

Causes of Reworks in Projects: A Systematic Review of Literature

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ARTICLE INFO	ABSTRACT
Received: 22 Oct 2024 Revised: 27 Nov 2024 Accepted: 08 Dec 2024	Rework is a critical issue the construction sector has faced from time immemorial, significantly impacting the performance and sometimes even the relevance of construction projects. Studying the causes of reworks to address this menace and its ramifications has become necessary for those working in the construction sector. Even though studies have tried to uncover the factors that cause reworks in construction projects, it still remains a most significant and often ignored or concealed problem in the construction sector. The aim of this paper is to identify the factors that lead to reworks in the construction projects. A systematic literature review was conducted to examine the causes of reworks in the construction projects. Forty-five research papers were selected following the protocols and procedures for a systematic literature review. After analyzing the papers, important causes of rework in construction projects were discovered, and they were categorized into six groups. This systematic literature review suggests the directions for future research in reworks that affect construction projects and emphasizes the need for more empirical studies to find solutions to minimize reworks. Keywords: rework, redesign, construction projects, building projects, systematic literature review, errors, construction.

INTRODUCTION

Reworks can have severe repercussions for organizations that work in the construction sector and impact the productiveness and performance of their projects (Elseufy et al., 2022; P. E. D. Love, Ackermann, Carey, et al., 2016). Rework is an important predictor of project cost and performance and can account for almost half of project cost discrepancies (P. E. D. Love, Ika, et al., 2019). Love and Edwards (P. E. D. Love & Edwards, 2004) defined reworks in construction projects as *“the unnecessary effort of re-doing a process or activity that was incorrectly implemented at the first time.”* Multiple studies have found that reworks significantly increase a construction project's cost and schedule and reduce productivity (Assaad et al., 2022; Doloi et al., 2012; Elseufy et al., 2022; Josephson et al., 2002; Li & Taylor, 2014; P. E. D. Love, 2002; P. E. D. Love et al., 2010; P. E. D. Love, Ika, et al., 2019). A study by Love (P. E. D. Love, 2002) found that reworks are the cause of more than half of the increase in construction project costs, and direct reworks accounted for about 26% of the increase in the project cost. The same study found that the cost incurred for direct and indirect reworks can be more than 5% of the original contract value, with direct rework cost marginally higher than indirect rework cost. Rework significantly affects the profitability of contractors in projects, especially if they are working on low margins (P. E. D. Love, Ika, et al., 2019; P. E. D. Love, Smith, Ackermann, Irani, et al., 2019).

There are predominantly two perspectives on reworks in construction project literature: the construction rework perspective and the project rework perspective. The construction rework perspective considers only the reworks for which the contractor has to bear the costs, and it does not consider scope modification and manufacturing problems that occur outside the construction site. Whereas scope modification and manufacturing problems occurring outside the construction site are considered within the scope of reworks from the project rework perspective (P. E. D. Love,

Smith, et al., 2018). The rework costs reported in various literature and reports differ significantly based on the perspectives on reworks taken in that study or report.

In highly competitive scenarios where contractors work on low-profit margins, reworks can seriously affect profitability (P. E. D. Love, Ika, et al., 2019). Notably, costs for owners are often as much as double what the contractors incur (B.-G. Hwang et al., 2009). If rework requirements are not identified near their origin, they will pass on to the next phase, significantly affecting project performance by increasing the cost and expanding the schedule (Li & Taylor, 2014). Undiscovered reworks in the initial stages of the project, like the design phase, can significantly impact the performance not only of the design phase but also the performance of construction stages will be affected, and it will also considerably raise costs in the construction stage (Li & Taylor, 2014). The cost of design changes can be almost double the direct cost of reworks (Josephson et al., 2002). The frequency of occurrence and time taken for completion of reworks significantly affect the project schedule (Arashpour et al., 2013; Rivas et al., 2011). Reworks, along with materials, equipment, and tools, are factors having the most influence on labour productivity. A study by Josephson et al. (Josephson et al., 2002) observed that the time spent on reworks accounted for about 7.1% of total work time, thus being a significant contributor to schedule overruns, reducing efficiency. Reworks are also a major cause of quality issues in construction projects (Naveed & Khan, 2022; Shoar et al., 2022).

