IMPACT OF CULTURAL, ECONOMIC AND TECHNOLOGY ON RISK MANAGEMENT OF CONSTRUCTION COMPANIES IN IRAN

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Abstract

The current research was conducted with the topic of investigating the effect of cultural, economic and technological factors on the risk management of construction companies in Iran. This research was applied in terms of purpose and descriptive-survey in terms of method. The statistical population of this research is: senior managers and engineers of grade 1 construction companies in Iran, of which 120 people were selected as a sample through sampling in available was selected and a researcher-made questionnaire was distributed among them and they were asked to rate each item according to its importance from one (lowest) to five (highest). To analyze the data, partial least squares technique was used with the help of SmartPLS software, and the results showed that cultural and economic factors do not affect the risk management of Iran construction companies, but technological factors have an effect on the risk management of Iran construction companies.

Keywords: *cultural factors; economy; technology; risk management; construction companies; corporate finance; risk analysis*

Classification JEL: G32, L74, M1, O16

1. INTRODUCTION

The successful completion of a project depends on the detailed analysis of possible risks in unfavorable conditions during the economic life of the project, and until the project is operational, risks can erupt during each phase of the project. In addition to the ability to pay debts, every project should have a suitable profitability so that investors are attracted to attend and invest in this project. The existence of various risks can affect the cash flows of the project, which, if not controlled, will lead to a lack of liquidity and ultimately non-payment of creditors' claims, and in this case, the project will face failure. Construction projects, like other projects, always deal with the category of risk and uncertainty, especially in those projects that involve the interests of people and society as potential shareholders. Risks create many difficulties and problems for the progress of the project, which strongly affect each stage of the project.

The lack of sufficient information in the field of risk and uncertainties related to the project causes disruptions in the progress and costs of the project and even the incompleteness of the project. Having said that, the risk analysis of this category of projects is considered a very important factor in the success of the project. In the current situation, the world economy is facing major crises, especially in most economic and financial fields. Due to the imposition of various sanctions and the impact of global crises, our country has many problems that cannot be solved easily if they are not dealt with scientifically.

Risks in the project are possible and unknown events or situations that affect the project goals in the form of positive or negative consequences. In fact, risk is a potential that can cause problems in project implementation and achieving its goals. Risk is an inherent part of all projects and it is not possible to completely eliminate it. Although it can be effectively managed to reduce the effect of risk in achieving project goals. But there is a possibility of its occurrence in at least one of the dimensions of the project such as scope, time, cost or quality. Therefore, the identification, analysis and prioritization of risk can play a significant role in the success of the project (Olfat et al., 2010). It is impossible to avoid and prevent the occurrence of risk in the project. Therefore, it seems necessary to use a comprehensive risk management system to manage all types of risk. Due to the inherent characteristics of large and complex projects, related organizations and companies need to use project management tools, techniques and methods. The impact of risk on projects and their success is an undeniable issue (Nazari and Jabri, 2014).

The first and most basic step in managing contractual risks is identifying the risk and allocating it between the parties to the contract. In order to identify the risk assessment matrix in projects, it is first necessary to explain the project and its life cycle, then their adjustment and balance factors, and then risk and risk management, then risk analysis and its steps, until finally after knowing the basic concepts Above, let's look at the main body of the research (Bordbar and Saibani, 2012). In fact, risk is created due to lack of proper management (Adeleke et al., 2018). It is clear that unforeseen events, which are called risks according to the definition, occur during the life of the project and some of them can cause serious damage to the project. Therefore, the theory of risk management is proposed as a technique for dealing with unpredictable events and controlling such events. (Hossein Alipour, Jahormi 2010).

In general, the effective factors in risk management of construction companies include economic and financial factors, administrative factors, political factors, cultural factors and technological factors. In this research, the impact of three factors (economic, cultural and technological) is investigated .Adeleke et al. (2018) stated in their research that economic and technological factors have an effect on proper and efficient risk management in construction projects, and on the other hand, Arditi et al. (2017) also discussed the impact of organizational culture and cultural factors on risk management. They noted that organizational culture has an effect in preventing project delays, and since improper risk management increases the cost and delivery time of the project, it can be said that cultural factors also affect risk management.

