*Original Paper*

# The Relationship between Business Intelligence and Organizational Agility with Emphasis on the Mediating Role of IT Infrastructure Flexibility (Case Study: Active Companies in Rasht Industrial City)

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*Abstract*

*The purpose of this research was to investigate the relationship between business intelligence and organizational agility, emphasizing the mediating role of IT infrastructure flexibility in companies operating in Rasht Industrial City. The current research is a cross-sectional and correlational research, and its statistical population consists of all managers of active companies in Rasht Industrial City, and 255 samples that were selected based on Morgan's table and by random sampling were used for analysis. Descriptive analyses were performed using SPSS 22 statistical software and final analysis was performed using Smart PLS 2 statistical software. The results of the research showed that business intelligence has a significant relationship with organization agility and IT infrastructure flexibility, and IT infrastructure flexibility has a significant relationship with organization agility. Also, the analysis results confirmed the mediating role of IT infrastructure flexibility in the relationship between business intelligence and organization agility, but the moderating role of IT infrastructure flexibility in the relationship between business intelligence and organization agility was not confirmed. Based on the results of the research, in addition to analysing key information and optimizing strategic decisions, company managers can use business intelligence as a tool to master new technologies for the development and prosperity of IT infrastructures.*

*Keywords*

*Business Intelligence, Organizational Agility, IT Infrastructure Flexibility*

## 1. Introduction

Organizational Agility is defined as a set of abilities of an organization in identifying and quickly responding to opportunities and threats. Theoretically, organizational agility is defined as three interrelated capabilities: customer agility, partner agility, and operational agility (Chen & Siau, 2020). Due to the rapid and extensive changes in the world around organizations, organizational agility is not considered an organizational choice, but rather an undeniable necessity and the factor that distinguishes successful and efficient organizations from ineffective ones; Because more agile organizations are always more successful in responding to the external environment (Harraf et al., 2015). Organizational agility includes the organization's capacity to change or adapt in response to environmental changes. Also, organizational agility involves controlling and responding to continuous and rapid changes in complex environments (Darvishmotevali et al., 2020).

Business intelligence is defined as a set of mathematical and methodological models for analysis that are used to extract useful information and knowledge from raw data for use in complex decision-making processes (Danesh GhalichKhani & Hakkak, 2016). The word Business Intelligence was first used in 1958 in an article by an IBM researcher. He considered the means of communication to guide a business as requiring the existence of an intelligent system and defined intelligence as the ability to understand the mutual relationship of the presented facts in a way that leads to the direction of action towards the desired goal (Zarei & Zarei, 2018). A business intelligence system is capable of covering the full spectrum of a business intelligence process, including the core components of data management and integration, analysis, presentation, delivery, and domain applications. The main purpose of business intelligence is to provide information effectively so that the organization achieves the proposed goals and strategies based on decision-making that leads to a competitive advantage in the market. In addition, the business strategy facilitates the acquisition of information from the grouping of data (Gilaninia et al., 2022).

Flexibility is broadly defined as the degree to which something is flexible and malleable; it refers to the ability to quickly and economically adapt information systems applications to changing business conditions within the system framework. Information technology infrastructure is a complex nature, because it includes both human and technical dimensions and their combination (Jaafarinia & Javanmard, 2014).

Information technology provides a flow of information that makes the supply chain more resilient and improvable, without undermining its efficiency. The flexibility of information technology has a major impact on performance and the company must be able to use its information output. Therefore, information technology should be applied in the company and supply chain to create a distinct competitive personality (Bavarsad et al., 2018). The term business intelligence is considered with a broader concept of competitive intelligence, which includes all the concepts of intelligence, including the external environment such as markets, competitors, suppliers and customers, and the internal environment such as strategy, culture, technology and employees (Bakhshandeh & Rahmati, 2016). The emphasis is on fostering a common organizational culture, so that people and technological tools are

15

directed in line with the same strategic vision (Azvine et al., 2005). It is possible that there is a relationship between an independent variable and its mediating variable so that it can affect the dependent variable (Preacher et al., 2007). Thus, in this research, information technology infrastructure plays both the role of a mediating variable and the role of a moderating variable. Business intelligence technologies facilitate analysis, data collection, analysis and distribution of information and are designed to support organizational decisions. Business intelligence tools provide past, present and future perspectives for employee use, as today's competition is driven by business intelligence, thus companies will achieve high competition by using business intelligence tools. Business intelligence must use vast amounts of data and help achieve competitive advantages such as better customer relationships and effective resource planning (Gilaninia et al., 2022).