Reworks also increase the chances of accidents and undesirable worker behaviors. It has been found that accidents and injuries occur more often when performing rework than when doing routine work (P. E. D. Love, Smith, Ackermann, & Irani, 2019; Teo & Love, 2017). The occurrence of accidents and injuries often increases significantly in a non-linear way, along with the increase in reworks (P. E. D. Love et al., 2015; P. E. D. Love, Smith, Ackermann, Irani, et al., 2019; P. E. D. Love, Teo, et al., 2018; P. E. D. Love & Teo, 2017; Pereira et al., 2019; Teo & Love, 2017; Wanberg et al., 2013). Antecedents to accidents such as high levels of mental pressure, exhaustion, improper use of equipment and materials, and inappropriate behaviors have been observed among workers in projects facing reworks (P. E. D. Love, Ika, et al., 2022; P. E. D. Love, Smith, Ackermann, Irani, et al., 2019; Pereira et al., 2019).

Reworks are almost always unanticipated; therefore, when dealing with reworks, there will be less information due to the uniqueness of the problems and the high pressure to correct them within a short time and at a lower cost (P. E. D. Love & Teo, 2017). Employee morale is adversely affected by reworks, and it is often found to be a significant demotivating factor among construction project employees (Brncich et al., 2011; P. E. D. Love, Teo, Davidson, et al., 2016; Rivas et al., 2011; Yap et al., 2019). Even after many studies about construction reworks and significant technological improvements over the years, reworks remain a significant problem in construction projects (P. E. D. Love, Smith, Ackermann, & Irani, 2019; Safapour & Kermansha, 2019). Foreseeing rework is difficult because of the complexity and interdependent nature of events that precede reworks and the projects' uniqueness (P. E. D. Love, Ackermann, Smith, et al., 2016; P. E. D. Love, Smith, et al., 2018; P. E. D. Love & Teo, 2017). Most recent studies in project reworks fail to add much-needed additions to the existing body of knowledge, and experts have called for a moratorium on such studies (P. E. D. Love, Edwards, et al., 2016). The absence of a proper review of the developments in this area might be the cause of the stagnant state of the present body of knowledge. We address this problem with this systematic review, which examines the causes of reworks in construction projects. We critically analyze the existing literature to understand what is known and what is yet to be known in the existing body of knowledge regarding the factors leading to construction project reworks.

METHODOLOGY

This paper uses the systematic literature review approach to study the causes of reworks in construction projects. The systematic review approach, which is extensively used in medical research, has gained widespread interest in other areas like project management (e.g., (von Danwitz, 2018), (Stingl & Gerald, 2017)), construction engineering (e.g., (Feng et al., 2022; Gharbia et al., 2020; Illankoon & Vithanage, 2023; Sánchez-Aparicio et al., 2023; Sánchez-Garrido et al., 2023)), and software engineering (e.g., (Kitchenham & Brereton, 2013), (Dybå & Dingsøyr, 2008)) in the recent years. Compared to narrative review, which is widely used in management research, the systematic review approach has more rigor and thoroughness, and it is also replicable because of its systematic and transparent procedures (Denyer & Tranfield, 2009; Tranfield et al., 2003). Systematic reviews are defined as a *“specific methodology that locates existing studies, selects and evaluates contributions, analyses and synthesizes data, and reports the*

evidence in such a way that allows reasonably clear conclusions to be reached about what is and is not known" (Denyer & Tranfield, 2009). Denyer & Tranfield (Denyer & Tranfield, 2009) identified the principles of systematic review for management research and developed a methodology for systematic literature review tailored for management and organizational research. In this study, we adopt the approach developed by Denyer & Tranfield (Denyer & Tranfield, 2009) for conducting the systematic literature review.

