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The Impact of Rework on Construction Cost Performance

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الملخص العربى :

كانت صناعة البناء تنظر دوما إلى المشاريع الهندسية باعتبارها الوسيلة التي تستطيع بها البشرية أن تحقق طموحاتها المختلفة. وينظر إلى إنجازات المشاريع الهندسية باعتبارها الوسيلة التي تستطيع بها البشرية تحقيق إحتياجاتها المختلفة، وتميل صناعة البناء إلى مواجهة العديد من المعوقات، مثل عيوب النوعية، وفرط الميزانية، وضعف الإنتاجية، والمطالبات التي تستغرق وقتا طويلا. وغالبا ما تحول هذه المشاكل دون إتمام المشاريع بنجاح. ونظرا للتأثيرات المحتملة لإعادة العمل على نجاح المشروع، حث الأكاديميون السلطات على تحديد مختلف العوامل التي يمكن أن تؤثر على إعادة تنفيذه. وينبغي تحليل هذه العوامل وتحديدها بصورة شاملة بغية الحيلولة دون تعرض المشروع لمزيد من التأخير ولتجاوز التكاليف. وتهدف هذه الدراسة إلى تقديم تحليل شامل لمختلف العوامل التي يمكن أن تؤثر على نجاح إعادة تنفيذ المشروع من خلال تحديد العوامل الرئيسية التي يمكن أن تؤثر على نجاح المشروع والعوامل الفرعية المختلفة التي يمكن أن تسهم في نجاحه. كما يستكشف مختلف الاستراتيجيات الإدارية التي يمكن تنفيذها لمنع آثار إعادة العمل.

الكلمات المفتاحيه : إعادة العمل ، العوامل ، التضيق ، الأداء ، أفضل الممارسات.

Abstract :

The construction industry has always regarded engineering projects as the means by which humanity can achieve its various aspirations. the achievements of engineering projects have been regarded as the means by which humanity can achieve its various needs.The construction industry is prone to encountering various stumbling blocks, such as quality defects, over-budget, poor productivity, and time-consuming claims.Due to the potential effects of rework on the project's success, the academics have urged the authorities to identify the various factors that can affect the project's re-execution. This study aims to provide a comprehensive analysis of the various factors that can affect the success of a project's re-execution by identifying the main factors that can affect the project's success and the various sub-factors that can contribute to its success. It also explores the various management strategies that can be implemented to prevent the effects of rework.

Keywords : rework , factors, constriction , performance, best practice.

1. Introduction

Construction projects are prone to experiencing various types of rework. These are usually costly and have a significant impact on a project's success or failure. Rework also has varying effects on a project's schedule and cost. The complexity of the project's budget, the availability of resources, and the time constraints of the crew are some of the factors that affect a project's success or failure.Sometimes, a project's owner or stakeholder decides to issue a rework to make a change to the design. This type of work can be carried out for various reasons, such as to improve the quality of the project or to avoid potential conflicts between the parties involved[1].

Understanding the various factors that affect a project's success or failure is very important to ensure that the project is completed on time and on budget.According to a study conducted by Karmanshachi and Rouhanizadeh in 2019, rework negatively affects a project's efficiency and performance. It can be defined as a change that deviates from the agreed upon contract. In 2002, Ssegawa and colleagues noted that changes in the construction procedure or plans are unavoidable due to the complexity of a project's design and construction phases[1], [2].

The construction industry is also liable for poor project management due to the design changes that are carried out during a project's construction.Through a comprehensive review of literature, the authors of this study identified 124 causes of rework. These factors were identified by several studies[3]–[6], a study conducted by the Construction Industry Institute revealed that 35 of the identified causes of rework were easily resolved by implementing BPs during the construction phase of a project.The most common reason for a project's rework is weather conditions. Other factors such as the availability of resources and the owner's decision to change the schedule are also factors that can affect a project's success or failure.

