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STUDY ON SCOPE VARIANCES IN CONSTRUCTION PROJECTS

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Abstract - *Scope variance is nothing but a rework. Rework is considered as a significant factor that influences the construction project performances. It is necessary when the elements of the building fail to meet the customer requirements. To elicit the views of professionals in the construction industry about the rework factors impact on construction project performance, questionnaire will be distributed and data's will be analyzed. The findings may help construction parties to understand causes of rework which affect construction project performance in terms of cost and time. The study focuses on the analysis of the rework activities by identifying the magnitude and its impact of Cost and Time in Construction projects. Positive aspects but also negative aspects of rework are highlighted and suggestion will be given to reduce the rework in construction projects.*

Key Words: **Rework, Time management, Cost overrun, Construction delays, Project performance.**

1. INTRODUCTION

Rework is the unnecessary effort of redoing an activity that was inaccurately done the first time. In essence, rework has become a non-value adding endemic symptom that seriously affects the performance and productivity aspects of construction project. It must be controlled. In construction process, error, omission and change frequently occurs and leads to rework in different stages of construction. Studies conducted in many countries indicated that rework increased the cost of the different work categories between 3% to 30% and caused delays in the different work categories resulting in the increase of their original duration from10% to 77%. In recent survey conducted in 2018, it was found that around 30% of the work performed by construction companies is actually rework. Besides, rework caused clients' and contractors' dissatisfaction. Yet a little is known about the background of rework and hence rework remains a major problem. Moreover, the factors that contribute to its occurrence are not fully understood, because the derivation of appropriate strategies for its reduction is problematic. Thus a comprehensive appreciation of the mechanisms that cause rework will enable project performance improvements to be made. The adverse consequences of rework include reduced profit, loss of market share, increased turnover of management, low productivity, high costs, and finally costly litigation between participants over responsibility for time overruns and construction delays.

1.1 Rework in Construction Industry

Rework plagues owners, managers, contractors and even labourers. It is the main reason for stagnant and declining productivity, stealing hours, days and even months from projects. Also it causes severe missed deadlines and budget overruns that builders fail to meet contracts and face consequences or at the very least, loss of good name and potential future business.

1.2 Sources of Rework

Rework may be obtained from various source like error, change and omission, etc. Longer the error goes unnoticed, the greater the possibility of rework taking place that significantly impacts expenditure and schedule. For example, a dimensional error or spatial conflict contained within design credentials may not arise until the project is being physically constructed on-site. A change is a directed action that alters current established requirements. Changes can have an effect on the aesthetics and well-made aspects of the building, the scope as well as the nature of work or may be its working aspects. For example, a client would initiate a change to the design of the building and therefore require rework due to redesign. Omission errors are a result of pathogens within a system those translate into error-provoking conditions within the firm and project. Examples include time pressure, under staffing, fatigue and inexperience. The sources of rework are shown in fig 1.

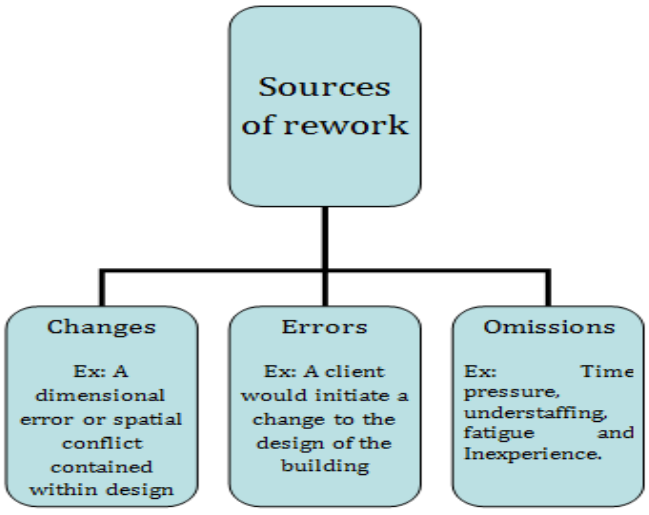

Fig -1: Sources of rework

1.3 Consequences of Rework

1. Redoing things takes time and might therefore lead to time delay. Rework can definitely influence the project planning. Time overrun might be a consequence of rework.