According to what was mentioned about the importance of risk management in construction projects and following the fact that today most of the construction projects are facing risks and each of these risks can somehow cause the project to face problems, it is necessary To address such an issue and measure the impact of cultural, economic and technological factors on risk management, therefore the cultural factor should be investigated as how the work and technical culture of executive agents is weak and the lack of attention to cultural issues and social norms in the design of buildings. He recognized the technology factor as an environment in which strategic plans should be considered. The economic factor can be understood as how the cost of access to materials, finance, labor equipment and the amount of demand. According to what was said, the objectives of the current research are to determine the impact of cultural factors on construction risk management, to determine the impact of economic factors on construction risk management, and to determine the impact of technology factors on construction risk management.

Therefore, we seek to answer these questions: Do cultural factors have an effect on construction risk management? Do economic factors affect construction risk management? Do technological factors affect construction risk management?

2. THEORETICAL FRAMEWORK

Risk

Risk is anything that threatens the present or future of an asset with the ability to earn money for a company, institution or organization. In fact, risk management and project management have many similarities in terms of roots and concepts, and both of these topics were raised in the late 1950s. By referring to different scientific sources, several definitions of risk can be found. Of course, each of these definitions has provided a different definition of risk depending on its dimension or perspective. Haji Aghaei (2008), in his research, considers risk as a phenomenon that actual and direct loss - through the reduction of income flow and capital loss - is inflicted on the institution. In his article, Kadkhodaei(2020) defines risk in such a way that risk refers to the possibility of danger and facing loss, and in general, it includes the deviation of events from desirable and expected cases. In most cases, the two words risk and uncertainty are used as equivalents and synonyms. But uncertainty, despite its close relationship with risk, is not equivalent to risk, and in the literature of risk management, these two terms are used separately from each other. According to his words, risk is uncertainty that can be measured, but uncertainty is an unmeasurable category. There is a difference between these two concepts in projects. All uncertainties in the project do not lead to risk; such as the variable exchange rate in the case of an organization that basically works with a monetary unit; or changes in legal rules and regulations regarding a project that is outside the scope of those regulations. In this way, it is clear that only a limited subset of all uncertainties in a project are presented as project risk. Project risk is any type of uncertainty that affects one or more project goals if it occurs.

Risk management approach and methodology

One of the outputs of the risk management planning stage is the risk management approach, and each project has its own approach. In some projects, it is necessary to carry out the risk management process in a precise and selective manner, along with the use of various techniques and experts, as well as the use of extensive inputs and special tools. On the other hand, simpler approaches are used in some other projects. At this stage, the approach, work method, tools and techniques that can be used in the risk management process, roles and responsibilities of each of the project stakeholders, reporting standards and finally the structure and the frequency of preparing and updating the reports is determined.

Project Management

Project management is the planning and directing of the project within the framework of time, cost and quality towards the creation of its specific results. Project management includes the activities of planning, organizing, monitoring and directing the implementation and tries to deliver

the specific and expected results with the previously agreed cost on time by using the resources properly. In other words: project management is the application of knowledge, skills, tools and techniques necessary to manage the flow of activities, in order to meet the needs and expectations of those in charge of project implementation.

Cost Management

The resulting flexible manufacturing system brings high productivity to the production organization. It should be noted that entering the competitive arena in today's world is not possible only by having advantages such as high levels of automation, flexibility and producing high quality products, but the existence of an efficient accounting mechanism in order to calculate the real cost is essential. And it is considered a supplement for the mentioned benefits.

3. RESEARCH BACKGROUND

Table 1 *Research Background*

R	Author	Research Title	Research Result
1	Park et.al (2016)	Risk ranking in large projects	Various permits, program delays, cash flow changes, errors in business processes, increased construction costs, inappropriate project budgets and financing, the possibility of financial risk, changes in macroeconomic indicators, project costs and project planning. introduced delay in launching, additional construction, consortium (contractor) conflict, delay in construction start and end, as effective risks in huge construction projects.
2	Kutsch, Hall (2010)	Willful neglect of project risk management	This paper presents the results of a qualitative study of IT project managers and examines their reasons for considering certain known risks as irrelevant. These results confirm and generalize Springer-Verlag, New York's Smithsonian classification of uncertainty and uncertainty, and especially provide some text-related perspectives on the phenomenon of "irrelevance" in project risk management. he does. We suggest that dealing with "irrelevance" requires defense mechanisms, efficient management of irrelevance, as well as adjustment and loyalty to priorities.
3	Lee et. al (2009)	Risk management of macro engineering projects using Bayesian belief network	It was found that large and medium shipbuilding companies differ from each other in terms of project implementation risks. Schedule overruns and specific dissatisfactions were more important for large shipbuilding companies, while budget and schedule overruns were more important for medium-sized shipbuilding companies. The change of risks related to the implementation of the project was evaluated through quality management risk reduction activities, and the strike of main elements and subcontractors in both large and medium shipbuilding companies. The results of the research should be so valuable that they can enable the participants in the industries to manage the engineering risks of large projects and also expand and develop our understanding and inference of the risks of shipbuilding in Korea.
4	Nazari & Jaberi (2015)	Identifying project risk with the design approach of risk failure structure, project-oriented	The necessity of using new technologies, the uniqueness of the projects, the lack of previous experience, the inadequacy of the existing knowledge with the required knowledge, the necessity of keeping pace with the global progress in the relevant industry and changing the macro strategies of the upstream institutions, the lack of accuracy