The basis of the current research is the model used in the research conducted by Chen and Siau (2020) and the findings indicate that according to the 255 investigated companies, the results show that business intelligence is associated with organizational agility and flexibility. The IT infrastructure has a significant relationship and the flexibility of the IT infrastructure has a significant relationship with the agility of the organization. Also, the analysis results confirmed the mediating role of IT infrastructure flexibility in the relationship between business intelligence and organization agility, but the moderating role of IT infrastructure flexibility in the relationship between business intelligence and organization agility was not confirmed.
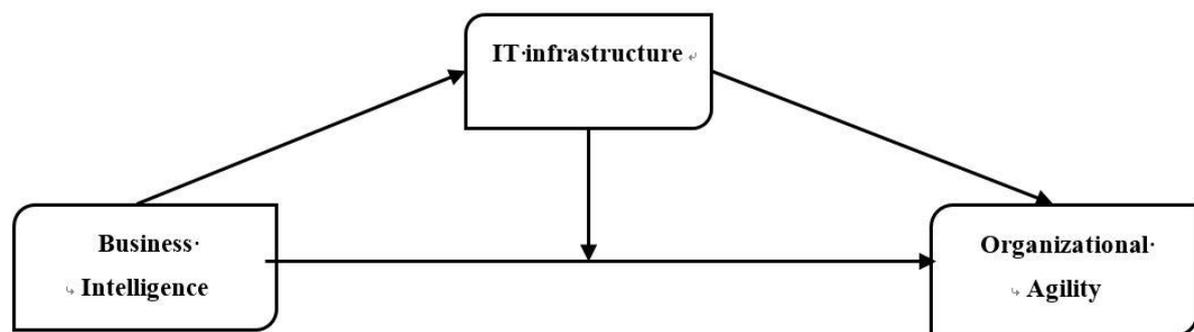


**Figure 1. The Conceptual Model of the Research Taken from the Research of Chen & Siau (2020)**

Chen and Siau (2020) conducted a research titled business intelligence and business analysis and IT infrastructure: impact on organizational agility. The results of this research have shown a significant relationship between the use of business intelligence and the flexibility of information technology infrastructure with organizational agility and cooperation to create a flexible information technology infrastructure. However, the results of this research did not show the suggested interaction between two organizational drivers for organizational agility. Cheng et al. (2020) conducted a research entitled Facilitating the Speed of Internationalization: The Role of Business Intelligence and Organizational Agility among 258 Chinese Companies. In this research, they concluded that business intelligence has a

16

significant effect on the speed of internationalization and organizational agility is a positive mediator of this causal relationship. Also, the findings indicated that negative cultural distance moderates the relationship between organizational agility and speed of internationalization. Darvishmutoli et al. (2020) conducted a study on the relationship between environmental uncertainty, organizational agility and organizational creativity in the hotel industry among 174 managers of five-star hotels. The findings of this research showed that organizational agility has a negative moderating role between competitive uncertainty and technology on organizational creativity. Also, these results showed that in highly dynamic and complex environments, organizations should reduce bureaucracy to manage challenges related to uncertainty. Meli án-Alzola et al. (2020) conducted a research titled Information Technology Capability and Organizational Agility. The results of this study indicate the mediating role of IT capability, which is the ability to manage technological resources, not only directly but also indirectly using information technology. However, the role of IT capability as a moderator was not confirmed in this research. Danesh GhalichKhani and Hakkak (2016) conducted a research under the title of a model for measuring the direct and indirect effect of business intelligence on organizational agility with the role of mediating empowerment. The results of this research showed that business intelligence has a direct and indirect effect on organizational agility through empowerment. Also, the effect of business intelligence on organizational agility, business intelligence on capability and the impact of capability on organizational agility were confirmed.