QUESTION FORMULATION

From the existing literature on construction projects, it was found that reworks are important problems in construction projects and are a major hassle for the construction sector. Several studies on construction projects in different settings have identified the causes of reworks. A systematic literature review is warranted to compile the findings from these studies to give practitioners and researchers an idea about the current knowledge about reworks in construction projects so that they can be mindful of reworks in their projects and pursue more meaningful research about reworks. The researchers put forth the following question for addressing this problem.

According to the current body of knowledge, what factors lead to reworks in construction projects?

The researchers address this question in this paper by conducting a systematic literature review following the guidelines of Denyer & Tranfield (Denyer & Tranfield, 2009). Figure 1 represents a flowchart depicting the systematic literature review process.

LOCATING STUDIES

Locating the literature for the study is an essential step in conducting a systematic literature review. It was decided to conduct the literature search on the electronic databases Scopus and Web of Science. These two databases were selected because they extensively cover peer-reviewed research papers in construction projects (Martín-Martín et al., 2018). Even though Google Scholar provides much more extensive coverage of literature, including grey literature, it was not used because the present study focuses on peer-reviewed academic research articles, and it will be extensively covered by using the database of both Scopus and Web of Science (Boeker et al., 2013; Martín-Martín et al., 2018).

A literature search was carried out in the Scopus and Web of Science databases in January 2024. Since the word redesign was used in some articles to indicate reworks during the design stages of projects, it was also included in the search string. The keywords used were rework, reworks, re-work, re-works, redesign, re-design, project, infrastructure, construction, civil, and engineering. The literature search rule used in Scopus was TITLE-ABS-KEY (("REWORK*" OR "RE-WORK*" OR "REDESIGN" OR "RE-DESIGN*") AND ("PROJECT*" OR "INFRASTRUCTURE" OR "CONSTRUCTION*" OR "CIVIL" OR "ENGINEERING")). The literature search rule used in Web of Science was TS = (("REWORK*" OR "RE-WORKS*" OR "REDESIGN*" OR "RE-DESIGN*") AND ("PROJECT*" OR "INFRASTRUCTURE" OR "CONSTRUCTION*" OR "CIVIL" OR "ENGINEERING")). The initial search returned 19,486 academic papers from the Scopus database and 7,214 academic papers from the Web of Science core collection database.

STUDY SELECTION AND EVALUATION

For the selection of studies for the systematic review, the researchers set the following inclusion and exclusion criteria.

5.1. Inclusion Criteria

The inclusion criteria used to filter the initial search output are listed below.

1. In order to identify the recent development in the issue being addressed, only those studies published between the years 2000 and 2023 were considered.
2. For this review, only articles published in English were included.
3. Only studies published in peer-reviewed journals were selected.

- Only articles published in the area of the construction industry and projects were selected for this study.

5.2. Exclusion Criteria

The exclusion criteria used to filter the initial search output are listed below.

- Publications, such as conference papers, dissertations, and white papers, were excluded.
- Research articles on reworks in sectors other than construction were not considered in this review to keep the review focused on the reworks and associated factors pertaining to the construction industry.

After applying the inclusion and exclusion criteria, 3,074 articles were selected from the Scopus database, and 2,048 articles were selected from the Web of Science database.

5.3. Screening Articles for Relevance to the Issue Being Studied

The researchers merged the Web of Science and Scopus results, and duplicates were removed using R Studio. After removing duplicates, 3982 articles were selected for further screening. The selected studies were further screened by reading their title to ensure the articles were in the construction field, and 878 articles were selected for further screening. The researchers went through the abstract and sometimes the full paper to ensure the relevance of each of the 878 articles to the problem being addressed in this systematic literature review. Out of 878 studies, only forty-five were selected for inclusion in this study. The various steps involved in selecting the forty-five articles are illustrated in Figure 1.