		industrial organizations	in cost estimation. Uncertainty of the amount and time of budget allocation, change in foreign currency income and instability of the budget, limited access to competent people in project management and implementation, impossibility of benefiting from the experiences of similar projects, incompatibility of the existing organizational structure with the project structure. , organizational bureaucracy and subsidiary companies and the plurality of subsidiary companies and upstream institutions, failure to achieve the required technical knowledge, change in contractual strategies, failure to achieve the required specifications, change in macro policies of upstream organizations and change in priority and The project goals were introduced among the risks affecting huge projects.
5	Nouri et.al (2015)	Risk analysis and financial evaluation in BOT power plant projects	They came to the conclusion that the need for electricity in developing countries like Iran is increasing day by day. The results of the simulation indicate the fact that in the power plant project, investors bear more risk than lenders. So that the risk of negative net present value of the project is 13.41% and the risk of reducing the debt service coverage rate from 1.2 is 8.65%.
6	Abbasi&Ramezaniyan (2015)	Identification and financial evaluation of BOT projects with risk management approach using AHP_DEA method	Based on this research, in BOT contracts, the contractual obligations of each of the parties to the contract and its implementation conditions and the other party should be clearly stated. Also, capitalizable obligations in BOT infrastructure projects should be seen in different stages and in different ways. Based on the results obtained from this research, in BOT contracts, the contractual obligations of each of the parties to the contract and its implementation conditions must be clearly stated.

4. RESEARCH METHODOLOGY

This research is descriptive-applied and in terms of data collection, it is survey research. In order to collect information, two library methods and field methods were used. The statistical population of the present study consists of senior managers and engineers of grade 1 construction companies in Iran, and some of them will be selected as samples through available sampling. Since access to all these people is not possible; Therefore, the sampling method is used. Since the population size is unknown, the following formula is used. In this formula, the most important parameter that needs to be estimated is S^2, which is the variance of the original sample. To calculate S^2, a number of questionnaires are distributed and the variance of the initial sample is calculated. The value is a fixed value that depends on the confidence interval and the error level (α). Usually, the error level is considered to be 5%. For example, if the error level or the significance level is considered equal to 5%, the confidence level will be equal to 95%. As a result, according to the statistical table, it will be 96.1. The value of d is also considered based on the same level of error or equal to 0.05. In this research, in order to determine the sample size, a preliminary study is conducted by distributing the questionnaire among 30 sample members, and by estimating the variance of the initial sample and the confidence level of 95%, the sample size is calculated using the following formula:

$$n = \frac{z_{\frac{\alpha}{2}}^2 * s^2}{d^2} = \; n = \frac{3.8416 * \; 0.078}{0.0025} = 120$$

According to the calculations, 120 people were estimated as the statistical sample of the study

Data Collection Tools

One of the most common tools in research is the use of a questionnaire, and the most common reason for its use is its simplicity. The questionnaire of the above research is a researcher-made questionnaire that is distributed among engineers and contractors and they are asked to rate each item according to its importance from one (lowest) to five (highest). The number of research questions is shown in the following table:

Table 2 *Questionnaire Components*

Variable	Number of *Q*uestions
***C*ultural *F*actors**	1-5
Economic *F*actors	6-10
Technology *F*actors	11-15
Construction *R*isk	16-20
Total	20

Validity and Reliability of research

The questionnaires of the current research have been approved by the relevant professors. In this research, Cronbach's alpha method was used to determine the reliability, and the value of the alpha coefficient is greater than 0.7, which indicates that the measurement tool has high reliability and its results can be trusted better.

