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Investigating the Impact of Control Mechanisms on the Performance of the Eleventh Campus Landscaping Project with the Role of Risk Management Complexity Moderator

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Abstract

This research aims to investigate the impact of control mechanisms on project performance with the role of moderating the complexity of risk management. Considering that the size of the statistical population in this research is 240 people, and according to Cochran's formula, the required sample size is 147 people. A standard questionnaire was used to collect data for this research. Questionnaires were distributed and collected using the available random method. In order to analyze the data, a structural equation test with partial least squares was used with the help of SMART-PLS software. The 95% confidence level test results showed that control mechanisms with the role of risk management moderators affect project performance. Controlling results has a positive effect on project performance. Behavior control has a positive effect on campus project performance. Self-control has a positive impact on project performance. Tribal control has a positive effect on project performance. Risk management moderates the relationship between control outcomes and project performance. Risk management moderates the relationship between behavioral control and campus project performance. Risk management moderates the relationship between tribal control and project performance. Risk management moderates the relationship between self-control and project performance. Project managers should direct the project to achieve better performance by applying risk management and control mechanisms.

Keywords: Control mechanisms, Project performance, Complexity of risk management, Control behaviors.

1 | Introduction

Construction management refers to providing professional management services to the owner of a project, either private or public, to achieve high quality at a minimum cost. Such services may include only a specific part of the construction program, such as the construction of a square, yard, or city, or may include

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responsibility for the entire project. This approach considers project planning, control, design, and construction as integrated tasks in a construction system [1], [2]. Where construction management is used, a team of owners, construction managers, architects, and contractors is created. The project participants, working together from the beginning to the completion of the project, try to provide the owner's best interests in the best way [3].

By balancing construction cost, project quality, and completion schedule, the management team strives to produce a project of maximum value in the most cost-effective time frame for the owner [4], [5]. Construction project managers typically measure project progress by implementing a series of controls over the schedules and budgets allocated to the project. The most up-to-date approach is to control various variables such as individual team performance, task completion during the project life cycle, and the team's competence [6].

In fact, project control objectives play an essential role in these frameworks that increase the chances of project success. Control mechanisms are used to support compliance with legal issues such as regulatory requirements, environmental and safety requirements, and others. Most of the time, the work of project managers is mainly focused on the planning and design stages of projects. In order to transfer a successful project, the project must be strictly managed, and the existing risks are either eliminated or minimized so that the project can maintain its goals in the implementation stage and project control mechanisms achieve the successful performance of the project [7], [8].

2 | Control Mechanisms

The implementation of quality control of construction projects relies on quality assurance procedures. Therefore, quality control is similar to quality assurance. Quality control in construction projects is carried out at each stage using various control charts, diagrams, and checklists[9].

Quality control in construction projects is defined as follows:

- *Inspection of execution works to confirm that works are performed/performed according to specified procedures and materials using approved methods, references, codes, and specified standards to meet the intended application.*

The basis of control mechanisms in construction projects is defined as follows:

- *Budget control, planning, monitoring, and project schedule control.*

Control in construction projects monitors the results of specific projects to determine whether they meet the relevant quality standards, eliminate the causes of adverse project performance, and control materials' physical and mechanical properties. This structural component is used to meet quality requirements [10].

Quality control includes the following steps:

I. Choose the subject of the control, that is, choose what we want to adjust.
II. Creating measurements and standards.
III. Determination of performance, product, and process goals.
IV. Measuring actual performance.
V. Comparison of actual measured performance with standards.
VI. Action on differences.

Some different methods and techniques can be used for quality control and process improvement. The most useful quality control methods are the fishbone, process analysis, and systematic methods. These methods can be used in different stages of a construction project to analyze the causes of rejection and take necessary preventive measures, develop a system for preparing and processing drawings and design documents, execution and installation, processing drawings and data tabulation. It is used in checklist format, preparation of construction schedule requirements, and many other applications.

There are many ways to improve the quality process. The presence of qualified workers on site and the use of appropriate standard materials and equipment contribute to the quality of the project. In addition, managers will be able to control the quality of the project by inspecting and protecting the work done.

According to researchers, there are two control mechanisms: Formal and social. Formal control focuses on using specific rules and procedures, while social control emphasizes mutual interests and norms. By using an explicit contract to specify the responsibilities and obligations of each party, formal control can reduce opportunism and protect inter-organizational relationships. Recent research suggests that formal control can facilitate a project's ability to leverage resources and enhance performance. When foreign firms cooperate with another firm, they tend to emphasize the role of formal control.