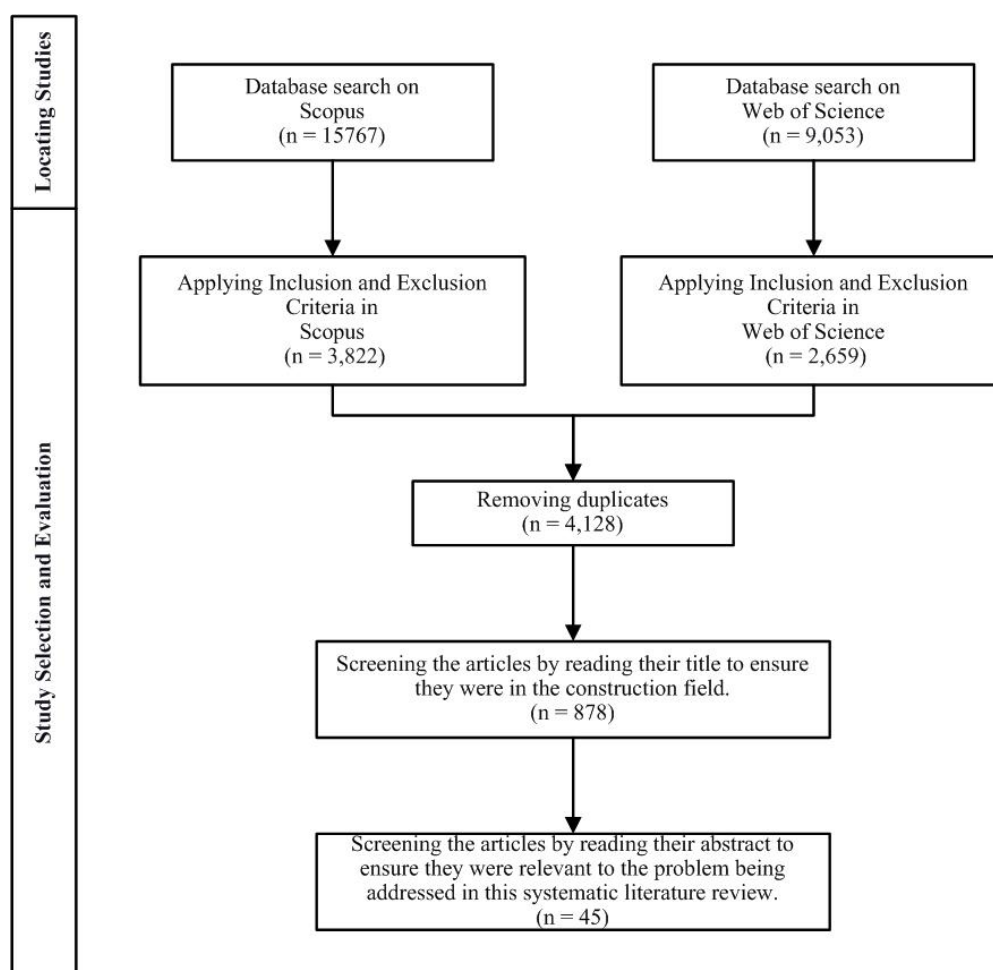


Figure 1: The systematic literature review article identification and screening process.

RESULTS

The study analyzed forty-five journal papers selected through the steps mentioned in Figure 1 to understand the causes of reworks in construction projects. A spreadsheet was created to help in analyzing the journal articles. The researchers thoroughly analyzed the forty-five selected journal articles to extract the causes of reworks identified or studied by those articles, and the findings from analyzing those articles were recorded on the spreadsheet.

