Factors Affecting Rework Cost In Construction

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Abstract- *Rework, are activities in the field, which have been completed, but were required to be repeated or undertaken again as a result of some impeding correction that was necessary to be carried out during the project. This is regardless of source, or effecting a change, not due to change of scope by the owner. Fundamentally, rework becomes necessary either when an element of building works fails to meet customer requirements, or when the completed work does not conform to the contract documents. In either scenario, the product is altered so as to ensure conformity. At as certain moment during construction, for example due to an error, rework is necessary. But the rework might not be discovered until some form of quality control check is done, after which it can be concluded as to what kind of rework needs to be done. Rework can also have internal or external origins. Changes in clients' expectations are an example of an external factor that might lead to rework. Rework can cause many costs to be higher than calculated at the start of the project. Rework can result from various sources such as errors, omissions and changes. While it is widely recognized that additional costs due to rework can have an adverse effect on project performance, limited empirical research has been done to investigate the influencing factors. The research presented in this paper aims to determine the influence of different project types and procurement methods on rework costs in construction projects.*

Keywords- Rework, Construction Projects, Rework Analysis, MICROSOFT PROJECT, Rework Cost Mechanism, Analytical Hierarchy Process, Importance Index

I. INTRODUCTION

Over the centuries, construction work across the globe has been a means for countries increasing their national economies. The construction industry has faced with the significant problems of high cost of project delivery, bad financial performance and in ability to deliver value to customers on time to time. As a result, the industry has been criticized extensively for poor performance and inefficient output. A major factor contributing to this failure is rework. Rework is defined as the unnecessary effort of redoing an activity that was in accurately The Researchers has indicated that rework is worsen by Errors made during the design process, errors which then appear downstream in the procurement process. The Researchers has argued that the longer an error goes undetected, the greater the possibility of rework occurring that significantly impacts cost and schedule. The Construction Industry Institute (CII)(1989) study of nine large industrial construction projects found that rework due to design error contributed an average of 79% of total rework cost. In relation to Busby and Hughes (2004) and Cooper (1993), errors are ten not readily identifiable and often only become manifest after a period of in cubation in the system. The extent of rework required, then, depends on how long the error has remained unnoticed. For instance, a dimensional error or spatial conflict contained within design credentials may not arise until the project is being physically constructed onsite. According to the researchers, errors occur as a result of a complex range of interactions, and hence attempting to segregate a singular causative variable is an unseemly strategy to undertake. Once an understanding of the typical nature and underlying dynamics of errors is acquired, only then can error reduction and error restraint strategies be implemented in projects.

A. CHANGES

Many of them stated that a change is in essence a directed action that alters current established requirements. Changes can have an effect on the aesthetics and well-designed aspects of the building, the scope as well as the nature of work, or its working aspects. According to CII, rework, exclusively in the form of changes can have a negative impact on productivity and project performance. Moreover, stated that a design-change client, for example, would indicate that a client would initiate a change to the design of the building and therefore require rework due to redesign. Design related rework in the form of change orders is the major source of rework in construction projects.

B. OMISSIONS

According to Reason (2002), omission errors arise when the mental process of action control is subjected to Strain or distraction. Reason(2000)says that omission errors area result of pathogens within a system hat translate in to error-provoking conditions within the firm and project.

Examples include time pressure, understaffing, fatigue and inexperience. He further lamented that pathogenic influences contribute to unworkable relationships and procedures as well as design and construction deficiencies which consequently contribute to rework. Failure to undertake procedural tasks during the design process and continual design reuse (Busby,1999) are leit motivs that emerge as practices contributing to omission errors. The work practices are implemented by organisations can aggravate similar errors, regardless of the skills and experiences of the people involved in a project.

