

# Rework Management in Construction

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**Abstract:** Rework in construction development projects can significantly degrade project cost and schedule performance. In a typical construction development project which involves design and construction, rework in the construction phase could increase construction cost by 10%-15% of the contract price (Burati. 1992, Josephson & Hammerlund 1999, Love & Li 2000). The proportion of money and time spent on rework in the design phase is usually higher (Smith & Eppinger 1997). In large, complex projects, undiscovered rework in the design phase can induce rework in the construction phase. The time when rework is discovered during the project development process affects the impact of rework on overall project performance. However, available knowledge is not always successful in improving project managers' understanding of the feedback mechanisms which drive undiscovered rework impacts on project performance, specifically the interaction between different phases during the developing process. The current work uses a system dynamics model of a two phase project development cycle to identify high leverage points for minimizing the impacts of rework on development project performance. Model analysis suggests that failing to discover rework near its creation in the project development process can magnify the impact of rework on project performance.

**Keywords:** Model analysis, development business, complexities

## 1. Introduction

Throughout the hundreds of years, development work over the globe has been a methods for nations increasing their national economies. The development business has confronted with the noteworthy problems of high cost of venture conveyance, awful money related execution and failure to convey value to clients on time to time. Therefore, the industry has been scrutinized widely for poor execution and wasteful yield. A central point adding to this disappointment is revise. Rework is characterized as the superfluous exertion of re-trying a movement that was erroneously done the first run through or the procedure by which a thing is made to fit in with the first necessity by finishing or remedy. Revise and wastages have turned out to be perceived as non-esteem including endemic side effects that genuinely influence the execution and efficiency parts of construction ventures and the issue of improve has been to a great extent overlooked by the development industry.

The development business is for the most part extend based and different complexities are natural in the development ventures, for example, managing various interests of numerous partners and resultant changes. Because of these trademark

complexities of development, changes might be esteemed inescapable in a few examples; be that as it may, uncontrolled events of adjust and wastages ought to really be all the more successfully controlled. This will basically enhance different focused on destinations of development extend administration regarding timetables, cost targets and item and administration quality. Adjust is a noteworthy supporter of time wastage and calendar overwhelms which in the end effect on cost, assets and quality. The unfavorable outcomes of revamp incorporate lessened benefit, loss of piece of the overall industry, specialist wounds, harmed notoriety, expanded turnover of administration and workforce, bring down efficiency, higher expenses, lastly, exorbitant prosecution between members over duty regarding invades and delays. In the long haul, improve can likewise influence a development organization's reputation and its capacity to pull in new business. In any case, little is thought about the foundation and thusly, improve remains an intrinsic issue. The absence of consideration regarding the main drivers of modify is by all accounts a worldwide marvel. On account of this, the point of this examination is to decide the basic reasons for modify amid development and also the effect of adjust on general venture execution so successful anticipation systems can be produced. Most development ventures have a collection of makes that leads adjust, this incorporate; omissions, modification, disappointments, legitimate correspondence, and lacking coordination and collaboration between partners. Perpetually, the effect of improve has seriously affected on the productivity, execution, and back of a venture. The specialists has pronounced that development experts do perceive that improve contributed fundamentally to poor development extend execution. Be that as it may, little is thought about the foundation and thusly, improve remains an intuitive issue. Moreover, in light of the fact that factors that add to its frequency are not completely comprehended, the induction of appropriate systems for its reducing is testing. Thus, an extensive energy about the strategy that reason revamp will empower development extend execution enhancements to be made. The absence of consideration regarding the underlying drivers of modify is by all accounts a worldwide noticeable reality. Because of this, the point of this exploration is to decide the basic reasons for revise during development, the two its immediate and aberrant expenses, and in addition the effect of improve on general venture execution so viable avoidance techniques can be created. During the time spent development, blunders, oversights and changes oftentimes happen and

prompt revise in various phases of development. Many examinations, which were led in numerous nations, demonstrated that modify expanded the cost of the distinctive work classes between 3% to 30% and caused delays in the diverse work classifications bringing about the expansion of their unique span from 10% to 77%. Contiguous, modify caused customer's and contractual worker's dissatisfaction.

