521	0.727	0.496	f9	0.51	0.583	0.669
e6	0.636	0.764	0.593	f10	0.653	0.544	0.77
e7	0.59	0.731	0.543	f11	0.317	0.396	0.483
e8	0.497	0.751	0.438	f12	0.403	0.47	0.571
e9	0.431	0.727	0.455	f13	0.509	0.5	0.685

The results showed that the factor load of the observable variables on the related hidden variable is at least 0.1 more than the factor load of the same observable variable on other hidden variables. Therefore, it can be said that the diagnostic validity at the representative level is confirmed.

Diagnostic validity at the construct level (or Fornell-Larker criterion) examines the variables relative to each other in terms of divergence. In this method, if the values of the main diameter, for each hidden variable, are greater than the correlation of that variable with other reflective hidden variables in the model, the diagnostic validity of the reflective measurement model is confirmed at the structural level. Table 3 shows the results of this test:

Table 3: Calculation of diagnostic validity at the construct level (hidden variables)

	Supply chain Ambidexterity	Supply chain flexibility	IT Capability
Supply chain Ambidexterity	0.837		
Supply chain flexibility	0.720	0.808	
IT Capability	0.689	0.701	0.738

In the table 3, all the reservoirs on the main diameter are bigger than the reservoirs below them. This means that the model design is done correctly and the concepts can correctly explain what they are intended for.

F² and q² statistics were used to measure the relationships between the main research variables. If the value of each of these statistics is close to zero, it means that there is no effect between the variables. The pi value indicates the significance of each of the above-mentioned effects. The following table shows the results of this test:

Table 4: Test results of research questions using partial least squares method (direct effect)

Hypothesis	independent variable	Dependent variable	Path coefficient	P value	T value	F ²	q ²	Result
H ₁	Ambidexterity	flexibility	0.225	0.346	0.944	0.038	0.007	Rejected
H ₂	Ambidexterity	IT Capability	0.844	0	22.712	2.481	0.503	Accepted
H ₃	IT Capability	flexibility	0.587	0.007	2.709	0.259	0.03	Accepted

Table 4 show that the two pillars of the supply chain have a positive and significant relationship with the information technology capability, and the effect of this relationship is evaluated as very strong. Also, there is a positive and significant relationship between the capability of information technology and the flexibility of the supply chain with a relatively strong effect. However, no significant relationship was found between the two pillars of the supply chain and the flexibility of the supply chain. These contents implicitly state that the Ambidexterity only affects flexibility through the mediation of IT-Capability and has no direct connection with flexibility. However, the mediating role of variable IT-Capability was also tested separately. The results of this test are shown in the table 5:

Table 5: Test results of research question using partial least squares method (indirect effect)

Hypothesis	independent variable	Mediator	Dependent variable	Path coefficient	P value	T value	Result
H ₀	Ambidexterity	IT Capability	flexibility	0.496	0.007	2.697	Accepted

It shows that the supply chain ambidexterity has a positive and significant relationship with the flexibility of the supply chain through the mediation role of information technology capability.

5- Discussion

In this research, there was no significant relationship between supply chain ambidexterity and supply chain flexibility. One of the most important reasons for this issue is that the gas company of Qom province is a state-owned company and has a hierarchical structure. In some cases, it has been seen that this relationship exists between these variables (Kristal et al., 2010), but all of them have been organizations that are managed by the private sector.

There was a significant relationship between supply chain ambidexterity and IT Capability. Increasing information technology capabilities requires the use of information technology within the organization. On the other hand, since the organization supplies the relevant hardware and software through contractors, it is important to identify and employ such contractors (Asree, 2016). Therefore, duality both inside and outside the organization can help to increase information technology capabilities.

It was also observed that there is a significant relationship between information technology capability and supply chain flexibility. The use of information technology in a public company (which is usually not agile) can lead to an increase in the speed and accuracy of processes. This position, in turn, increases the speed of the organization's reaction to internal and external changes and increases flexibility. Since the existence of a time gap between the stimulus and the response is one of the main causes of inconsistency between the components of a supply chain (Schipper, 2020), this improvement will also lead to the flexibility of the supply chain.

Finally, this research showed that in the gas company of Qom province, there is a significant relationship between supply chain ambidexterity and the flexibility with the mediating role of information technology capability. Galgo Burin et al. (2020) showed that the effect of ambidexterity on flexibility is strengthened when the company has IT capabilities; Therefore, the result of the research is in complete agreement with their results.

The capability of information technology enables companies to discover knowledge, exploit strategy content resources and facilitate the coordination of these resources, leading to responsiveness to market changes (Liu, 2016). Organizational ambidexterity strengthens a company's leadership in the market and in the field of technology in the long term, because with this ability, companies can actively deal with environmental changes. This duality can improve a company's flexibility in quickly and effectively solving issues that arise during the production of new products (Lee and Sangra, 2016). Applying information technology capabilities through supply chain duality can help improve operations (Yao, 2010).



6- Managerial Applications

Since the capability of information technology has an impact on the flexibility of the supply chain, it is suggested to the gas company of Qom province to use solutions that lead to the improvement of the capability of information technology in order to improve the flexibility of the supply chain. Some of these solutions, according to the opinion of researchers such as Tripathy (2016) and Qrunfleh and Tarafdar (2014), are: the managers of the organization help to improve the quality of the organization's performance by knowing the needs of the company and satisfying the needs according to each department, so that in this way to achieve better organizational performance. Information technology can provide a lot of help to the flexibility of the supply chain by accelerating the activities of the organization and increasing the order and precision in carrying out the activities. Also, using information technology capabilities to increase the speed and ease of using new technologies to support the flexibility of the supply chain.

Since the ambidexterity of the supply chain has an effect on the capability of information technology and the capability of information technology is also effective on the flexibility of the supply chain, it is possible to use solutions that lead to the promotion of ambidexterity and the capability of information technology to improve flexibility. Some of these solutions include: improving the final performance of the organization or company in terms of providing services (production, inventory, transportation and distribution), as well as gaining a competitive advantage and continuing the supply chain in a more stable manner. Based on Liu (2016) and Lee and Sanghra, (2016), suggested that managers should use the capabilities of information technology, knowledge derived from the discovery and exploitation of strategy content resources, and facilitate the coordination of these resources, to respond quickly and in time to supply chain ambidexterity, in response to market changes.

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