In 2012, a study conducted by the Construction Industry Institute (CII) revealed that the use of BPs can help improve the efficiency of a project by identifying the various factors that can affect a project's success or failure. The study also noted that the factors that can cause a project's rework were categorized into three main categories: people, organization, and project. The objective of this study is to analyze the various factors that affect a project's success or failure and the effectiveness of BPs in reducing the cost of rework[7].

Over the years, various researchers have been trying to identify the most common factors that can cause a project's rework. Despite the numerous studies that have been conducted on the subject, there is still a lack of definitive information on the factors that can affect a project's success or failure[8], [9].Despite the numerous studies that have been conducted on the subject, there is still a lack of definitive information on the factors that can affect a project's success or failure. This is because, in most studies, the main focus has been on identifying the factors that can cause a project's rework. However, when it comes to implementing effective practices to reduce the cost of rework, the industry has neglected this important aspect.The literature has also been used to analyze the various factors that can affect a project's success or

failure. These include the design errors and changes that are carried out during a project's construction.

2. Rework in Construction Projects

Several studies were preformed to analyze the various factors that can affect a project's rework[5], [10]. They focused on four phases that are designed to reduce the risk of rework. These phases include categorizing the cause of the issue, assessing the scope of the rework, getting ready for remedial activities, and coordinating changes into the administration framework.In addition, during the early stages of a project's construction, change orders can be easier to oversee. This is because, as mentioned earlier, they can make a project's rework possible. A 2014 study suggested that a plan review process can help reduce the number of reworks on a construction project[4].

According to [11], it is generally recommended that change orders be issued with minimal cost overwhelms during the initial design stage. However, the lack of commonality among various approaches to overseeing change orders can cause delays and cost overwhelms.The strategies and methods used for assessing and managing the various aspects of a project's rework are often inefficient and lead to costly delays. Due to the increasing complexity of construction projects, stricter procedures and techniques are needed to limit the cost of rework and prevent costly delays.

3. Rework Impact on Project Performance

Several studies have been conducted to analyze the effects of rework on a project's performance. In one study, the researcher contacted the owners, managers, and clients of multiple construction projects in Sweden to find out how much of a project's cost was spent on rework. The researcher found that an additional 7.1% of the project's total work time was required to cover the cost of the rework[12], [13].

A survey was conducted in Singapore to gather information about the performance of 32 construction companies. It was revealed that the frequency of rework is one of the factors that contribute to the high schedule performance of the industry.The study conducted by Wang & Yang in 2014 revealed that about 58% of construction projects experienced some type of rework. This significantly increased the average time it took to complete a project. A similar study conducted by Thomas & Napolitan in 1995 and Kermanshachi et al. in 2018 revealed that the cost of a project's rework can affect the labor productivity[14].

Due to a change in scope, the project's baseline has to be revised. This process can involve making corresponding changes to the project management plan, schedule, and resource plan.A proper scope change mechanism should take into account the various factors that affect the project's schedule and cost. This includes the impact of the change on the schedule and the costs associated with the same.Since the scope change process can involve implementing new

features and workflows in an automation tool, it is important that the new requirements are taken into account[12], [15].

One of the main factors that affects a project's scope is the change in requirements. This process can be carried out through a corrective action or a preventive one. A formal request for a change has to be raised in order to take into account the various factors that affect a project's schedule and cost[16].When a project's quality is not good enough, it is referred to as defective repair. This issue can happen during the testing phase of an automation tool, as the quality of the deliverables has not been found satisfactory. The project's charter clearly states that the project should deliver on time. Therefore, any change in the schedule should involve the addition of a new cost.

A change management system should be used to handle all the changes that are brought about through a scope change. This can be used to perform preventive repairs, identify and resolve defects, and make changes to the project management plan.Before a scope change can be carried out, all the stakeholder groups should be informed about the changes it will affect. This can help prevent potential issues and improve the quality of the project[10].

All the changes that are brought about through a scope change should be categorized as preventive or corrective actions. Only those that are feasible and can be implemented from a functional or technical standpoint should be approved.The proposed changes should not affect the project's overall objectives or the purpose of the project. This ensures that the project's goals and objectives can still be achieved[17].