Table 3

Reliability of the questionnaire

Variable	Number of Questions	Alpha Coefficient
Cultural Factors	1-5	0/785
Economic Factors	6-10	0/801
Technology Factors	11-15	0/799
Construction Risk	16-20	0/756
Total	20	0/861

Data Analysis Method

The partial least squares technique has been used with the help of SmartPLS software. Partial least squares is a non-parametric method that is a suitable substitute for the structural equation model. The partial least squares method is less sensitive to the sample size and does not require the data to be normal.

Model Fit Indices

In the partial least squares technique, unlike the structural equation model, there are not many indices to fit. The main fit indicators of the measurement model are:

- Convergent validity
- Divergent validity
- HTMT index
- Composite reliability

The main fit indicators of the measurement model are:

- Detection coefficient R2
- GOF index
- Blindfolding index Q2
- Effect size index F2

- **Partial least Squares Sample Size**

The issue of PLS sample size determination is one of the important issues of partial least squares. Another area where covariance-based structural equation modeling is suggested is the situation where the sample size is small, for this approach the minimum sample size should be 100 (regardless of other data characteristics) to avoid problematic solutions. and achieved an acceptable acceptance level. Even many researchers suggest a minimum sample size of 200 to avoid results that cannot be interpreted (such as negative variance or correlation above 1).

Partial least squares can also be used in situations where the sample is very small. Although such conditions can only be used for statistical power analysis. Monte Carlo showed that this approach can be used for sample size less than 50, H. Using 27 variables, Veld analyzed two hidden constructs and data sets consisting of 10 samples. However, considering the large-scale sustainability problem, this model still faces limitations.

Summary of partial least squares discussion

Partial least squares is a solution for testing hypotheses and is used when the sample size is limited or the data is not normal. Without assumptions such as distribution assumptions, or nominal, ordinal, and interval scales for variables, the work results can be used. Of course, it should be kept in mind that partial least squares, like all statistical techniques, requires certain assumptions. The most important hypothesis is the "predictive" diagnosis. This requirement states that the systematic part of the linear regression should be defined based on the situational expectations of the dependent variable so that conclusions can be drawn based on the regression. However, the problem of large-scale stability remains.

Considering the problem of consistency in large samples, one can doubt the appropriateness of partial least squares and ask why this technique cannot guarantee one of the key features of a statistical model (stability of the estimator). The answer is that this approach enters different situations with its own principles. The goal of covariance-based structural equation modeling is to determine the parameters matrix of the model Φ, which the covariance matrix predicted by the theoretical model $\Sigma(\Phi)$ is very close to the sample covariance matrix S has it. For this purpose, the function $F(S, \Sigma)$ must be defined. When $S=\Sigma$, this function assumes zero value, other cases when the value of the function is positive, the difference between Σ and S increases. Considering that the sample covariance matrix is based on the probability of the measured index, the function that is used a lot in this regard is the theoretical normal maximization function.

5. RESEARCH FINDINGS

SPSS software (version 22) and Smart-PLS software (version 3) were used for data analysis, and a significance level of 0.05 was considered.

- **Descriptive Statistics**

In total, out of 120 people who answered the questions in the questionnaire, 118 were men and 2 were women. In total, out of 264 respondents, the age groups are 24 to 33 years (22 %), 34 to 41 years (39.8 %), 42 to 29 years (32.2 %), and 50 to 55 years (6 %), as well as all respondents. They had a bachelor's degree (72.5 %) and a master's degree or higher (27.5 %).

- **Inferential Statistics**

After examining the statistical sample in the form of descriptive statistics, in this part the analysis of the data collected on different statistical tests is discussed. The inferential statistics tests used, the application of each of these tests and the software package used for each of the statistical tests used. It is summarized in Table 4. In the following, each of these tests and the analysis related to each one will be described.

