# Investigatins the impact of using PMIS in resource management on cost of projects as a conceptual model in construction projects

# Investiga el impacto del uso de PMIS en la gestión de recursos en el costo de proyectos como modelo conceptual en proyectos de construcción

Seyed Karim Mosavi[1], Azim Hosseini[1*], Hamid Reza Vosoughifar[1], Rambood Barandoust[2], Ghodratollah Mohammadi[3]

[1] Department of Civil Engineering, South Tehran Branch, Islamic Azad University, Tehran, Iran.
[2] Department of Industrial Management, Imam Khomeini Memorial Branch, Shahreri, Islamic Azad University, Tehran, Iran.
[3] Department of Mining Engineering, South Tehran Branch, Islamic Azad University, Tehran, Iran.

*Corresponding author E-mail: Azim_hosseini@azad.ac.ir

## ABSTRACT

The Project Management Information System (PMIS) is a powerful tool in project management discussions due to its many benefits. Improper deployment of a PMIS and disregard for its qualitative factors influencing project success will never lead to the achievement of project goals. The purpose of this study was to investigate the impact of using PMIS on the cost management of construction projects that have used this information system. In this study, the impact of PMIS quality factors such as project quality, level of implementation technology, level of design skills, teamwork coefficient and execution time on project cost management was evaluated. The statistical population is the questionnaire of projects implemented through PMIS in construction projects, based on which 100 questionnaires were distributed among the projects and then collected. In this study, structural equation modeling has been used to investigate the research hypotheses. In this regard, "SPSS" software was used. The results of this study indicate that system quality, information quality and service quality have a positive effect on project success in terms of cost management.

**Keywords:** PMIS, Cost management, Construction projects, Conceptual model

## RESUMEN

El sistema de información de gestión de proyectos (PMIS) es una herramienta poderosa en las discusiones de gestión de proyectos debido a sus muchos beneficios. La implementación incorrecta de un PMIS y ignorar por sus factores cualitativos que influyen en el éxito del proyecto nunca llevará al logro de los objetivos del proyecto. El propósito de este estudio fue investigar el impacto del uso de PMIS en la gestión de costos de proyectos de construcción que han utilizado este sistema de información. En este estudio, se evaluó el impacto de los factores de calidad de PMIS, como la calidad del proyecto, el nivel de tecnología de implementación, el nivel de habilidades de diseño, el coeficiente de trabajo en equipo y el tiempo de

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ejecución en la gestión de costos del proyecto. La población estadística es el cuestionario de proyectos implementados a través de PMIS en proyectos de construcción, basados en los cuales se distribuyeron 100 cuestionarios entre los proyectos y luego se recogieron. En este estudio, el modelado de ecuaciones estructurales se ha utilizado para investigar las hipótesis de investigación. En este sentido, se utilizó el software "SPSS". Los resultados de este estudio indican que la calidad del sistema, la calidad de la información y la calidad del servicio tienen un efecto positivo en el éxito del proyecto en términos de gestión de costos.

**Palabras clave:** PMIS, gestión de costos, proyectos de construcción, modelo conceptual

# 1. INTRODUCTION

In today's complex and modern world, the role of management information systems and its undeniable impact on societies and organizations is evident. Information plays an important role as the main source of power and dominance over others. one of the most basic and vital applications of information can be seen in the field of management. Using correct, accurate and timely information in decisions, planning and other management issues can be very effective in the type of fate of the organization. In the present age, the expansion and complexity of specialized organizations have made the traditional management systems inefficient. Today's new and efficient tools are nothing but management information systems.

Project management information systems are a set of techniques and tools used in project management that are designed and implemented with the aim of collecting and organizing information in a project. Project managers use these tools and techniques to collect uniformity and distribute information electronically. (Salimi,2014).

So far, various methods have been proposed for classifying information systems. In general, two methods of classification based on organizational levels and also classification based on organizational activity have been considered more than other methods. In the following, these classifications are presented according to the point of view (Sardari, & Asadi,2018).