The causes of reworks were classified into six heads: (1) Design and scope changes, (2) Planning, coordination, and communication issues, (3) Errors, (4) Quality issues, (5) Schedule pressure, and (6) Accepting reworks as normal. Design and scope changes were the most frequently reported cause of rework, and Accepting reworks as normal was the least reported one.

6.1 Design and Scope Changes

Design and scope changes, usually initiated from the side of clients, are among the most significant factors that cause rework, thereby escalating costs and causing delays (Garg & Misra, 2021; B.-G. Hwang et al., 2009; Josephson et al., 2002; P. Love et al., 2018; P. E. D. Love et al., 2010; P. E. D. Love, Smith, Ackermann, Irani, et al., 2019; Shen et al., 2021; Yap et al., 2017). Josephson et al (Josephson et al., 2002) classified the causes of reworks according to their impact on rework cost, and design-related causes were found to be the most significant contributor to rework cost, followed by management issues. A study on client-related reworks found that changes made in the scope and plan of the project to be the most impactful client-related factor that leads to reworks in building projects; another study conducted among construction workers also indicated the same (B. Hwang et al., 2014; Rivas et al., 2011). Apart from client-initiated changes, changes carried out to accommodate the needs of end users, regulatory bodies, contractors, and subcontractors can also cause design-related reworks (P. E. D. Love & Smith, 2003; Shen et al., 2021).

Incomplete designs and unresolved design issues at the start of construction can lead to reworks (Ajayi et al., 2016), and sometimes, the late discovery of existing constraints and requirements is the cause of design-related reworks (Mitropoulos & Howell, 2002). Undiscovered design reworks can cause significant cost escalations in the construction phase and reduce project performance (Li & Taylor, 2014).

Client-initiated design changes, especially at the last minute, are known to lead to long rework times (B. G. Hwang et al., 2014). Client-directed changes in projects are usually the result of flaws in documentation, which are in turn caused by low design fees and schedule pressure, leading to sidestepping of reviews and other quality control procedures (P. E. D. Love, Edwards, Irani, et al., 2009; P. E. D. Love, Edwards, Smith, et al., 2009; P. E. D. Love et al., 2004). Significant flaws in the design that lead to reworks include poor and incomplete design, cutting corners, and coordination issues. (P. E. D. Love et al., 2004; Wuni et al., 2023). Moving to new projects without reflecting and learning from previous projects might be why design and scope changes are creeping up repeatedly as a significant rework cause (P. E. D. Love et al., 2004).

6.2 Planning, Coordination, and Communication Issues

Erroneous and differing understanding among stakeholders in a project about its various aspects, like aim, scope, design, and details in the contract, can lead to mistakes that need to be reworked (Doloi et al., 2012; Garg & Misra, 2021). These faulty understandings are usually the results of problems in planning, coordination, and communication, which are among the top factors that result in reworks, as they often lead to incompatibilities and eleventh-hour changes (B. G. Hwang et al., 2014; P. E. D. Love et al., 2010; P. E. D. Love & Smith, 2003).

A recent study identified coordination issues as one of the foremost causes of reworks in construction projects (Garg & Misra, 2021). Ambiguities in communication, disturbances, and interferences happening during activities, delays, etc., cause various problems in construction projects that may lead to reworks, and these problems also diminish the chance of early discovery of errors and reworks (Ford & Sterman, 2003a; Igwe et al., 2022; P. E. D. Love, Edwards, Irani, et al., 2009).

Inadequate client/owner involvement in planning and implementation, insufficient communication and coordination with the design team, etc., usually results in changes and reworks (P. E. D. Love et al., 2004; P. E. D. Love & Smith, 2003). The cause of the low client/owner involvement is usually that they may not be aware of the

significance of their active participation in the design and construction activities of the project (P. E. D. Love & Smith, 2003). Methods like design scope freezing, which are used supposedly to minimize changes made in projects, can become counterproductive as clients/owners can become intimidated because it restricts their flexibility. Unless the scope of the project and the needs of the client are well defined before the finalization of contract documentation, some change requirements may come up during the construction phase and result in reworks, thus affecting project performance concerning cost and schedule. Therefore, methods like design scope freezing should be used only with proper project management practices like meticulous scoping and planning, good change management programs, constructability reviews, etc. (P. E. D. Love et al., 2004).