Table 4 *Statistical tests used and their application*

R	Tests Used	Application	Software
1	Cronach's Alpha Cefficients	Review of the reliability of the questionnaire	SmartPLS
2	Confirmatory Factor Analysis (CFA)	Questionnaire Validity Review	SmartPLS
3	Correlation Test	Significance of the relationships between variables	SmartPLS
4	Structural Equation Modeling (SEM)	Testing research hypotheses	SmartPLS

Analysis of the measurement model with confirmatory factor analysis (testing the validity of the questionnaire)

In order to analyze the internal structure or in other words the validity of the questionnaire and discover the constituent factors of each obvious variable, the confirmatory factor analysis (CFA) tool is used. The results of the confirmatory factor analysis of the items or questions of the research questionnaire are summarized in Figure 1. The factor loadings related to each of the constructs or research questions were significant at the 99% and 95% confidence levels; Therefore, the studied constructs have high validity in terms of validity. Research variables in structural equation modeling are divided into two categories: latent and manifest. Obvious or observed variables are directly measured by the researcher, while hidden or unobserved variables are not directly measured, but are inferred based on the relationships or correlations between the measurement variables. In other words, the hidden variables are the same as the main research variables and the obvious variables are the questions of the questionnaire. Latent variables, in turn, are divided into two types of endogenous or flow-receiving variables and exogenous or flow-giving variables. Each variable in the structural equation model system can be considered as both an endogenous variable and an exogenous variable. An endogenous variable is a variable that is influenced by other variables in the model. On the other hand, an exogenous variable is a variable that does not receive any effect from other variables in the model, but has an effect by itself. In addition, with the help of factor load, it is possible to say which index or item has a greater contribution to the measurement of its hidden variable. Each questionnaire item or question that has a higher factor load has a greater power or contribution in measuring the related hidden variable.

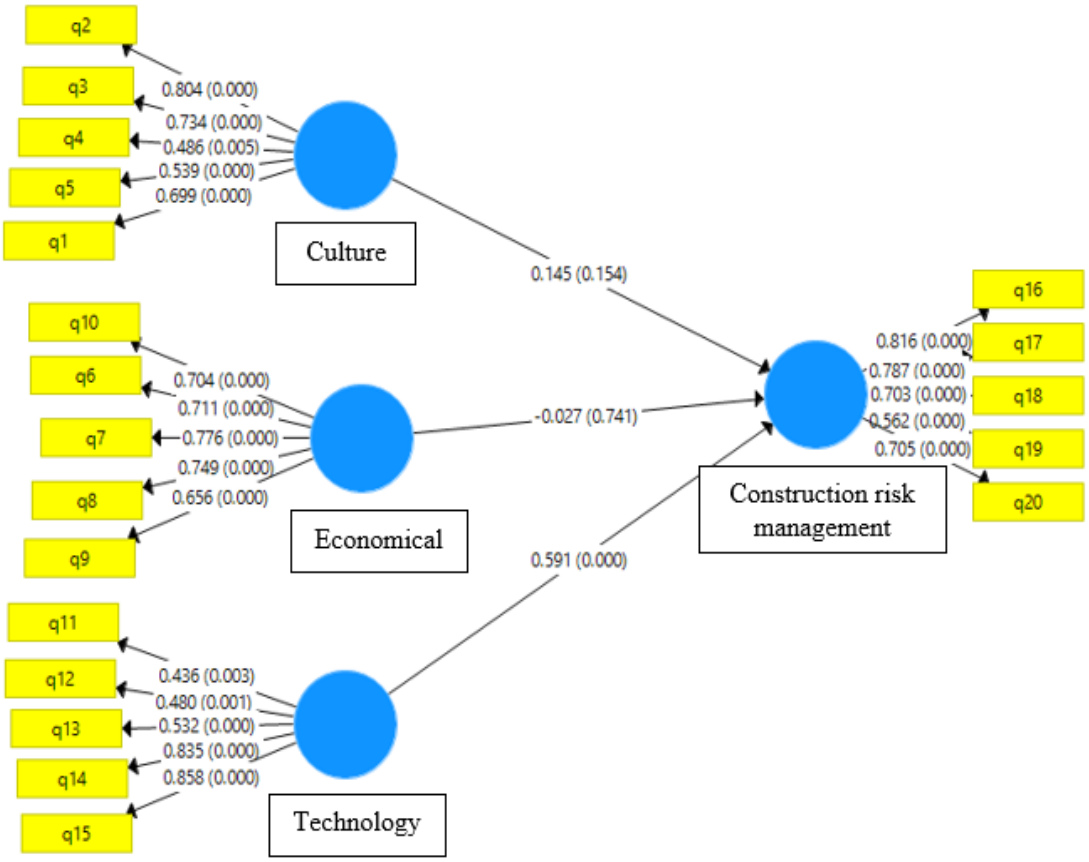

Figure 1 *Factor loadings of the research constructs*

According to the factor loadings in Table 4, it can be seen that all items or questions of the questionnaire have relatively acceptable validity. (factor loadings are greater than 0.4).