**A. Rework sources**

Basically, rework can be obtained from various sources like errors, changes and omissions.

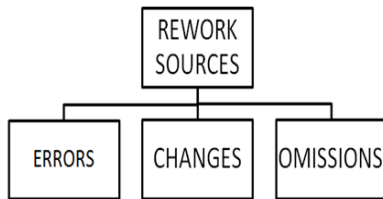


Fig. 1. Rework sources

**B. Objectives of rework**

Specific objectives include the following:

- To determine the influence different project types have on the causes of rework in construction projects;
- To determine the impact of rework on organizational and project performance;
- To determine the influence various project types have on rework costs (direct and indirect) in construction projects;
- To determine the influence various procurement methods have on total rework costs and construction projects;
- To design and develop rework reduction and containment strategies.
- To identify and evaluate the variables, of factors influencing rework in construction.
- To identify and categorize the root causes in specific groups.
- To suggest viable recommendations to reduce the occurrence of rework and its adverse impact.

**2. Literature review**

Feng, Tommelein and Booth (2008) characterized modify as either positive or negative. Positive revamp includes esteem, for example, when plans are adjusted and members in the outline procedure leave with a superior comprehension of client prerequisites. Burati et al. (1992) utilized deviation classes in view of development, outline, operability, creation and transportation to distinguish the reasons for improve from nine optimized mechanical development ventures. Wyatt and Mohamed (1997) proposed a revise classification system in light of three guideline gatherings: individuals, plan and construction. Love et al. (1997) reasoned that a few causes are

interrelated because of the many-sided quality of development operations. Love and Li (2000) likewise ordered adjust in three classifications, specifically cli-ent-started changes, non-varieties, and imperfections

**3. Impacts of rework on cost and time**

The significance of development industry is endorsed in all groups. It is one of the real enterprises in the financial development and progress. A gigantic measure of cash, time and en-ergy devouring in this part show the vital part of this industry. Development industry incorporates structures development, as well as spreads streets, extensions, dams and high rises development.

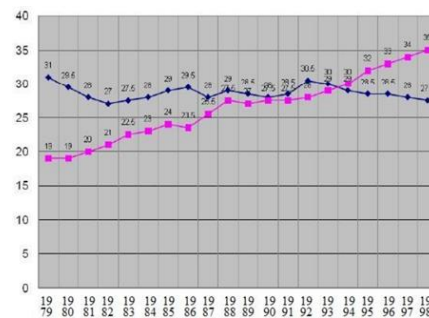


Fig. 2. Rework on cost and time

**A. Impacts of rework**

As indicated by the theoretical model of revise, which was given in the Figure 2.1, improve has impact on the efficiency and venture execution. By the importance of profitability, adjust influences confidence level, weakening of supervision, struggle, truancy, weakness and correspondence.