Meanwhile, as with any type of alliance, there is usually a "Social aspect" to coordination between companies. Here, the formal control mechanism comes into play, which is characterized by certain features such as relying on informal structures and self-implementation by each party. Difference in focus Compared to formal control, social control is where a group shares values, beliefs, and goals to reinforce and reward appropriate behaviors.

3|The Importance of Project Performance

Today, performance processes are the key to the success of any project. A strong project performance process management approach is of great importance in construction companies. Companies have learned from experience that business performance process management is a strong investment in the face of rapid environmental change. Business performance process management, by having multiple models required by companies, provides an integrated and systematic method for designing, implementing, and managing the business process of companies to perform all project processes automatically.

Performance involves using different forms of learning, including learning by doing and traditional learning; both are based on market-based learning mechanisms and improve business performance and marketing capabilities in companies. It also uses the insights and experiences gained to provide customers value in a competitive environment.

Organizational performance can be examined based on the following different perspectives:

I. Company performance from the customer market perspective.

II. Company performance from the perspective of factor markets.

The life cycle of a project during planning operations

This cycle includes four theoretical or initial stages: Planning, execution, and control, as well as the final or conclusion phase.

In the initial stage of operation, feasibility and economic studies and estimates of time, cost, and resources are carried out, and the initial analysis and initial risk of the project are defined according to time, cost, performance, and the required resources. More complete specifications are prepared in the planning stage, detailed initial planning is carried out, and executive planning is ready according to policies, methods, and task descriptions. The project is implemented according to forecasts in the implementation stage, which includes implementing the plan and its control. The necessary materials and resources (Machinery, human resources, and consumables) are prepared, and resources are organized and allocated. , and the required contracts are concluded and implemented.

Progress, quality of implementation, and implementation errors are controlled during implementation. One of the notable points in controlling documentation during implementation is to create the possibility of very good use in the final stages of control. Finally, in the final stage, project delivery, final reports, and project evaluation are carried out, and the final summary of the project's final profit or loss is analyzed and reviewed. *Fig. 1* show schematic of the project planning and control system.

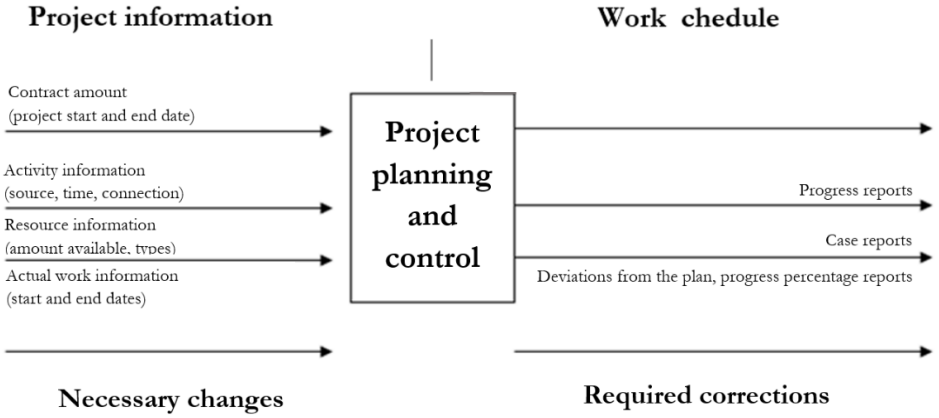

Fig. 1. Schematic of the project planning and control system.