The configuration management of the project should also be followed in order to use the correct versions of the project management plan. This can help prevent potential issues and improve the quality of the project.The final requirements should also be obtained as soon as possible in order to minimize the risks associated with the changes. This process should also involve establishing a control structure for the team members[18].

If the proposed changes are excessive and would affect the project's overall objectives or the purpose of the project, then the project should be terminated.One of the most important factors that the project's management should consider when it comes to implementing a scope change is ensuring that the requests of the external and internal stakeholders are met.

4. Change Orders in Construction

Due to the increasing number of studies on the effects of change orders on a project's performance, a number of examinations have been conducted to analyze the factors that contribute to the delays and cost overruns. Some of the key factors that influence change orders include the owner, the consultant, and the contractor.Most owners hire and retain contractors and consultants to address and modify the design changes of a project. They typically do so in response to the changes brought about by the changes in the scope and designs. Although many researchers believe that owner-induced changes in the design and scope of a project are the primary factors that contribute to the project's schedule and cost

overruns, other factors such as design errors and errors are also known to affect a project's performance[7].

Mistakes and alterations in the design and scope of a project are very common in construction projects. They can cause significant delays and cost overruns, and they can even affect the efficiency of the project's workforce. These factors can also lead to the hiring and retention of additional workers.Although many researchers believe that owner-induced changes in the design and scope of a project are the primary factors that contribute to the project's schedule and cost overruns, other factors such as design errors and errors are also known to affect a project's performance. Rework is also an essential part of any project's success. Due to the varying aspects of a construction project's schedule and budget, the availability of resources for planning and managing changes, and time constraints, different types of change orders can affect a project's performance[9].

5.Rework due to Design error or changes

Mistakes and design changes in the construction industry are known to be one of the most common factors that affect a project's performance. According to Chandrasusha and Basha, in 2017, design-related errors and changes were the most common cause of rework in construction projects.A case study conducted on a highway and masonry project revealed that due to the design errors and changes in the construction drawings, there was a significant increase in the project's cost and delay in its schedule. Another contributing factor to the delays and cost overruns was the lack of coordination between the various design teams[19].

Many researchers also believe that the lack of communication between the design and the project's operations can lead to a project's rework. This issue can also be prevented by having a clear understanding of the project's requirements and design. In order to minimize the effects of design-related errors, it is important that the project's design and requirements are regularly reviewed.In order to prevent the effects of design-related errors and changes, it is also important that the project's design and requirements are regularly reviewed. This can be done through the use of a design freeze.A study conducted by Wilson & Odesola in 2017 revealed that the top five factors that caused the most amount of rework in oil and gas projects were the lack of communication between the project's operations and the design team, as well as the lack of proper documentation.

The study identified various factors that can lead to a project's rework, such as the lack of documentation related to the project's design and requirements, the communication between the project team members, and the lack of site verification. It also recommended that the design management and constructability reviews be conducted during the design phase to improve the project's performance.The lack of technology has also been identified as one of the factors that can lead to a project's rework. This issue can be solved through the use of Building Information Modeling. This method can help minimize the effects of design-related errors and changes[15].

Despite the various obstacles that prevent the implementation of BIM, it is still beneficial to have it as an alternative method to reduce the effects of design-based errors. It allows the various design teams to visualize the project's design and provide an accurate and complete understanding of the project's construction processes.In 2018, Zhao, Yang, and Hwang identified the top three strategies that can help reduce the amount of rework in construction projects. These include using BIM throughout the design and construction phases, performing design reviews, and auditing the project's systems to prevent future issues[17].

6.Other factors causing rework

One of the most common issues that construction firms face is the issue of change order or rework. Aside from the lack of communication between the project team and the operations, the involvement of the clients also contributes to the issue. A study conducted by the three researchers in 2014 revealed that about 80.4 percent of the 381 projects analyzed in Singapore experienced client-related rework. The results of the study showed that the average cost of the project due to this issue was increased by 7.1%, and the delay by 3.3 weeks was also recorded[16].