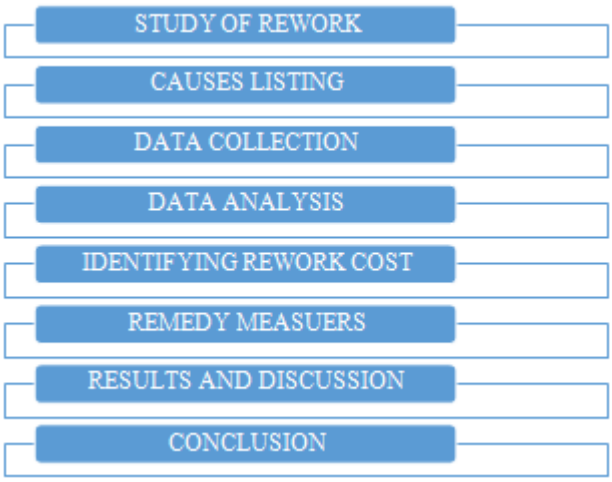
II. RESEARCH OBJECTIVES

The overall objective of this research is the improvement of construction performances and productivity in building construction industry by focusing on reducing rework with the implementation of best practices as the rework is one of the major determinants of construction performance affected.

The specific objectives of the study are:

- To study rework.
- To identify factors affecting rework in building construction
- To find rework cost from critical task using MSP
- To propose best practices to minimize rework in building construction.
- To develop checklists to minimize rework for selected trades.
- Calculate the total rework cost in construction project.

III. METHODOLOGY



A. DATA ANALYSISMETHOD

For achieving the goal of this research two approaches are used first one is relative importance of factors and second is rework cost mechanism. The analytical hierarchy process is found by the relative importance of main factors and co-factors of each group and IMPI is used to calculate the relative importance of all factors. And the other approach is found out the total rework cost.

B. ANALYTICAL HIERARCHY PROCESS(AHP)

This multi criteria decision making method is used to compare the factors of rework of Table 3.1 which is done by pairwise comparison of alternatives followed by normalization of matrix such that each alternatives sum to 1 by evaluating priority vectors and calculating the consistency index of each value and analyzing the same by consistency ratio which should be less than 10% or 0.1. The consistency is calculated by using the following formula.

Table 1. Consistency index and Consistency ratio

Sr No.	Factors	Formula
1.	Consistency index	CI= , λ_{max} -n/(n-1) Where, $\lambda_{max}$is maximum Eigen value., N is number of comparisons
2.	Consistency ratio	CR= CI/RI Where ,RI= random consistency index

C. IMPORTANCE INDEX(IMPI)

This research methodology is done in two stages. The first stage incorporated a literature search and meeting. The factors were derived through books, articles, web and world wide project administration diaries causing rework. As a result of this stage, 35 causes of rework is found out. These causes were classified into 5 groups. The second stage incorporates arrangement of data for positioning of causes of rework in construction projects by calculating Frequency index and severity index.

Table 2 Importance Index (IMPI)

Sr No.	Factors	Formula
1	IMPORTANCE INDEX(IMPI)	IMPI= (F.I.*S.I.)/100
2	FREQUENCY INDEX(F.I.)	$F.I.=\sum a\frac{n}{N}*\frac{100}{4}$ Where, A, Is The Constant Expression Weight Given To Each Responses, N Is The Frequency Of Responses, N Is The Total No. Of Responses.
3	SEVRITY INDEX(S.I.)	$S.I.=\sum a\frac{n}{N}*\frac{100}{4}$ A, Is The Constant Expression Weight Given To Each Responses N, Is The Frequency OfResponses N, Is The Total No. OfResponses

IV. DATACOLLECTION

Following sites are selected for rework analysis as a case study:

1. Cement Mortor Lining Of Ms Pipes Location: Wagholi-M.S.Pipe Yard Company: L&T
2. Guniting Work Of Ms Pipes Location: Wagholi-M.S. Pipe Yard Company: L&T
3. Devarai Residense Location: Ranjangaon Company: S.K Developers

V. EXPECTEDCONCLUSIONS

1. To identify and evaluate the main sources of rework.
2. To distinguish the factors responsible for rework in construction.
3. Ranking of rework factors.
4. Calculate the total rework cost in construction project

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