- **Data analysis through structural equation modeling**

The process of data analysis based on structural equation modeling includes a series of steps that can be summarized in the diagram below. In the following, some of the most important steps will be explained and then the analysis of the survey data will be discussed.

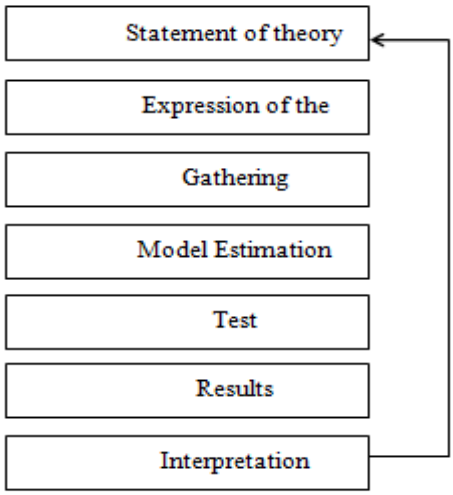

Figure 2 *Basic steps of analysis*

Expression of the model: This step is actually the formal expression of the model and is one of the most important steps in modeling structural equations. In fact, no analysis is done unless the researcher first states his model, which is about the relationships between variables. This step includes formulating (setting) an expression about a set of parameters. These parameters show the nature of relationships between variables in the context of structural equation modeling. In structural equation modeling, the size and sign of these parameters are determined. The goodness of fit indices of the model can be seen in the following table:

Table 5 *Goodness indices of model fit*

	Cronbach's alpha	**rhorho_a index**	**Combined reliability**	**Average of the variance of the extract**
Culture	0/8	0/798	0/858	0/503
Economical	0/816	0/818	0/89	0/73
Technology	0/725	0/769	0/8	0/577
Construction Risk Management	0/723	0/728	0/801	0/567

The results indicate a good fit of the model.

Estimation of the model: after expressing the model, the next step is to obtain the estimation of the free parameters from a set of observed data. Iterative methods such as maximum likelihood or generalized least squares are used to estimate the model. The working method in these estimation procedures is that in each iteration, an implicit covariance matrix is created and compared with the covariance matrix of the observed data. The comparison of these two matrices leads to the production of a residual matrix, and these repetitions will continue until this residual matrix becomes a minimum. Calculations or estimation of parameters are possible with maximum 250 repetitions. If the number of repetitions exceeds 250, the parameter estimation calculations will be stopped.

Estimation of the research model: the model in the coefficient estimation mode shows the path coefficients of each of the research hypotheses and the factor loadings of each of the items or questions of the questionnaire. The model shows the significance of each of the coefficients of the hypothesis path in the case of significance of the coefficients or the t-statistic. In fact, with the help of the model in the estimation mode of the path coefficients, it is possible to obtain the path coefficients between hidden variables and the path coefficients between manifest and hidden variables (factor loadings). In the significance mode, the model also shows the value of the t statistic for each hypothesis to test the significance of each hypothesis. The interpretation of factor loadings in the measurement model analysis section and the interpretation of path coefficients and t-statistics are also fully described in the research hypothesis test section.

Test and interpretation of research hypotheses with structural equation modeling (SEM): another type of relationship between variables in the structural equation model is of direct effect type. The direct effect is actually one of the components of structural equation models and shows the directional relationship between two variables. This type of relationship is mainly evaluated by one-way analysis of variance. This type of effect actually expresses the assumed causal linear effect of one variable on another variable. Within a model, each direct effect specifies and expresses a relationship between a dependent variable and an independent variable. Although a dependent variable in another direct effect can be an independent variable and vice versa.