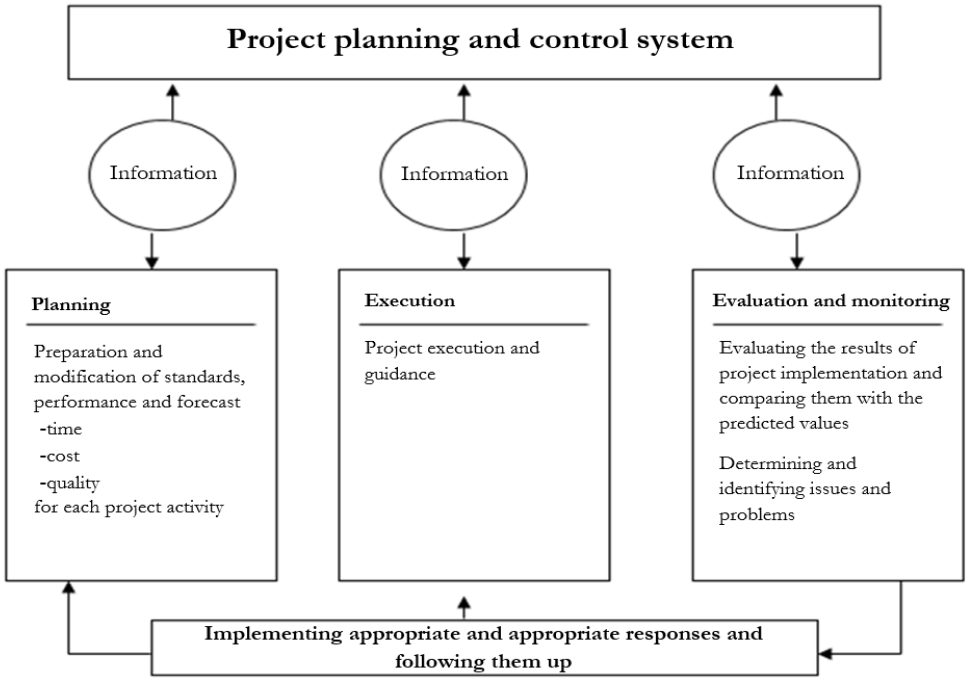

Fig. 2. How the project planning and control system works in different stages of its implementation.

4 | Phases of the Project

Planning can be the most time-consuming phase of a project, but in any case, the time spent on it will be the most productive. The person who completes the project planning phase is sure that the project work and its management will be easily possible.

The main steps of this project will be as follows:

I. Determining goals.

- *The goals that move the project are drawn by the top management, i.e., the employer.*
- *Project start and end time, budget.*
- *Intermediate goals. Important events that should happen during the project.*
- *Allocation of employees or responsible departments needed to achieve project goals. This section includes groups whose participation is essential in completing the project.*

II. Preparing the plan.

- *We prepare a WBS.*
- *We differentiate and highlight tasks by determining their relationships.*
- *We specify the prerequisites of the work and what should be done before or after the other work.*
- *We determine the activities that can be done at the same time.*

III. We measure the time each activity takes.

IV. We determine the costs and resources related to each activity.

V. We implement the obtained information in PRIMAVERA software and perform our analysis on reports and charts.

5 | Research Variables

A variable can be defined as a characteristic, attribute, or factor common among individuals in the population under study, which can have different and quantitative values. This number or value attributed to the variable indicates a change from one individual or state to another. Scale scales for measuring variables include nominal, ordinal, interval, and ratio scales. The first scale for measuring variables is the nominal scale.

In this scale, individuals or objects are placed in classes based on a specific qualitative rather than quantitative criterion. The numbers in this scale are arbitrary and used solely for naming and convenience; no meaning can be inferred from them. The numbers used in the nominal scale do not indicate the absolute or relative value of the characteristic. They are only used to determine the members of each class.

The ranking scale has all the features of the nominal scale. In this scale, the relative status of objects or individuals is determined based on a specific characteristic without determining the distance between them. The basic condition for measurement in this scale is to observe the criteria for ranking objects or individuals, which means that a method must be used to determine whether the person or object being measured has a greater, lesser, or equal value. The distance scale has all the characteristics of nominal and ordinal scales. In addition, the distance of each attribute to its origin is also specified in this scale.

This scale specifies the order of the objects or attributes to be measured and the distance between the measurement units. Equal distance between numbers indicates equal distance between the measured characteristics. The relative scale has all the characteristics of distance, ordinal, and nominal scales. This scale is the highest level of measurement, and there is a true zero for it. This scale can use a ratio to compare two values or two units.

All variables in this study are qualitative, and the measurement scale of these variables is interval. As presented in the conceptual model, the independent control mechanism variable and the project performance variable are the dependent variables, and the project performance is the moderating variable. The independent variable is the variable through which the dependent variable is predicted; in other words, the independent variable affects the dependent variable positively or negatively. The dependent variable is the variable that is affected by the independent variable. As a result (See *Table 2*), the change changes the independent variable, and the research aims to describe and predict that change.

Table 1. Characteristics of research variables.

Variable	Variable Type	Measuring Scale	Measuring Spectrum
Control mechanisms	Qualitative	Distance	Likert scale
Risk management complexity	Qualitative	Distance	Likert scale
Project performance	Qualitative	Distance	Likert scale

5.1 | Questionnaire and Method of Implementation

A questionnaire is a set of questions that the respondent gives the necessary answers to. This answer constitutes the data required for the research. Answering a standard question may require selecting an option from a set of predetermined answers. The main advantage of this type of question is that it is easy to extract and analyze data quickly. This questionnaire consists of 34 questions. In this questionnaire, all questions are closed to facilitate and accelerate the collection of information, and the Likert scale (Ordinal scale) is used to grade the answers.

Table 2. Scoring of questions on the Likert scale.