Deliberate concealment of errors and reworks by contractors and project team members to avoid being blamed and losing image is a problem that can give a false sense of progress in the project's completion. This practice either reduces the quality or, in case of late discovery of these problems, will lead to more extensive and costlier reworks (Ford & Sterman, 2003b; P. E. D. Love, Edwards, et al., 2016; P. E. D. Love, Smith, Ackermann, & Irani, 2019; P. E. D. Love, Teo, Davidson, et al., 2016; P. E. D. Love, Teo, Morrison, et al., 2016).

6.3 Errors

Errors made by the people working on projects are an important source of quality issues and reworks, but it is the organizational factors like mismanagement and lack of attention to quality and safety that attenuate the impact of these errors (P. Love et al., 2018; P. E. D. Love, Matthews, Sing, et al., 2022; P. E. D. Love, Smith, Ackermann, & Irani, 2019; P. E. D. Love, Teo, et al., 2018). Errors in construction projects can be classified into individual errors and organizational errors. Organizational errors occur when more than one individual's negligence or divergence from specified procedures causes the error (P. Love et al., 2018). Inadequate supervision and inspection are important sources of errors and reworks, and insufficient supervision and inspection reduces the chance for early discovery of errors and reworks (Garg & Misra, 2021).

Unfamiliar or out-of-the-ordinary circumstances, especially when accompanied by time and cost constraints, can lead to biased decision-making, leading to errors, which are an important source of project reworks (P. E. D. Love, Ackermann, Smith, et al., 2016; P. E. D. Love, Teo, et al., 2018). The culture of error prevention, which prevails in most organizations, assumes that all errors can be avoided. Such a culture usually condemns people for reporting errors, thus leading to the concealment of errors by workers so as to prevent shame (P. E. D. Love, Teo, et al., 2018). This phenomenon has been associated with the concept of functional stupidity, where the organization discourages employees from critically evaluating existing norms and practices, thus avoiding new knowledge that can potentially reduce reworks (P. E. D. Love, Smith, Ackermann, & Irani, 2019).

Errors in the contract documentation are usually the major problem that happen in the initial stage of the construction project that can cause reworks downstream (P. E. D. Love & Smith, 2003). Design documentation errors can result from urgency and pressure on the design firm from clients (P. E. D. Love, Teo, et al., 2018). Errors happening in the initial stages that stay hidden for a long time and discovered in later stages cause a decline in quality, increase project completion times, and cause costly reworks (P. E. D. Love, Matthews, Ika, et al., 2022; P. E. D. Love, Teo, et al., 2018; Matthews et al., 2022; Parvan et al., 2015).

6.4 Quality Issues

Reworks are a major cause of quality issues in construction projects (Naveed & Khan, 2022; Shoar et al., 2022). Inadequate quality management practices in construction projects usually lead to higher rework costs (P. E. D. Love, Edwards, Smith, et al., 2009). Reworks related to quality emerge when initial work fails to meet the required quality criteria; these reworks are the effort needed to ensure that the work meets the necessary quality standards (Ji & AbouRizk, 2018). The most important factor that causes safety and quality issues is human error, often facilitated and amplified by the organizational environment (P. E. D. Love, Smith, et al., 2018). Quality-related issues constitute a significant source of reworks in construction projects and usually occur because organizations often ignore the importance of quality (P. E. D. Love & Matthews, 2022). Poor execution of the contract, which can be considered a non-conformance or quality problem, is also a significant cause of reworks. Use of inappropriate and low-quality equipment, improper handling of materials, and low-quality/inappropriate materials can cause reworks (Garg &

Misra, 2021; Islam et al., 2021). Some reworks and non-conformities will be discovered only a long time after the formal completion of projects. Addressing these issues is usually considered to be maintenance work. However, the work that arises as a result of faulty project works are reworks and, therefore, cannot be legitimately called maintenance works (Alexander et al., 2019).