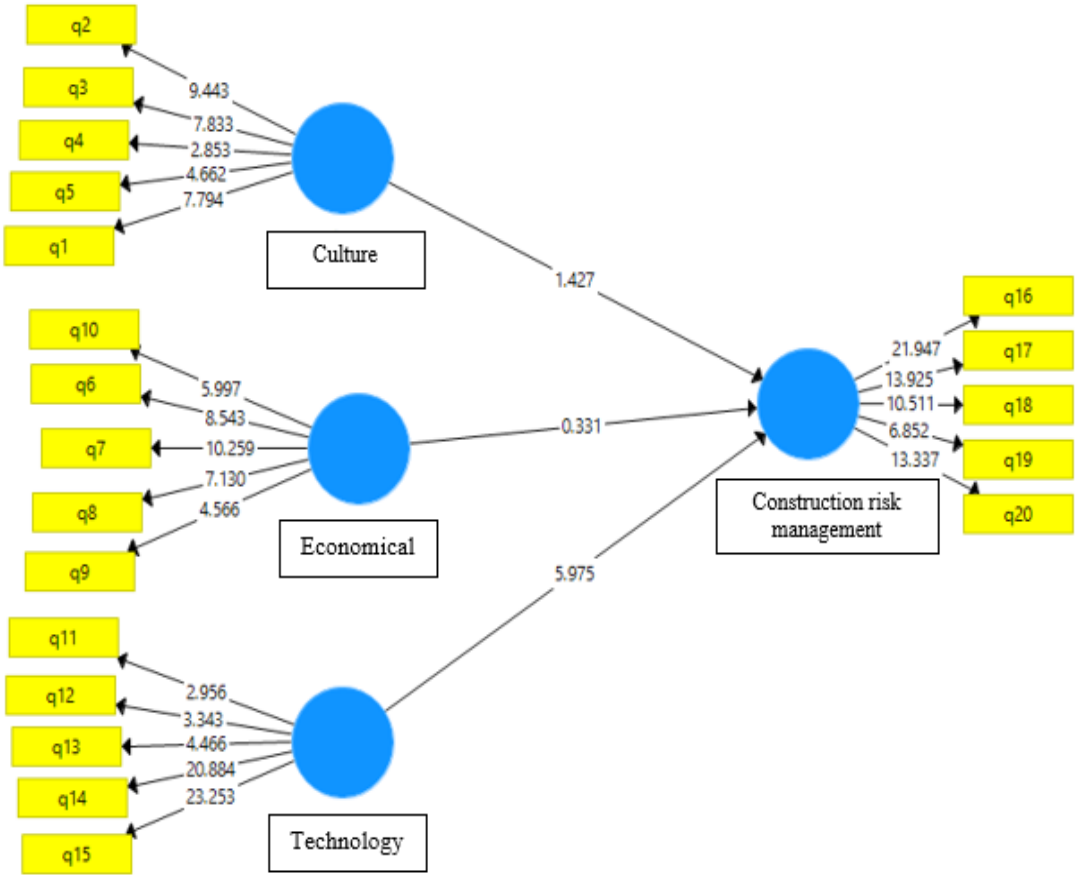

Figure 3 *Analysis diagram of partial least squares method in the case of T coefficients*