Chen and Siau (2012) conducted a research titled the impact of business intelligence and flexibility of IT infrastructure on competitive advantage: organizational landscape agility and investigated the impact of IT infrastructure on competitive advantage through agility. The results of this research indicated that by using the flexibility of the technology infrastructure, it is possible to respond to environmental opportunities and threats faster and achieve a competitive advantage. Hashemi et al. (2017) conducted a research titled designing a model to evaluate the development of an organizational dashboard with business intelligence logic in organizations in Iran Khodro Engineering and Parts Supply Company. The results of this research showed that due to the existence of the strategic planning process, organizational performance evaluation and procedures based on the quality management system, as well as the existence of Oracle software, system and software platforms are available in this company; However, due to the low priority of business intelligence issues in Sapco, the process of developing a dashboard with business intelligence logic is not a high-priority organizational project and needs more work in this area. Bavarsad et al. (2018) conducted a research titled the effect of information technology infrastructure flexibility and organizational learning on performance with the mediating role of supply chain performance in manufacturing companies of Khuzestan province. The results also showed that supply chain performance had a positive and significant effect on organizational performance and its mediating role in the impact of information technology infrastructure flexibility and organizational learning on organizational performance was confirmed. Ahmadyan and Mohajeran (2019) conducted a research on the structural model of relationships of organizational intelligence, organizational agility and

innovation in higher education among employees of Urmia University. The results of this research show the direct effect of organizational intelligence on innovation, organizational agility on innovation, and the effect of organizational intelligence on agility, as well as the indirect effect of organizational intelligence on innovation through the mediation of organizational agility. Jafarzadeh Zarandi et al. (2019) conducted a research titled presenting an organizational agility model based on information technology in Iranian sports organizations. The findings revealed that technology knowledge, network communication, architecture and data services, technology management, technology foundations, compatibility and speed of technology were considered among the main axes of this infrastructure, and the assumption of organizational agility was also strengthened. Ebrahimpour Azbari et al. (2016) conducted a research on the effect of supplier integration capability on company performance with the role of organizational agility among 80 companies located in Rasht Industrial City. The results of this research showed that the ability to integrate with suppliers directly and indirectly has a significant positive effect on the performance of companies. Jafarinia and Javanmard (2014) conducted a research on the effect of information technology infrastructure flexibility and supply chain management operations on competitive advantage and financial performance in manufacturing and industrial companies in Ahvaz city. The results of this research showed that a high level of supply chain management operations leads to an increase in competitive advantage and financial performance, and a high level of flexibility of information technology infrastructure leads to an increase in competitive advantage, but does not lead to an increase in financial performance, and competitive advantage has a positive effect. And has a direct effect on financial performance.

As the study of the theoretical foundations and background of the research shows, it can be seen that different researches have addressed the variables considered in the current research from different aspects, but so far in Iran, there is no research on the relationship between business intelligence and organizational agility, emphasizing the mediating role of flexibility. The construction of IT among the CEOs of active companies has not been paid, therefore, considering that limited research has been done in this field, the present study aims to answer the question of whether there is a relationship between business intelligence and organizational agility, emphasizing the role of a mediator. Is there a relationship between the flexibility of IT infrastructure in companies operating in Rasht Industrial Town? And if there is a connection, how will the process be?

## 2. Methodology

The research method of the current study is descriptive-correlational and analytical, which was conducted in the field. The statistical population of the research was 726 active units from the companies in Rasht Industrial City, and based on Cochran's formula, 255 companies were selected for the research sample. To achieve the goals of the research, Chen and Lin (2020) questionnaire for the business intelligence component; Talon and Pinsonlet (2011) questionnaire was used for the IT

flexibility component, and Zhang and Sharifi (2000) questionnaire was used for the organizational agility component.

The formal and content validity of the questionnaires was approved by the experts and their reliability was calculated in a preliminary test with Cronbach's alpha of 0.867 for organizational agility questionnaire, 0.919 for business intelligence and 0.806 for IT infrastructure. To analyze the collected data, descriptive statistical methods of mean, standard deviation, frequency distribution table and percentage were used from SPSS Version 22 software and for inferential statistical methods including confirmatory factor analysis with the help of Smart-PLS software.