Project management information systems help plan, schedule, and budget and execute project management and, if properly designed, it can become a very useful and practical tool in the hands of project managers. According to one study, 75% of large IT projects managed under PMIS support were successful, while 75% of projects that did not use the system were unsuccessful (Bagherinia, & Hamzehpour,2016). Information systems that are avialable for organizations and their hierarchical occupations can be classified in two main ways. Systems that available in organizational levels and are managed periodically, then a comprehensive system deals with these levels. 2) The activity of systems in dealing with fundamental interactions. In a study in 2014, the impact of project management information system on the success of construction projects and production of a case study of Mapna Boiler companies has been studied.

Today, the use of PMIS project management information system is one of the most important and effective factors in the timely implementation and success of construction projects. It helps project managers and executives to properly guide and execute projects on time yy creating the right flow of information. In most of the proposed models to measure the impact of IS information system on the success of work in the organization, the factors affecting the use and user satisfaction are considered, while manufacturing projects due to its process and complex nature, which consists of several different activities that require other important factors such as reporting, identifying critical activities and their impact on information quality and project management quality to assess the impact of information flow in the project. Accordingly, the purpose of this paper is to provide a model to examine the impact of project management information system on the success of construction projects.

For this purpose, after examining different PMIS models and identifying important and influential factors in effective and efficient project management, a conceptual research model is presented and its relationships are examined using structural equation modeling method performed by Lisrel software. The results of research on three large project-oriented companies in Iran indicate that the project management information system, considering the factors of cost reporting, updating, identifying critical activities and resource constraints, providing comprehensible and graphical data after the impact on information quality and quality of project management affects ultimately the success of construction projects (Kalhor, & Javanmard,2015).

In a study conducted in 2017, the use of project management information system in project-oriented organizations and its impact on the coherence and unity of procedures over time and the growth of a comprehensive culture of project management have been studied. According to the results of the hypothesis test, PMIS is useful and effective in preparing useful information for managerial decision making, creating an integrated information system for the project and creating coherence between different parts in order to strengthen the management arm of the whole collection. Also, the results of the hypothesis test, PMIS, are useful and effective in raising the level of project information security, appropriate and timely support of the staff of the project organization, and creating confidence in the employer regarding the health of the project progress process (Ansari, & Ahmadi, 2017).

Therefore, according to the above, the advancement of technology and the advent of new management tools, conducting this research and identifying the factors involved in designing an efficient project management information system causes the necessity for the issue to become more apparent.

## 2. MATERIALS AND METHODS

Any theory and theoretical foundation, no matter how reliable and well-explained, can not be considered completely reliable and proven without implementation and practical testing.

Due to the diverse nature and changing conditions governing the various parameters in them, executive and cinstruction projects have a different structure and procedure from the current daily work of organizations. According to this issue, project management is always more difficult than the administrative and normal affairs of the organization and requires more attention to different and variable dimensions of work.

Project planning is the determination of a time sequence in the form of scheduling to perform interrelated activities that lead to the completion of the project. The sequential dependence of the activities is in fact the stages of the project, the priority and delay of which must be observed due to technical limitations in the implementation of the project. Constraints are an integral part of the project, but to be more consistent with the real world of projects, resource constraints, which have attracted the attention of many researchers in the preparation of scheduling, need to be considered and extensive research to be conducted in this field.

In addition to financial and time constraints, project excutives also face physical resource constraints; Physical resources are mainly meant manpower and machinery. The physical needs of a construction project company also change with time and during the construction process. Therefore, companies usually provide a limited number of each of the physical resources and plan the implementation of projects accordingly. Large companies, in order to avoid problems caused by the modification or absorption of physical resources consecutively, usually plan several simultaneous projects in such a way that the company's manpower and machinery are not unused and are engaged in different projects consecutively.

The purpose of scheduling is to complete the project in the shortest time and with the least cost, in addition to satisfying the constraints related to resource constraints, and to minimize fluctuations in the use of resources during the period of executing the project. To optimize time-cost and executive resources in

construction projects, different methods including mathematics and meta-innovation are used in two areas of time-cost balance analysis and leveling-allocating resources.