The involvement of the clients in the project's design and construction process is also a contributing factor to the issue of client-related rework. According to a study conducted by Karmanshachi et al., in 2017, the cost and quality performance of a project were affected by the change of plans or scope. Other factors such as the staff turnover and the reallocation of projects are also contributing factors to the issue of client-related rework. In 2004, Edwards, Irani, and Love identified various factors that can affect the quality and cost of a project's work. These include the lack of supervision by the contractors, poor use of materials by the subcontracted workers, and the carelessness of the employees[10].

Another common issue that can affect the quality and cost of a project's work is the lack of proper documentation. This issue can lead to the project's budget being changed and the scope being modified. Other factors such as the poor economic conditions of the local construction industry and the lack of skilled and experienced workers are also contributing factors to the issue of client-related rework. A study in 2017 revealed that scheduling pressure can have a negative effect on a project's performance. It noted that working out of sequence or order can lead to defects, and losing the motivation to work can also be caused by this issue.

A study conducted by Josephson, Li, and Larsson in 2002 identified various factors that can affect the cost and quality performance of a project's work. These include the lack of proper documentation, the poor economic conditions of the local construction industry, and the lack of skilled and experienced workers.The impact of the client's changes and extra orders on the project's performance was the primary factor that caused client-related rework. Production management was also cited as one of the most common factors that can affect a project's work. Defects in machines were also identified as one of the most common factors that can affect a project's performance.

The use of materials that are too hard to use and late delivery of goods were identified as the most common reasons for client-related rework. Other factors such as the lack of coordination and inadequate designs can also affect the project's performance.

6.1 Best Practices

Through the efforts of the Construction Industry Institute (CII), various techniques have been identified that can improve the efficiency of a project's construction execution. These include the implementation of single or multiple project-specific procedures. Numerous studies have also been conducted to analyze the effects of these procedures on a project's overall performance.

Despite the potential of construction BPs to improve a project's performance, it is not feasible due to the various factors that can affect a project's work. A hole in the data suggests that proper procedures are not yet established in construction projects. This is why an intensive investigation is needed to determine how to use construction BPs in a project.According to the institute, construction BPs can help improve the efficiency of a project's construction execution and lead to successful supervising large scale projects. A construction BP is a strategy or procedure that can be used to prompt upgrades in a project's performance.

the Construction Industry Institute (CII) released a set of construction BPs that are designed to help improve the efficiency of a project's execution. These include the planning and alignment of a project's structure, materials management, and quality management. Although a start-up BP is usually implemented when a project is almost finished, it is not feasible to implement this procedure in a project due to the various factors that can affect its performance. This is because the planning and arrangement of a start-up does not add to the overall project's administration or decrease the remaining tasks required for rework.

Since the goal of the project performance analysis is to measure the utilization of the construction BPs, the metrics and benchmarking methods used to analyze the effectiveness of these procedures were not designed to provide a comprehensive view of the project's overall performance. Instead, they were used to analyze the various tasks related to the project's rework. One of the limitations of the construction BPs released by the institute was that change management was prohibited on the grounds that it can affect the entire scope of a project's work. To determine the effects of different construction BPs on a project's performance, the researchers analyzed the effects of each procedure on the cost of rework.

7. Conclusion

This study focused on identifying early rework indicators that can be used to improve the quality of work performed by an organization.The study identified various factors that can affect the quality of work performed by an organization, such as inadequate coordination, poor use of technology, and improper implementation of quality assurance procedures. Other

common indicators include lack of staff supervision, poor management, and construction errors.

The study identified seven common rework indicators that are commonly used by project-based organizations. These include: inappropriate design, unclear scope definition, material selection, improper site conditions, financial issues, lack of information about the project, and government policy changes.The study also identified various factors that can affect the quality of work performed by an organization, such as inadequate knowledge, poor management, and construction errors. Based on the literature, it was concluded that the most common factors that can affect the quality of work performed by an organization are lack of experience and expertise, conflict among workers, and lack of motivation and reward.

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