## 3. Result

**Table 1. Demographic Information of the Samples**

|  |  | **Abundance** | **%** |
|---|---|---|---|
| **gender** | Female | 249 | 97.6 |
|  | Man | 6 | 2.4 |
| **education** | BS | 140 | 54.9 |
|  | Master's degree | 103 | 40.4 |
|  | PHD | 12 | 4.7 |
| **Age** | up to 40 years | 13 | 5.1 |
|  | 41 to 45 years | 85 | 33.3 |
|  | 46 to 50 years | 90 | 35.3 |
|  | Over 51 years old | 67 | 26.3 |
| **Work Experience** | under 10 years old | 27 | 10.6 |
|  | 11-15 years | 137 | 53.7 |
|  | 16-20 years | 53 | 20.8 |
|  | Over 20 years old | 38 | 14.9 |

The results of Table 1 show the demographic information of the samples.
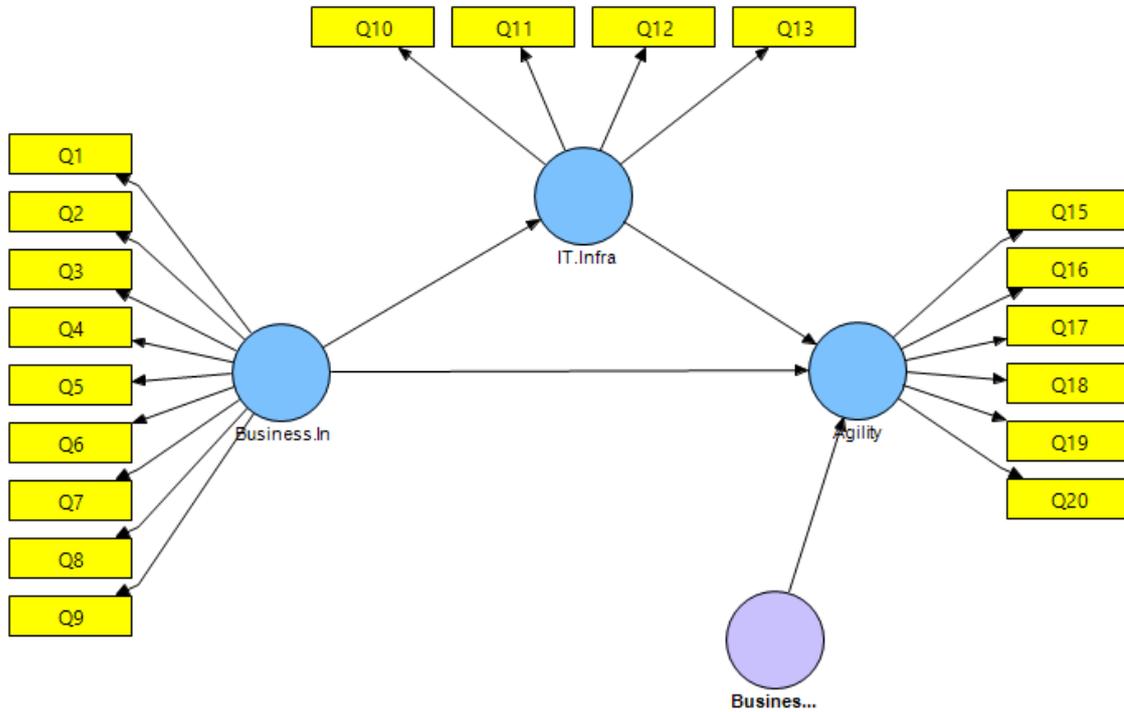
**Figure 2. The Initial Research Model in PLS2 Software**

**Table 2. Cronbach's Alpha, AVE, CR, R2 and Q2 Indexes**

| Variable | Cronbach's ALPHA> 0/7 | AVE> 0/4 | CR> 0/7 | $R^2$ | $Q^2$ |
|---|---|---|---|---|---|
| Organizational Agility | 0.867 | 0.604 | 0.901 | 0.688 | 0.408 |
| Business Intelligence | 0.919 | 0.617 | 0.934 | - | - |
| IT infrastructure | 0.806 | 0.635 | 0.873 | 0.873 | 0.366 |

According to the results of Table 2, Cronbach's alpha, AVE, CR, R2 and Q2 reported are consistent with the standard value of the test criteria, so it can be said that the assumption of normality of the data is established.