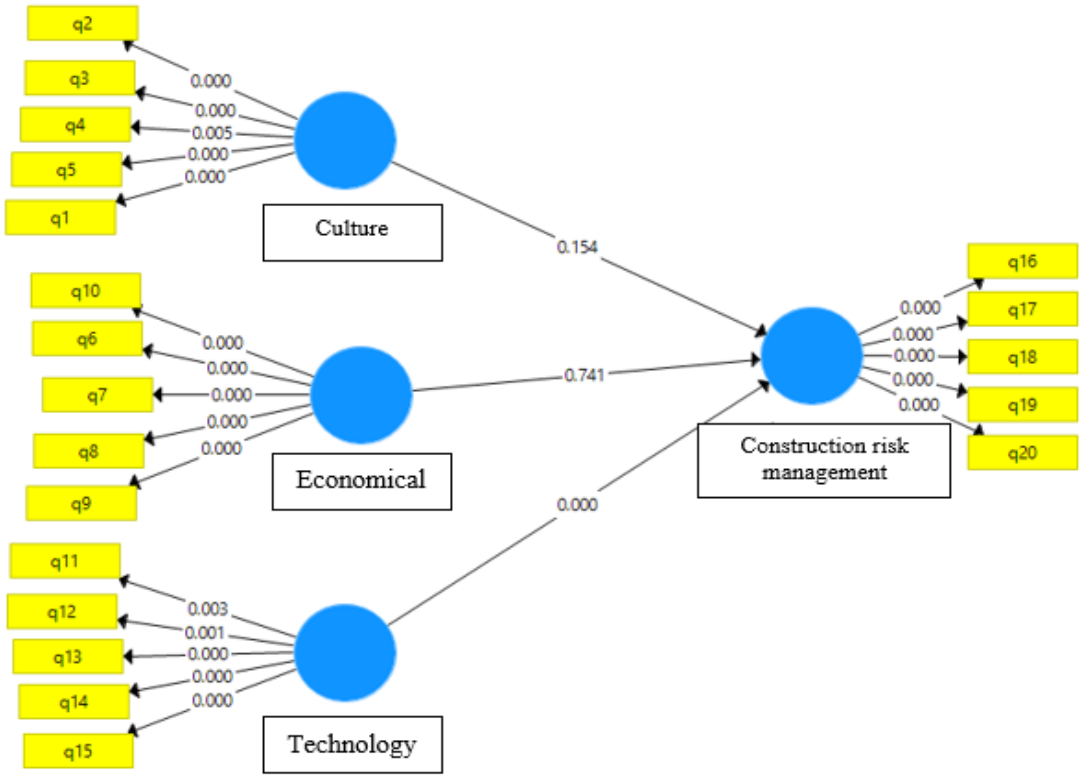

Figure 4 *Analysis chart of the partial least squares method in the case of significant coefficients (P-Value)*

According to the results obtained from the t statistic, the hypotheses are answered as follows: (if the significance level of each hypothesis is lower than 0.05 or the t statistic is in the range greater than 1.96 or smaller than -1.96, it indicates the confirmation of that hypothesis has a standard error of 5%).

Table 6 *The results of the T statistic*

Hypothesis	Impact	*T-Value*	Condition
Cultural factors have an impact on construction risk management.	0/145	1/427	Rejected
Economic factors affect construction risk management.	0/027	0/331	Rejected
Technology factors affect construction risk management.	0/591	5/975	Accept

The results indicate the rejection of the first and second hypotheses and the confirmation of the third hypothesis.

6. CONCLUSIONS

The current research was conducted with the topic of investigating the effect of cultural, economic and technological factors on the risk management of construction companies in Iran. The statistical population of the present study consisted of senior managers and engineers of Grade 1 construction companies in Iran, and 120 of them were selected as a sample through available sampling, and a researcher-made questionnaire was distributed among them and they were asked Give a score to each item according to its importance from one (least) to five (most). The partial least squares technique was used with the help of SmartPLS software to analyze the data and the following results were obtained for each of the research questions:

- **Do cultural factors influence construction risk management?**

The obtained results showed that cultural factors do not affect risk management; The results obtained are inconsistent with the research findings of Adele et al. (2018). In their research, they showed that cultural factors have an effect on construction risk management. Perhaps regarding the inconsistency of this hypothesis with the research of Adele et al. (2018), it can be said that the results obtained are different due to the different members of the society.

- **Do economic factors affect construction risk management?**

The obtained results showed that economic factors do not affect risk management; The results obtained are inconsistent with the research findings of Adele et al. (2018). In their research, they showed that economic factors have an effect on construction risk management. One of the reasons for the inconsistency of these two hypotheses with the findings of the study by Adele et al. (2018) could be the economic conditions governing the two statistical populations under study, and because the results are dependent on the statistical population of the same study; For this reason, it can be said that the rejection of this hypothesis in this research and its confirmation in the evidence research (2018) is not a proof of the invalidity of the work or any such issues.

- **Do technological factors influence construction risk management?**

The obtained results showed that technological factors do not affect risk management; The results obtained are in line with the research findings of Adele et al. (2018). Regarding the explanation of this hypothesis, it can be said that according to the results of these findings, technological factors are one of the factors that affect the risks of the construction industry. In today's world, there are various titles and parameters in management, which management requires proper recognition and understanding and special knowledge. Paying attention to each of these titles and determining the similarities and differences between each of them requires enough time, but What is more

important than all management titles today, as the main factor in determining plans and decisions in high-process environments, is the application and use of risk management techniques and technology-based systems to the same extent. Technology has increasingly affected how organizations, bodies, public and private companies function and the role of technology-based systems in the efficient performance of administrative and commercial affairs is undeniable. Diversity and scope Activities make it impossible to deal with all matters, so classifying matters and prioritizing some important matters over others are not very important. It becomes necessary. Today, the use of technology in risk management is very important and has a deep impact on how to organize the automation activities of organizations and manage the cycle of creating mechanized systems.

Practical suggestions regarding the confirmation of the hypothesis that technological factors have an effect on construction risk management. The researchers suggest the following:

In order to reach a balance in construction costs, transparency must be created in this market to minimize construction risks.

Taking advantage of the expertise, taste and art of engineers and using the latest methods in the world, and of course equipping a modern workshop.

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