In a project with a fixed schedule and predetermined stages, a wide variety of issues and problems lead to change in planning, increasing costs and delay. Delay means any lag behind this schedule, which of course delays are due to several factors and can be divided according to those factors. Delay can also be classified according to its consequences. For example, there are delays and critical problems that eventually lead to time delays in the delivery of the entire project, and the rest of the delays and problems are classified as non-critical. Critical delays usually occur in relation with critical and core project activities, also known as work control items. All projects have critical activities and the sequence of these activities is known as the critical path. Large contractors often cite uncertain completion times in the contract to avoid pitfalls and legal deficiencies, or set a project schedule in the most pessimistic way possible, which is known as the most critical path method.

Management, in order to perform its main task, which is to make decisions in such situations, needs accurate, fast, up-to-date and efficient information in order to be able to make its decisions based on credible support. The task of Project Management Information Systems (PMIS) is to collect and process and refine raw project data and generate the basic and analyzed information required by management in all the various input parameters to the project. From this information, organizational knowledge is created over time and over several projects.

In this paper, the purpose is to investigate the impact of using PMIS in resource management on the cost of projects as a conceptual model (Figure 1).
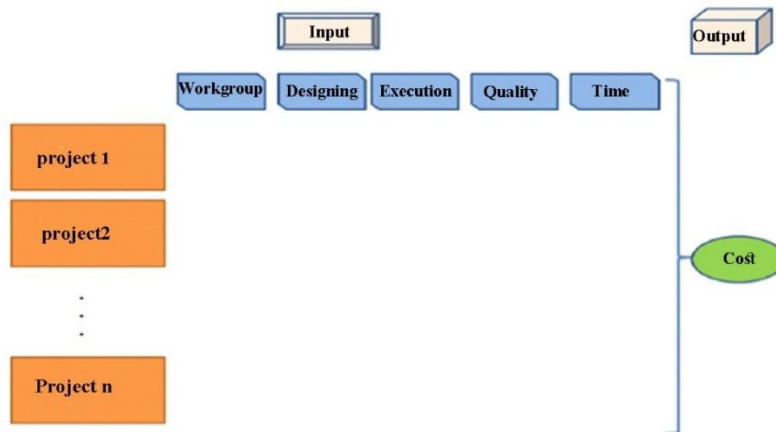
Figure 1. Conceptual model

As it was mentioned in this study, a number of questionnaires have been distributed as Table 1 among contractors and construction project managers in which the project manager according to his experience to the required parameters of the project, i.e, the desired quality level, technology level , the level of design skills and teamwork coefficient gives a score between 1-10 and announces the duration of implementation in terms of months and the amount of cost savings (due to the use of PMIS) in terms of percentage and as an estimate.

Table 1. Structure of questionnaire form

| Percentage of cost savings due to PMIS | Teamwork coefficient (human resources) | Design skills level | Implemented technology level | Quality level of the project | Project implementation time (in months) | Line |
|---|---|---|---|---|---|---|
| 0-100% | 1-10 | 1-10 | 1-10 | 1-10 | 1-120 | 1 |
| | | | | | | . |
| | | | | | | . |
| | | | | | | . |
| | | | | | | . |
| | | | | | | 100 |

But before using the collected data, this data must be validated. Validation for a statistical data set means examining the coverage of all different scenarios as well as the independence of independent input variables from each other, which has its own mathematical methods.

First, a questionnaire is distributed among a number of professors to verify its accuracy, and after collecting data, standard methods such as Gronbach's alpha reliability test and chi-square test are used to check validity and coverage and the analysis of collected data.

The Cronbach's alpha test or reliability of questionnaire is a statistical test that results in a coefficient. It is used to test the reliability of a designed questionnaire that does not have a correct or incorrect answer. Cronbach was a researcher who, based on the Kuder-Richardson method, proposed a formula for estimating the validity of such questionnaires, known as the Cronbach's alpha method, which is used to measure the one-dimensionality of attitudes, judgments, and other categories that are not easy to measure. The value of this coefficient is obtained from Equation (1):

$$\alpha = \frac{K}{K-1}\left(1 - \frac{\sum_{i=1}^{K}\sigma_i^2}{\sigma^2}\right)$$

(1)

In the above equatiuon, the coefficient K is the number of questions and $\sigma i$ is the variance of each question and $\sigma$ is the total variance of the questionnaire.