## 4. Communality Criteria

The quality of the measurement models in the PLS method is evaluated using the Communality criterion. This criterion shows how much of the variability of the indicators (questions) is explained by the self-related construct. Communality criteria related to each index is obtained through the average of the second-order values of the relationship between that index and its related structure, which are the factor loadings (Davari & Rezazadeh, 2014).

## 5. Redundancy Criterion

The Redundancy criterion is obtained from the product of the communality values of the structures in their respective R2 values, and it indicates the amount of variability of the indices of an endogenous structure that is affected by one or more exogenous structures. Accepted (Davari & Rezazadeh, 2014). Table 3 shows the results of the variability of the endogenous structure index:

**Table 3. Communality and Redundancy Criteria**

| Variable | Communality | Redudancy |
|---|---|---|
| Organizational Agility | 0.604 | 0.284 |
| Business Intelligence | 0.617 | - |
| IT infrastructure | 0.635 | 0.367 |

Factor loadings are calculated by calculating the correlation value of the indicators of a structure with that structure. If this value is equal to or greater than 0.4, it confirms that the variance between the structure and its indicators is the variance of the size error. The measurement of that structure is more and the reliability of that measurement model is acceptable. In the present study, questions No. 14, 21 and 22 were removed from the model due to their low factor load and the model was implemented again. Table 4 shows the results of factor loading:

**Table 4. Results of Factor Loadings**

| | Business Intelligence | IT infrastructure | Organizational Agility |
|---|---|---|---|
| Q1 | 0.859 | | |
| Q2 | 0.877 | | |
| Q3 | 0.831 | | |
| Q4 | 0.844 | | |
| Q5 | 0.871 | | |
| Q6 | 0.657 | | |
| Q7 | 0.837 | | |
| Q8 | 0.583 | | |

| | | | |
|-----|-------|-------|-------|
| **Q9** | 0.647 | | |
| **Q10** | | 0.891 | |
| **Q11** | | 0.871 | |
| **Q12** | | 0.685 | |
| **Q13** | | 0.721 | |
| **Q15** | | | 0.744 |
| **Q16** | | | 0.726 |
| **Q17** | | | 0.839 |
| **Q18** | | | 0.857 |
| **Q19** | | | 0.730 |
| **Q20** | | | 0.779 |

Also, Table 5 presents the correlation values between research variables. In divergent validity, it is acceptable when the AVE for each construct is greater than the shared variance between that construct and other constructs in the model. In PLS, this is checked by means of a matrix, the houses of this matrix contain the values of the correlation coefficients between the constructs and the square root of the AVE values of each construct, so it can be concluded that the relationships between the variables are meaningful. Now we can fit the proposed structural model in Figure 3 assuming normality.