Optional	I completely agree.	I agree.	To some extent	I disagree.	I completely disagree.
Prize	5	4	3	2	1

5.2 | Reliability Measurement

To measure reliability, a preliminary sample of 30 respondents was distributed in the pre-test, and then, using the obtained data, the reliability coefficient was calculated using Cronbach's alpha coefficient test using SPSS 24 software, and the alpha coefficient values obtained in the pre-test are more than 70 percent. Therefore, the scale used is valid. *Table 3* shows the Cronbach's alpha coefficient of the variables.

Table 3. Cronbach's alpha coefficient of the questionnaire.

Variable	Cronbach's Alpha
Control mechanisms	0.95
Project performance	0.80
Risk management complexity	0.88

5.3 | Data Analysis Methods

Research questions in organizational research rarely involve just two variables. The researcher is almost always faced with a multitude of potentially important variables to explain, predict, or better understand organizational phenomena. In this regard, having a good theory to guide the interpretation stage of the research is essential. Multivariate analysis methods are a key tool for organizational researchers because they have the ability to combine multiple variables and help understand complex organizational behaviors and phenomena. The present study performs data analysis at three levels: Univariate, bivariate, and multivariate. The research variables are examined separately at the univariate analysis level, and the relationships between the variables are not considered. Appropriate descriptive and inferential statistical methods are used at this level, and a picture of the studied population is obtained.

This section uses the inferential method to calculate central and dispersion indices and draw proportional charts, including descriptive statistical methods and testing the mean of a statistical population to test the significance of generalizing the means to the statistical population.

Pearson correlation coefficient was used in the analysis of two variables. The reason for examining the Pearson correlation is to use a multi-valued distance scale to measure variables. Unlike other correlation coefficients, discrete correlation shows the degree of correlation between two variables by eliminating the effects of other variables. In the present study, only Pearson correlation coefficient was calculated due to the absence of a control variable.

The correlation coefficient is insufficient to know the degree of change of the dependent variable when several independent variables simultaneously affect it. Therefore, the structural equation modeling method was used to examine the quantitative relationships of variables. The structural equation is a multivariate analysis and belongs to the multivariate regression family. More precisely, the development of a linear model allows for the simultaneous testing of a set of regression equations.

There are two approaches to estimating the parameters of a structural equation model, which include the covariance-based approach and the variance-based approach. Both approaches estimate the research model in the form of two components. The first component is a measurement model that estimates the relationships between observed and latent variables. The second component is a structural model specifying the underlying variables' assumed causal structure.

6 | Conclusion

In general conclusion, it can be said that project managers are responsible for ensuring the progress of their projects according to the proposed budget, schedule, and objectives. They can lead projects by applying control mechanisms (Results control, behavioral control, tribal control, and self-control) when dealing with the project team. Project control refers to the set of mechanisms that project team members use to motivate people to work in such a way as to achieve the desired goals. Project control is known to be very important for project management. Based on control and agency theories, two modes of formal outcome control and behavior control are available to managers to motivate and guide project team activities. In fact, the control of the result includes the definition of the specific outputs of the desired task. When using outcome control, a manager focuses on defining appropriate objectives that allow the project team to decide how to achieve those output objectives.

Therefore, outcome controls are used to evaluate performance based on the extent to which goals are achieved rather than on the processes used to achieve goals. In contrast, behavior control involves defining appropriate steps and procedures for the project team as they perform their tasks. Therefore, behavioral control is used to evaluate performance based on the extent to which the salesperson adheres to prescribed procedures. In contrast to outcome control, the basic assumption behind the application of control mechanisms is that following prescribed steps and procedures will lead to optimal project performance. Therefore, applying control behavior minimizes deviation from the prescribed process and, hence, should maximize the probability that the project will lead to the desired outcome.

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Author Contributions

Both authors have significantly contributed to this research:

Soodabeh Mehri: Originated the study, constructed the research framework, devised the methodology, and conducted the data analysis.

Hamzeh Asna Ashari: Gathered and processed data, assisted in writing the manuscript, and conducted the literature review.

Both authors participated actively in discussing the results, reviewing, and refining the manuscript. They have read and approved the final version of the paper and accept full responsibility for its content.

Data Availability

The data supporting this study's findings can be obtained upon request from the corresponding author. Certain datasets may not be publicly available due to privacy, ethical considerations, and institutional regulations. However, data can be provided under specific agreements for academic and research purposes.

Researchers and interested parties are invited to contact the corresponding author for further questions regarding data availability.

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Conflicts of Interest

The authors assert that no conflicts of interest are associated with this research. This article's findings, interpretations, and conclusions reflect solely the authors' views and do not necessarily represent those of the affiliated institutions or funding bodies.

Consent for Publication

The authors confirm consent for the publication of this work

Ethics Approval and Consent to Participate

No studies involving human participants or animals were performed in this research.

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