The higher value of this coefficient indicates a greater correlation between the questions of the questionnaire and the reasonableness of the questions, because the variance of the answers was less and obviously the interviewees had the same opinion about the questions. In the present study, i also represent the question counter and K is equal to 100.

The variance itself is a data scatter test that measures the square of the distance between the numerical values of the data and the average value of the data. If the variable Xi represents the N number of data according to Equation (2), there will be the following assumption:

$$\sigma^2 = \frac{1}{N}\sum_{i=1}^{N}(x_i - \overline{x})^2$$

(2)

The variable $X^{-}$ represents the average value of the values obtained by the variable X and it is shown in Equation (3):

$$\bar{x} = \frac{1}{N} \sum_{i=1}^{N} x_i = \frac{x_1 + x_2 + \cdots + x_N}{N}$$

(3)

The second criterion for validating the questionnaires is Chi-square test or Chi-square test, which is a statistical data test designed to measure the independence and non-correlation between statistical variables. Certainly, in designing a questionnaire to avoid deviating from the results and reproducing the questions, they should contain independent concepts and there should be no meaningful connection and repetition between them.

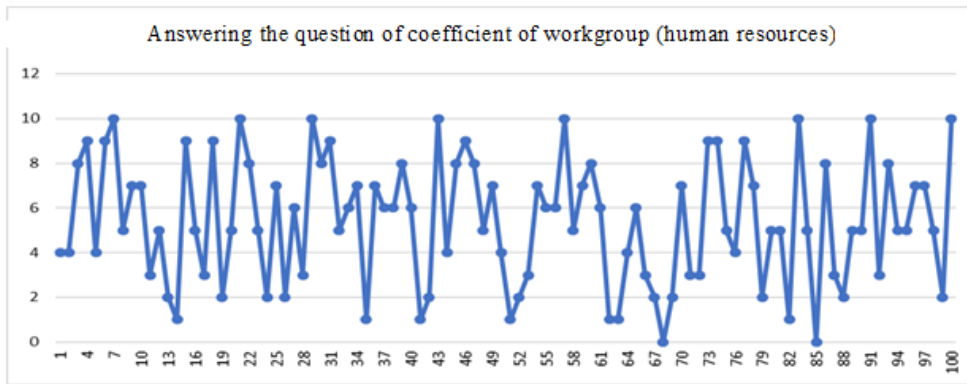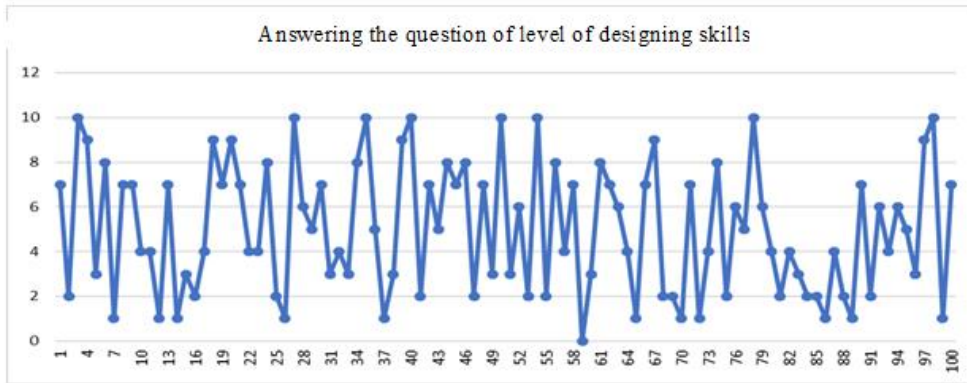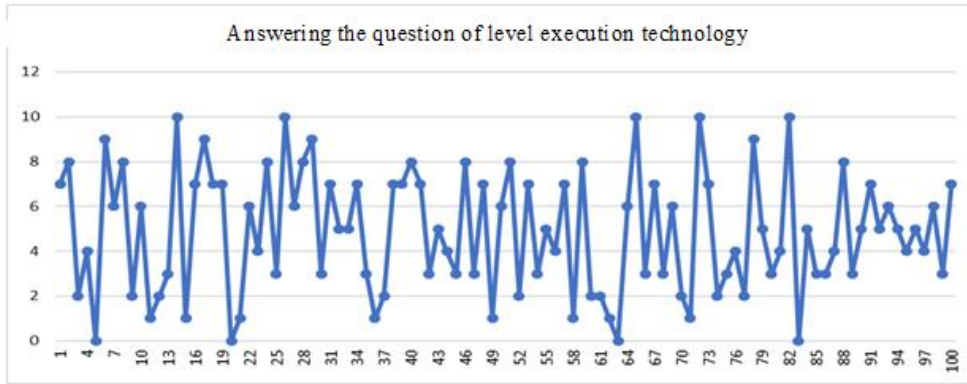$$Ch^2 = \sum_{t=1}^{m} \frac{(O_t - E_t)^2}{E_t}$$