2. A second indicator is labour overrun. If work has been completed incorrectly this can be seen as non-productive time and rework takes attempt and thus results in labour overrun. If additional hours (and thus added labour costs) were needed to realize a project than estimated, it might be due to rework.

3. Rework often means that parts of a structure have to be scrapped and new material is needed to rebuild it. Extra material used might indicate rework as well. It is shown in fig 2.

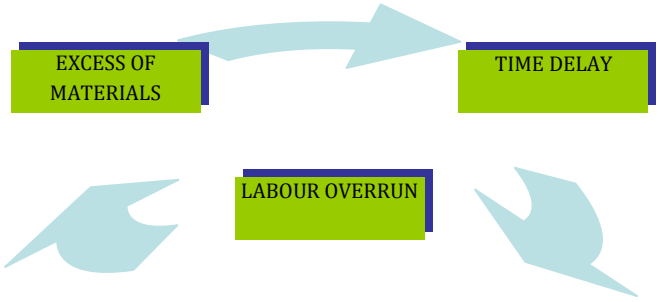

Fig -2: Consequences of rework

1.4 Scope of work

This study is important to identifying and to evaluating the main factors affecting the productivity of construction projects and to improve the rework reducing condition for the projects. The findings may help construction parties to understand causes of rework which affect construction project performance in terms of cost and time. The study focuses on the analysis of the rework activities by identifying the magnitude and its impact of Cost and Time in Construction projects. Positive aspects and also negative aspects of rework are highlighted and suggestion will be given to reduce the rework in construction projects.

2. LITERATURE STUDY

It represents an overview of literatures collected from various journals. **Mehboob Basha et al (2017)** [1] determined the underlying causes of rework during construction, and its impact on the overall project performance in order to develop effective prevention strategies. The root causes of rework was categorised into client-related, design-related and contractor-related factors etc., The study also suggested that rework is a problem faced in most of the construction industry and better understanding of the causes will assist the project managers to identify the methods to improve or eliminate rework. The outcome revealed the top rework causes occurring in the construction industries, the impacts and its effects on the organisation. **Adnan Enshassi1 et al (2017)** [3] identified the factors that contribute to rework and investigated their possible impact on construction project performance. The results of this research revealed that contractor's related rework causes and human resources capability related rework causes are the major categories which impact on the construction project performance. In addition, the findings showed that attempts to fraud, competitive pressure, ineffective management, schedule pressure and the absence of job security are the main rework factors which have a considerable influence on construction project productivity. **Ibrahim Mahamid (2016)** [7] studied rework in residential building projects in the West Bank in Palestine. It investigates rework cost and causes. The identified causes were classified under 4 groups: contractor-related causes, client-related causes, consultant-related causes and environmental causes. 62% of the surveyed contractors indicated that the average of rework cost in residential building construction projects that they have experienced during the last five years is between 10% and 15% of the original contract cost. **Sharmila et al (2016)** [20] aimed at developing a standard methodology for measuring and classifying construction field rework. To reduce rework, it is imperative to identify what its causes are and then understand how these causes are interrelated; the level of rework in 10 construction projects would depend on external factors such as excessive workload and market conditions. Increased defects and poor workmanship may arise from limitations on the availability of good subcontractors and workers, and additional or unwarranted pressures for early completion.

3. OBJECTIVE OF THE STUDY

- To identify cause of rework and to determine their degree of severity on the performance in terms of time and cost in construction projects.
- To determine the impact of rework on organizational project performance (cost and time), through case studies.
- To determine the measures for reducing the incidence of rework in construction projects.
- The main objective if the study is shown in fig 3.

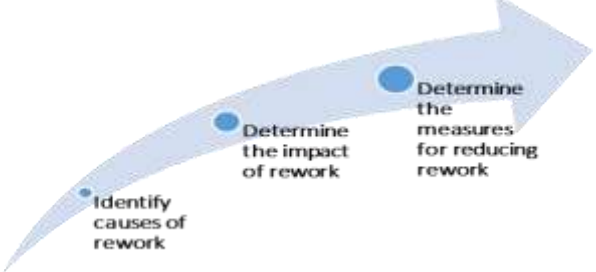

Fig -3: Objective of the study

4. REWORK FACTORS

There are numerous factors that contribute to rework in construction project. The factors which have greater impact on construction project performance. Client Related Factors, Design Related Factors, Contractor Related Factors, Construction process Related Factors.
In addition to the rework causing factors obtained from the literatures, the external factors i.e. the additional factors other than those collected from the literatures were collected through site observation.