**Table 5. Internal Correlation between Research Variables**

| **Variable** | Organizational Agility | IT infrastructure | Business Intelligence |
|---|---|---|---|
| Organizational Agility | 0.777 | | |
| Business Intelligence | 0.773 | 0.785 | |
| IT infrastructure | 0.772 | 0.767 | 0.796 |
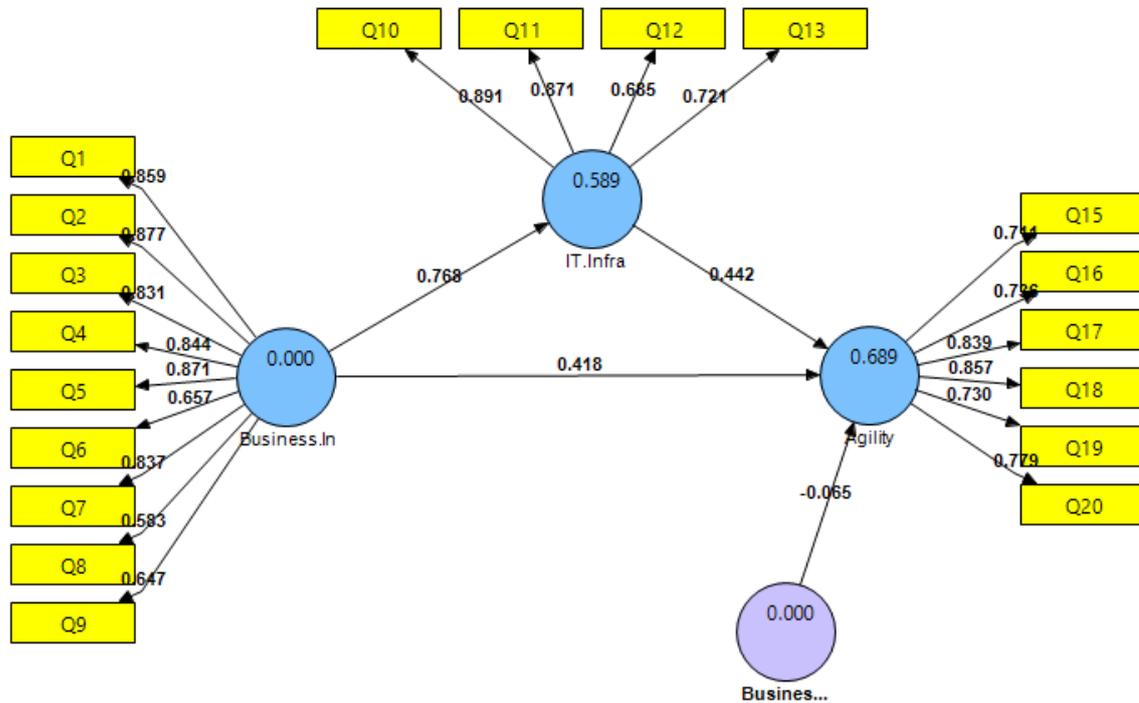
**Figure 3. Structural Equation Model in Path Coefficient Mode**

After the theoretical formulation of the model and checking the related assumptions, the model fitting should be done, the general information about which is presented below, and then the details of the model are presented. The overall model includes both measurement and structural model parts, and by confirming its fit, the fit check is completed in a model. To check the fit of the overall model, only one criterion called GOF (Goodness Of Fit) is used. The GOF criterion is related to the general part of structural equation models. This means that with this criterion, the researcher can control the overall fit after checking the fit of the measurement part and the structural part of the overall research model. Wetzels et al. (2009) introduced three values of 0.01, 0.25 and 0.36 as weak, medium and strong values for GOF (Davari & Rezazadeh, 2014). The GOF criterion is obtained through the following formula:

$$GOF = \sqrt{communality \times \overline{R^2}}$$

$$GOF = \sqrt{0.618 * 0.638} = 0.627$$

It can be seen that the value of 0.627 was obtained for the GOF criterion in the present study, thus it can be said that the model of this study has a strong fit.
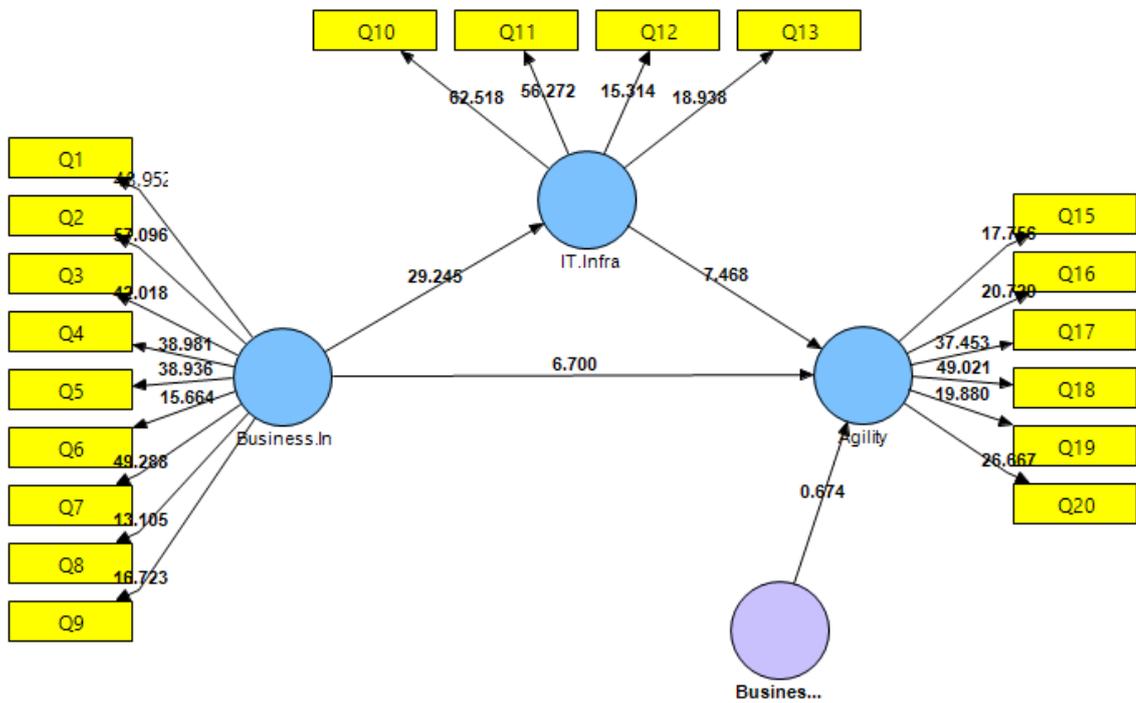
**Figure 4. The Model of Structural Equations in the State of Significance**