(4)

In equation (4), t is the repetition counter of the questionnaire distribution and m is the total number of people asked and O is the frequency (or variance) of the answers to each question and E is the frequency expected for that question. The expected frequency of all classes should be zero, and there is no need for the data to be normal. In this article, if 100 questionnaires are distributed, each question is repeated 100 times and m = 100.

In statistical science, the frequency of a variable is called the repetition of observing different values in the data of that variable. The absolute frequency of a data is the number of times that data is repeated. The absolute frequency of xi data is shown by fi. If the data are categorized, the absolute frequency of the i-th category will be equal to the number of members of this group, and if the i-th group has an absolute frequency of fi obtained by n data, the relative frequency of this category is defined as fi /n. In other words, in the case of this article, the frequency of each variable is equal to the average values read for that variable (that question) and E is the value of the average score predicted for that question. During m times repeatition of that question and output the formula shows the distance between the received answers and the expected values and finally the variance of the outputs of this relationship for each question during all 6 questions, the greater the amount indicates the conceptual independence of the questions.

## 3. RESULTS AND DISCUSSION

After distributing the questionnaires and obtaining answers from the questioners, the answers to each question are in the form of diagrams (Figure 2).

## Answering the question of level execution technology



## Answering the question of level of designing skills



## Answering the question of coefficient of workgroup (human resources)



## Answering the question of percentage of cost savings caused by PMIS
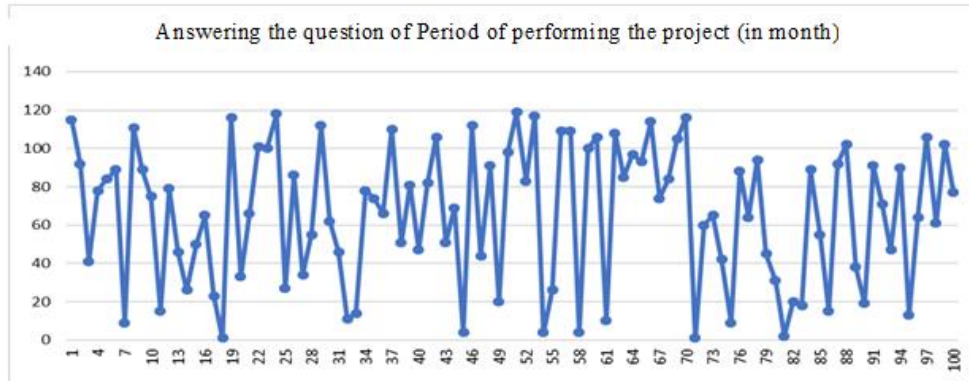


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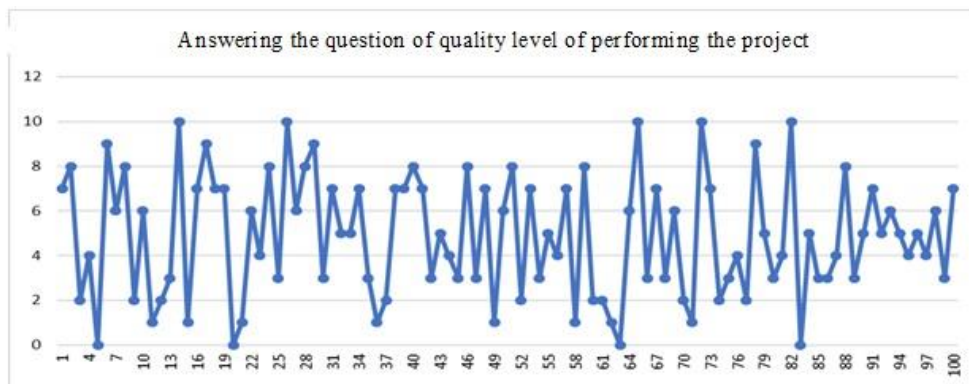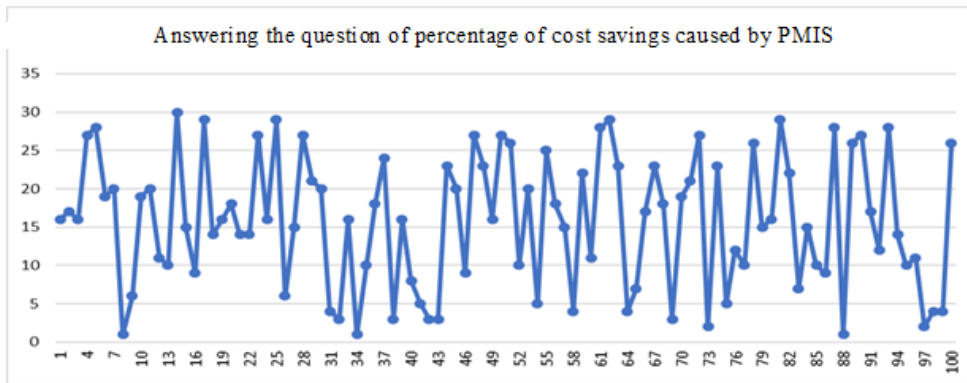
Figure 2. Graphs related to the answer to each question in the questionnaire

As it can be seen, in response to the project quality level, implementation technology level, design skills level and teamwork coefficient, most of the answers are average and equal to 5. This indicates that the above level is average. At the response level, the duration of the project, like at other levels, was 65 months on average. In response to the percentage of cost savings caused by PMIS, the average response is approximately 16%, indicating that there is no cost savings.

After sorting and obtaining the answers, it is time to analyze the collected data, which in SPSS software, after entering 100 answers for each of the 6 questions, it can be easily counted and observed Cronbach's alpha coefficient values through the menu in Figure 3.
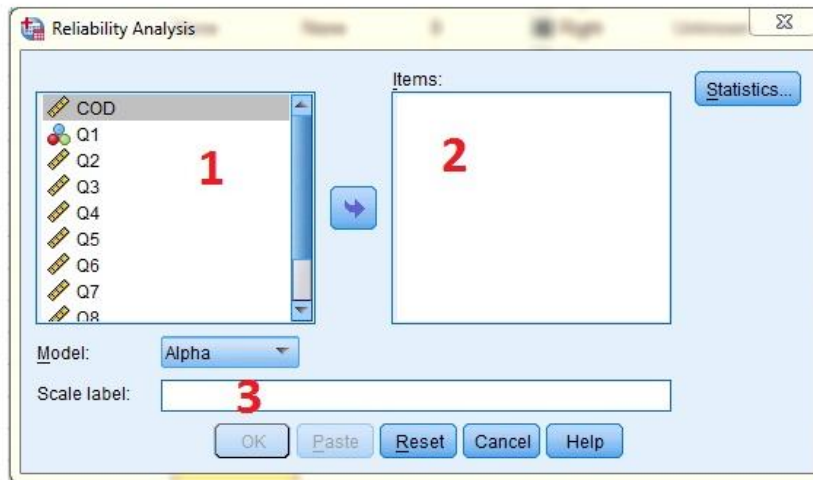


Figure 3. The first menu indicating the number of questionnaires, the second menu indicating the number of questions per questionnaire and the third menu indicating the value of the alpha coefficient.