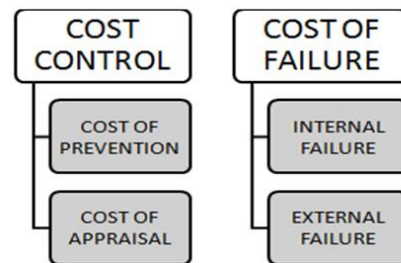


Fig. 3. Cost control and failure

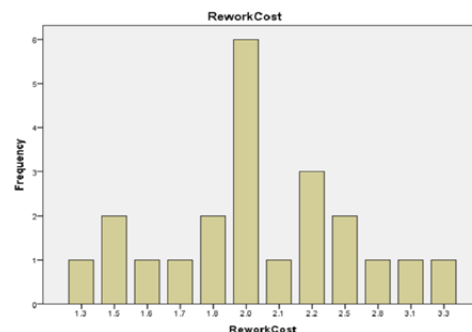


Fig. 4. Rework on cost

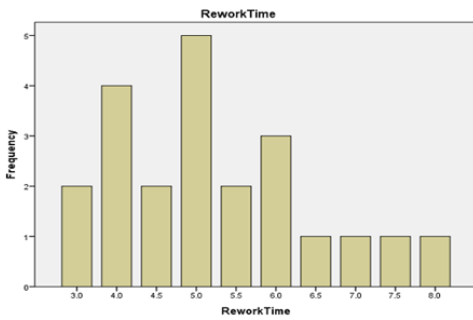


Fig. 5. Rework time



Fig. 6. Contractors share in rework

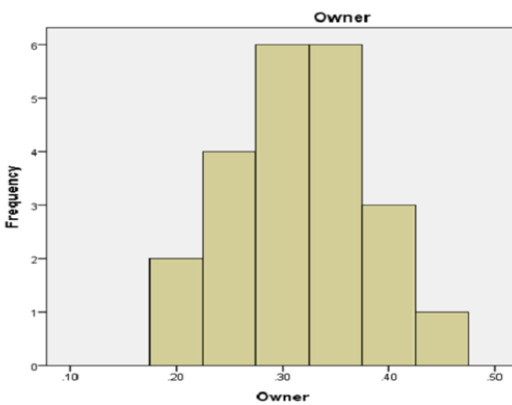


Fig. 7. Owners share in rework

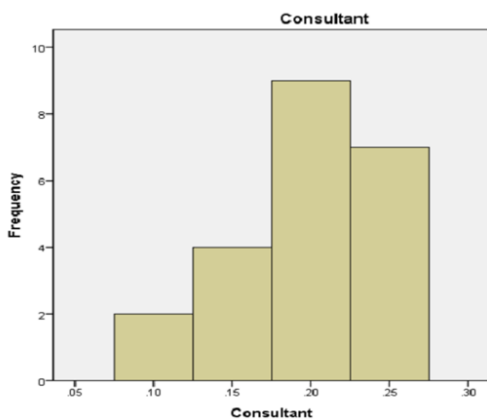


Fig. 8. Consultants share in rework

#### 4. Conclusion

Rework is one of the major determinants of construction productivity. This thesis aimed at investigating the reworks in constructing reinforced concrete structure by determining the wasting cost and time delay due to rework, identifying rework factors, and exploring the frequency and effect of rework items in project cost and time. The methodology used in this study was case study and questionnaire survey. The case study project was three blocks of 8-storeys residential buildings with reinforced concrete structure and the total construction area of 12000 square meters. Excavation was done by owner and the construction of reinforced concrete structure was done by main contractor. Main contractor hired subcontractors for execution. The data collection was through the personal observation and also interviews of the civil engineer supervisors. In addition to the case study, a questionnaire survey was conducted among medium to large size (ranged between 5000 to 16000 square meters of construction area) reinforced concrete construction projects. 22 construction projects contributed to this survey.

Furthermore, setting out errors, due to poor communication and coordination between the main contractor and subcontractors and the lack of skills on the part of the artisans, were identified. In addition, inexperience on the part of the leading hand and trades foremen and their inability to interpret the structural drawing contributed to rework during construction. Similarly, the analysis of the research instrument found that the most predominant source of rework included non-compliance with specification, setting out errors, changes made at the request of the client, poor communication with design consultants and low labor skill levels. Nevertheless, the causes of rework were found not to vary significantly with various project types. The most conclusive finding may be, however, that the economic benefits of recording incidences of rework and quantifying its costs have been overlooked. The total cost of rework for the projects sampled was calculated, and it was found that the total mean cost was 5.12% of the original contract value. Therefore, it can be concluded that rework can make a significant contribution to a project's cost overrun. Nonetheless, rework costs were found not to vary significantly with project type and various procurement methods used. Thus, the implementation of systems for measuring rework costs will possibly eliminate or reduce the costs of rework and subsequently improve overall cost performance in a construction project. Frequency and cost and time severity of 17 common rework items during the construction of reinforced concrete structure consisted of 4 phases of construction were investigated in the survey. Factor analysis was performed to find the correlation among the rework items of each phase of construction. According to the results of questionnaire survey, changing the designed steel bar diameters due to unavailability, using inappropriate head for poker vibrators, and lacking reinforcement bars were the most three frequent rework items, respectively. The results of factor analysis demonstrated that, 17 investigated rework items can be categorized into 4 components and each component represents one phase of the constructing reinforced concrete structure. These phases are: formwork which represented 33.11% of variance, reinforcing

with 21.58%, concrete work with 13.45%, and excavation with 6.89% of represent of variance.

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