6.5 Schedule Pressure

Schedule pressure is a factor that has a cyclical relationship with reworks, often operating as a vicious cycle that has negative ramifications for the project's performance. Schedule pressure leads to people cutting corners to complete work on time and committing mistakes due to psychological tensions caused by schedule pressure. These, in turn, will lead to rework requirements that need more time to complete, thus leading to more schedule pressure, especially when there are contractual obligations or penalties for late completion (P. E. D. Love & Matthews, 2022; Mitropoulos & Memarian, 2012). The effect of schedule pressure is amplified in unexpected and uncommon situations, as in such cases, the ability of people involved in the project to make unbiased and error-free decisions will be very low due to stress (P. Love et al., 2018; P. E. D. Love & Matthews, 2022). Human reasoning and decision-making efficiency are sharply reduced when facing tight time schedules. Very tight and often impossible-to-achieve schedules can lead to neglect of quality management activities, leading to errors that need to be reworked (Doloi et al., 2012). Schedule pressure will be high for mission-critical construction projects because of the urgency to start operations at the earliest (P. E. D. Love & Edwards, 2013). In such situations, management might take the risk if the management's perceived risk of rework is lower than the potential gains due to earlier operations. Often, the hazards and reworks due to those decisions are higher than expected, leading to further delays in starting operations (Bogus et al., 2011; P. E. D. Love et al., 2011). The high degree of concurrence coupled with excessive schedule pressure increases the chance for errors and quality issues to go unnoticed because of haste working and less focus on quality control activities. When discovered in later stages of the project, these issues might need reworks, which eat into the project's valuable resources and affect performance (Ford & Sterman, 2003a).

6.6 Accepting Reworks as Normal

The most dangerous of all the factors causing reworks is the organizations' attitude of accepting reworks as a normal and unavoidable aspect of projects. Several studies on construction projects have found evidence that organizations consider reworks as a normal part of construction project work (P. E. D. Love et al., 2011, 2017; P. E. D. Love, Smith, Ackermann, & Irani, 2019; P. E. D. Love, Smith, et al., 2018; P. E. D. Love, Teo, Morrison, et al., 2016). It has been observed in complex projects facing high uncertainty, rework cost within the limit of a certain percentage of capital expenditure is deemed allowable (P. E. D. Love et al., 2011; P. E. D. Love & Edwards, 2013). The danger of this attitude is that when rework is seen as normal and unavoidable, the organization will not take any active steps or develop mechanisms for reducing rework (P. E. D. Love, Smith, Ackermann, & Irani, 2019). In such situations, there will not be any internal mechanisms or conversations among the project team on why rework occurred and how it can be reduced (P. E. D. Love et al., 2017). In such situations, reworks can grow more significant than expected and observed so that organizations might become uncertain about the actual reworks cost (P. E. D. Love et al., 2011; P. E. D. Love, Smith, et al., 2018; P. E. D. Love & Smith, 2003).

DISCUSSIONS AND DIRECTIONS FOR FUTURE RESEARCH

By conducting a systematic literature review on the factors that cause reworks in construction projects, this paper has shed light on the important causes of reworks in construction projects. This study categorized the causes of reworks into six groups, namely, (1) Design changes and scope changes, (2) Planning, coordination, and communication issues, (3) Errors, (4) Quality Issues, (5) Schedule Pressure, and (6) Accepting reworks as normal. This categorization of causes of reworks can be helpful for researchers looking to study the important causes and dynamics of reworks in construction projects, and it will also help practitioners like project managers and contractors to be conscious of the major causes of reworks and, therefore, take steps to reduce the incidences of reworks. The use of a systematic review approach gives more rigor and thoroughness to the study presented in this paper and makes it transparent and replicable.