SPSS software calculates the Cronbach's alpha coefficient for each questionnaire separately. The Chi-Square standard calculation is also available from this menu as shown in Figure 4.

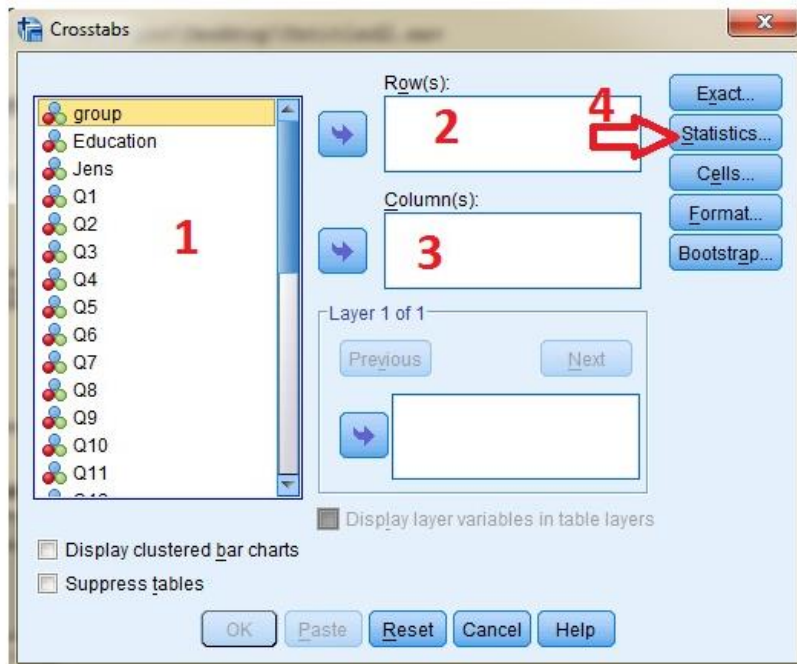Analyze ────→ Descriptive Statistics ────→ Crosstabs



Figure 4. How to calculate the chi-square coefficient for each questionnaire

After entering the data into SPSS software and calculating the above coefficients, it was discovered that the Cronbach's alpha coefficient for all data is about 0.5 and the chi-square coefficient is higher than 0.6. This indicates the desirable quality of the questionnaire and the answers are in the appropriate range.

## 4. CONCLUSION

In this research, a Project Management Information System (PMIS) has been used to improve the management of construction project costs. For the high impact of this system, all factors including the quality of the project, the level of implementation technology, the level of design skills, teamwork coefficient and execution time on project cost management projects have been evaluated. After preparing a questionnaire for the influential factors, the process of reviewing the models was done with "SPSS" software. Finally, it is shown that the percentage of cost savings due to PMIS is below 20%, which is necessary to create a PMIS information system in construction projects .

## Acknowledge

## REFERENCES

Ansari, M,. & Ahmadi S. (2017). The use of project management information system in project-based organizations and its impact on the coherence and unity of procedures over time and the growth of a comprehensive project management culture, *11th International Conference on Strategic Management, Tehran , Iranian Strategic Management Association.* [In Persian]

Bagherinia, K., & Hamzehpour, R. (2016). Study of Management and Project Performance, caused by the Establishment of Project Management Information System (Case Study: Ahwaz Urban Train Line Project), *12th International Project Management Conference, Tehran, Research-Industrial Group of Ariana.* [In Persian]

Kalhor, A., & Javanmard, H. (2015). Investigating Effects of Project Management Information Systems on Success of Manufacturing and Production Projects: Case Study of Mapna Boiler Co. *Indian Journal of Fundamental and Applied Life Sciences ISSN*, 2231-6345.

Salimi, B. (2014). Application of Project Information Management Systems (PMIS) in Matrix Organizational Structure to Create a Knowledge-Based Organization, *International Conference on Management in the 21st Century, Tehran, Institute of Modiran-e- Ide Pardaz in Vira Capital.* [In Persian]

Sardari, M., & Asadi, M. H. (2018). Artificial Intelligence in Construction Management, *National Conference on Civil Engineering and Architecture in 21st Century Urban Management*, Karaj, Permanent Secretariat of the Conference.[In Persian]