After checking the fit of the measurement models, structural model and general model, according to the data analysis algorithm in the PLS method, the researcher is allowed to examine and test his research hypotheses and reach the research findings. This section consists of two parts: 1) examining the significance coefficients of Z; that the coefficients higher than 1.96 indicate the significance of the effect of one variable on another variable at the 95% confidence level and confirm the hypothesis, and 2) checking the standardized factor load coefficients related to the paths of each of the hypotheses.

**Table 6. General Results of Research Assumptions**

| Theories | t statistic | Path coefficient | Sobel test | effect intensity | Moderation test | Confirm or reject |
|---|---|---|---|---|---|---|
| Business Intelligence→ | 29.245 | 0.768 | | | | |
| Flexibility of IT | 0.674 | 0.065 | | | - | reject |
| infrastructures → | 7.468 | 0.442 | - | - | | |
| Organizational Agility | 6.700 | 0.418 | | | | |
| Business Intelligence→ Organizational Agility | 6.700 | 0.418 | - | - | - | Verification by direct contact |

| Business intelligence → flexibility of IT infrastructure | 29.245 | 0.768 | - | - | - | Verification by direct contact |
|---|---|---|---|---|---|---|
| Flexibility of IT infrastructure → organization agility | 7.468 | 0.442 | - | - | - | Verification by direct contact |
| Business intelligence → with IT infrastructure flexibility → organization agility | - | - | 7.600 | 0.447 | - | Verification by direct contact |
| Business intelligence → with IT infrastructure flexibility → organization agility | -0.065 | - | - | | 0.674 | reject |

## 4. Discussion

*There is a significant relationship between business intelligence and organizational agility, emphasizing the mediating role of IT infrastructure flexibility.*

Business intelligence is basically the same human intelligence that is applied in affairs and activities. This is the use of artificial intelligence in the business system. By accessing and analyzing data, it helps the users of the organization to make better business decisions (Dinesh, 2021). Organizational agility is the ability to quickly understand and respond to market opportunities and threats, and business intelligence can help measure the role of organizational agility. Since business intelligence can increase awareness of product trends and customer changes, it can contribute to organizational agility by providing timely information to detect changing trends. (Chen et al., 2012). The obtained results show the rejection of the above hypothesis and this result is inconsistent with the results of Chen & Siau (2020) and Chang et al. (2020)

*Business intelligence has a significant relationship with organizational agility.*

Some of the reasons and the necessity of moving towards organizational agility can be seen as fierce competition in the business environment, increasing customer expectations, globalization, cultural and social issues, limited skilled manpower, information technology, innovation and initiative, and changes. Information technology in its different forms (Internet, intranet, e-commerce, e-business, etc.) is an effective facilitator that can support the concept of agility. The use of information technology is an organizational advantage that the success of the organization depends to a large extent on its optimal use (Jafarzadeh Zarandi et al., 2019). The results of the analysis for this hypothesis showed that business

intelligence has a significant relationship with organizational agility and the type of this relationship is direct and positive. This result is consistent with the research results of Chen and Siau (2020), Danesh GhalichKhani and Hakkak, (2016), Ahmadyan and Mohajeran (2019).