Love et al. (29) expressed their concern about the failure of some recent studies on reworks in construction projects to substantially advance the existing body of knowledge and even called for a moratorium on such studies. This pointed to the need for review and consolidation of existing knowledge in this area. This study was able to bring together the research findings on rework causation in the construction projects in the period from 2000 to 2023, thus consolidating the knowledge developed on the subject during the time.

The analysis of the literature revealed a need for more studies on construction reworks in the developing world, as most of the existing studies were done in the context of developed countries. There is also a need for more studies that tap into the knowledge of the construction workers as their knowledge and experience of reworks have been studied less compared to project managers, management staff, contractors, and designers. The organizational and behavioral factors that play the role of enablers in reworks need to be studied further. The fact that some organizations consider reworks as a normal part of projects is worrisome and this is a problem that should be studied further and needs solution. There is a dire need for the development of tools and technologies for the early identification of reworks, and there is a need for more empirical studies on solutions to reworks in construction projects. More research focusing on organizations that complete construction projects with no or very low reworks needs to be conducted so that the methods and practices that make this possible can be identified and applied in other construction projects. The main causes and the dynamics of reworks that arise in projects that use newer construction technologies and methodologies, like the application of the Internet of Things, modular construction, and construction 3D printing, will be different compared to the traditional construction projects and need the attention of researchers as the scope and use of these technologies and methodologies are exponentially increasing.

CONCLUSIONS

This systematic literature review investigated the causes of reworks in construction projects. The major causes of reworks in construction projects identified from the existing literature were categorized into six groups. This review found that among the causes of reworks, those related to design and scope changes were the most reported in the literature. These changes are often initiated by the customers and significantly affect the project's performance, especially if they occur toward the final stages of the project. Considering the effect design and scope changes can have on construction projects, actively involving all stakeholders from the initial design stages of projects is suggested, and major project works should be started only after reaching a consensus about the design and scope of the project. In case a change request comes, the costs of accommodating that request and the benefits or importance of that change to the project should be discussed among all stakeholders before making a decision.

The second most reported cause of reworks in literature, identified by this review, was those resulting from planning, coordination, and communication issues. Construction projects are complex activities where multiple people or teams work together for a common goal. Various stakeholders' knowledge, thoughts, and interests might be different, influencing their behavior and approach to the project. The complex nature of the construction projects and the disparity in thoughts and interests of the stakeholders warrants meticulous planning and proper coordination and communication among various stakeholders to avoid or minimize reworks (Goedert & Rokoei, 2016)(Hasanzadeh & Esmaeili, 2022).

This review found that errors are a significant source of reworks in construction projects. Even though people make errors, organizational factors usually make them more problematic. Project organizations need to develop a culture of error management because all errors cannot be prevented but should be addressed. Quality issues have also been reported as a significant source of rework in the research articles analyzed in this review; this brings forth the need for good quality management practices in construction project management to reduce reworks. Schedule pressure is another cause of the rework reported in the literature. High schedule pressure caused often by setting tight and impossible schedules can negatively impact performance and thus should be addressed using appropriate measures. One of the most interesting but worrisome causes of rework reported in the literature is that organizations accept rework as a normal part of their project. This attitude can have very serious impacts on a construction project as it will cause the project team to neglect the causes of reworks and also avoid learning from previous occurrences of reworks. To address the rework issue, the first thing that should be done is to recognize it as a serious problem that needs to be handled appropriately.

This paper consolidated the knowledge about the causes of reworks in construction projects by conducting a systematic review of the literature. The work presented in this paper will help researchers and practitioners to have a better understanding of the causes of reworks, which persist as a significant problem in construction projects. This paper also suggested directions for future research to further the knowledge about the dynamics of reworks in construction projects.

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