i. Operability Changes - changes made to improve operability
ii. Fabrication Changes - changes made during fabrication
iii. Transportation Changes – changes and omissions made in the method of transportation
iv. Human Errors – errors, changes and omissions made during construction

Some of the possible rework areas include

i. Appearing cracks at the corners of concrete elements
ii. Displacement of formwork at the time of placing concrete
iii. Fabricating inaccurately dimensioned concrete elements
iv. Leaking concrete from joints of formwork
v. Changing the designed steel bar diameter due to unavailability
vi. Wasting reinforcement bars by wrong workmanship
vii. Lack of reinforcement bars.

5. QUESTIONNAIRE AND RESPONSE

The questionnaire was designed based on the factors that were identified and is designed to obtain all the required data from the respondent for the successful completion of the project. The questionnaire is divided into 2 sections. The first section contains general information about the respondents such as name of respondent, age, gender, designation, experience, qualification, etc. The second section shows the factors related to scope variance in construction. Based on literatures there are 4 factors considered for the questionnaire design. Each of these considered of several sub factors. The two sections are given below

a) SECTION A: Respondent Identity

b) SECTION B: Factors causing rework.

The respondents were asked to rate their views on rework according to respective rating scale (1 to 5). To protect privacy, respondents were guaranteed with confidentially and nondisclosure of their responses. The questionnaire was distributed through both online survey (Google forms) and Manual survey (questions in persons). The collected data's were analyzed and ranked based on the responses.

5.1 Response Rate

40 questionnaires were distributed to the targeted respondent in order to identify the major causes of reworks in construction industry. In those 24 responses has been received. The responses rate of this survey was 60%. The response rate will be explained in the following table and chart.

Table -1: Respondent's Profile

RESPONDANTS CATEGORY		RESPONSE RATE
Age	(20 - 29)	79 %
	Others	21 %
Gender	Male	72 %
	Female	28 %
Experience	2 – 6 yrs.	41 %
Site Engineers		45 %
Project Estimation	Less than 50 lacks	54 %
	Greater than 50 lacks	46 %

40 questionnaires are distributed to site engineers, design engineers, project managers, and consultants, contractors through both manual survey and online survey (Google forms). Among this 24 response was received during the short period. In this 24 response was received during the short period. The response rate was 60%.

5.2 RESULTS AND DISCUSSION

The survey result shows that 58% of the respondents agree that the client related rework is caused mostly due to inadequate briefing before and at the time of construction. 46% of respondents agree that the client initiated changes causes much rework in site. 50% of the respondents agree that the 2 factors i.e., lack of employee motivation, rewards, labour reallocation to other projects and the personal issues of the contractor leas to rework. 56% of respondents agree that excessive overtime leads to rework. Also around 71% of the respondents do agree that rework can be reduced by qualified consultant or contractor as well as by qualified supervision. It is represented in chart 1.

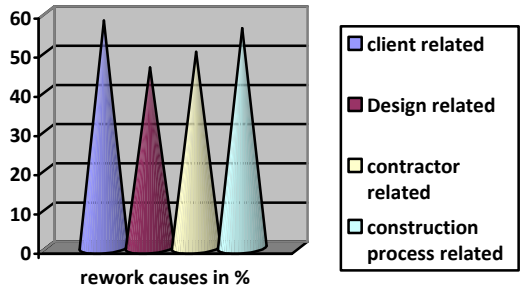

Chart -1: Response rate

6. CONCLUSIONS

In today's world, the construction industry is rated as one of the key industries. It helps in achieving the goals of society. Study and knowledge of construction process is very important because they cause losses to the governing agencies and also influence the rework in the construction industry. Prior knowledge of rework during construction can save money and time. This research is intended to identify the causes of probable factors resulting in rework in building construction. The study investigates all the possible factors through questionnaire survey.

Questionnaires are distributed to site engineers, design engineers, project managers, and consultants, contractors through both manual survey and online survey (Google forms). The response rate was 60%. The survey result shows that 58% of client related, 56% of construction processes and 50% of contractor related factors causes rework in construction.

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