*Business intelligence has a significant relationship with IT infrastructure flexibility.*

Evaluation and impact of the use of information technology and its relationship with the organization's agility and determination of the organization's agility level according to this impact, organizations to know solutions to increase the profit of their investments and more use of information technology to achieve and improve agility and Gaining a competitive advantage will enable. The adoption of information technology in private and public organizations can be a suitable platform for the growth of the concept of organizational agility (Jafarzadeh Zarandi et al., 2019). The results of the analysis for this hypothesis showed that business intelligence has a significant relationship with the flexibility of IT infrastructure and the type of this relationship is positive and direct. This result is consistent with the research results of Chen and Siau (2020), Chen and Siau (2012).

*The flexibility of the IT infrastructure has a significant relationship with the agility of the organization.*

Since companies are facing a changing environment, fierce competition and rapid technological development, how to survive these challenges is an important question. Of course, for small and medium enterprises and large enterprises, responding to change and exploiting market opportunities is the main capability of survival and success. Therefore, companies should use their resources in innovative ways to create a competitive advantage. Resources include all the assets, capabilities, organizational processes, firm characteristics, information and knowledge controlled by a firm that enable that firm to understand and implement its efficiency and effectiveness strategies. In fact, information technology infrastructures are an important part of the company's resources and capabilities and support operational and strategic activities (Masa'deh, 2013). The results of the research showed that the flexibility of the IT infrastructure has a significant relationship with the organization's agility, and this relationship is positive and direct, and this result is in line with the results of the research by Chen and Siau (2020), Jafarzadeh Zarandi et al. (2019).

*The flexibility of IT infrastructure plays a mediating role in the relationship between business intelligence and organizational agility.*

The results of the Sobel test for this hypothesis showed that the flexibility of IT infrastructure plays a mediating role in the relationship between business intelligence and organizational agility, and the type of this relationship is positive and direct. The results show that the research is in line with the research of Chen and Siau (2020), Meli án-Alzola et al. (2020) and Ahmadyan and Mohajeran (2019).

*The flexibility of IT infrastructure plays a moderating role in the relationship between business intelligence and organizational agility.*

Since the results of the analysis for this hypothesis show the rejection of the above hypothesis, this result is consistent with the research of Meli án-Alzola et al. (2020).

The limitation in this research is related to the inherent limitations of the questionnaire, which can cause problems in the results of the research due to reasons such as people's lack of correct understanding of the questionnaire questions or their unwillingness to answer the questions correctly. Also, sometimes there are differences between people's beliefs and what they say, which causes people not to express their true opinion, and this issue can cause a decrease in the accuracy of the obtained results. Come from research.

Based on the results of the research, it can be suggested to the companies and managers, considering the confirmation of the positive relationship between business intelligence and organizational agility, it is suggested to the managers of industrial companies active in Rasht city, and also considering the issue that business intelligence causes that Information related to product trends and customer changes will increase, so managers can contribute to their organizational agility by providing relevant information in time to recognize the trends of these changes. Also, taking into account the confirmation of the positive relationship between business intelligence and the flexibility of IT infrastructure, the managers of these companies should increase the areas of flexibility in their IT infrastructure by applying artificial intelligence and thus improving business intelligence in their organization. Considering the fact that in the current research, the positive relationship between the flexibility of the IT infrastructure and the agility of the organization has been confirmed, the managers of these companies can provide the grounds for making their organizations more agile by making the IT infrastructure flexible. And finally, considering the confirmation of the mediating role of IT infrastructure flexibility in the relationship between business intelligence and organizational agility, and since information technology is one of the strategic factors that can affect the business performance of organizations, the need for the attention of company managers Active in the city of Rasht, issues related to technology are emphasized so that they can ultimately improve their agility and organizational performance.

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29