ANALYSIS OF REWORK IN CONSTRUCTION INDUSTRY CASE STUDY –CLIENT AND CONTRACTOR

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ABSTRACT: **The importance of construction industry is approved in all communities. It is one of the major industries in the economic growth and civilization. A huge amount of money, time and energy consuming in this part indicate the important role of this industry. Construction industry not only includes buildings construction, but also covers roads, bridges, dams and skyscrapers construction. The methods of construction improved through thousands of years and new construction technologies emerged meanwhile. As technologies are improved nowadays, construction industry is getting automated and prefabrication method becomes very popular in many countries. Although the role of human in construction is decreased in recent years, still human has a major role, so mistakes are still exist. In the process of construction, mistakes frequently occur and they lead to reworks indifferent stages of construction. In general, rework and wastages are known as non-value adding symptoms that affect the productivity and performance in construction projects and probably the most complete definition of rework is provided by Ashford which defines rework as the procedure that is making an item to adjust with the original requirements by correction or completion. Rework may happen because of the lack of quality control, insufficient maintenance, using unskilled workers and inadequate tools, etc. The reworks sometimes are happenings demolishing and rebuilding and sometimes as requirement of extra works. The most important effect of rework is on productivity and productivity influences cost, time, and quality within the construction project. According to Kazaz and Ulubeyli enhancement of productivity has many advantages such as reducing total cost and production duration, improving quality, increasing product market share, and increasing salaries and employment. Generally, productivity growth is the most important economic indicator through it fast living standard growth could be attained**

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I. INTRODUCTION

The importance of construction industry is approved in all communities. It is one of the major industries in the economic growth and civilization. A huge amount of money, time and energy consuming in this part indicate the important role of this industry. Construction industry not only includes buildings construction, but also covers roads, bridges, dams and skyscrapers construction. Construction methods have been changed enormously since human started to construct shelters. There was not adequate design information and people had to do everything by human force because there was no machine at that time.

The methods of construction improved through thousands of years and new construction technologies emerged meanwhile. As technologies are improved nowadays, construction industry is getting automated and prefabrication method becomes very popular in many countries. Although the role of human in construction is decreased in recent years, still human has a major role, so mistakes are still exist. In the process of construction, mistakes frequently occur and they lead to reworks indifferent stages of construction. In general, rework and wastages are known as non-value adding symptoms that affect the productivity

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1.1 OBJECTIVES

The general objectives of this research are improving the construction quality and optimizing the rework through the use of a case study and conducting a questionnaire survey and by focusing on rework as one of the major problems in construction industry. The specific objectives of this study are:

1. To investigate and identify the rework problem in construction field work.
2. To classify the root causes of rework in construction industry.
3. To determine the impact of rework on project performance.
4. To develop rework reduction strategies by questionnaire survey.
5. The above points will be studied with case study of 2 Public projects and 5 private projects.

II.LITERATURE SURVEY

[1] Peter E. D. Love, ZahirIrani, and David J. Edwards; "A Rework Reduction Model for Construction Projects"IEEE Transactions on Engineering Management, Vol. 51, No. 4, November 2004
Rework is endemic problems in building construction projects.To reduce the incidence of rework throughout the construction supply chain, data from 161completed projects were gathered using a questionnaire survey. Stepwise multiple regression was used to determine the significant variables that contributed to rework in projects. In conjunction with previously reported research, these variables were used to develop an alternative procurement model for reducing rework in projects.

[2] L.O. Oyewobi1, D.R. Ogunsemi "Factors Influencing Reworks Occurrence in Construction: A Study of selected building projects in Nigeria" Journal of Building Performance ISSN: 2180-2106 Volume 1 Issue 1 2010
To improve the performance of projects the research work evaluated rework in some selected building projects in Niger State. The work identified some factors contributing to rework which was categorized under three main headings; technical, quality and human resources factors to actually dig down into the casual of rework. A structure questionnaire was self administered on projects identified to have experienced rework amongst the selected projects and these were ranked according to their perceived degree of severity.
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[3]Ekambaram Palaneeswaran and Muthukaruppan Ramanathan and Chi-ming Tam "Rework in Projects: Learning from Errors"Surveying and Built Environment Vol 18 (2), 47-58 December 2007 ISSN 1816-9554
Construction projects are mainly multidisciplinary and involve several consultants and contractors. Project success is mainly propelled by essential understanding of the design principles and construction methods by various team players. Effective coordination frameworks and efficient arrangements for information and communication are essential for project success.
Reduction of rework and wastages is crucial for achieving good performance in project systems. Rework occurrences in construction projects are mostly avoidable as these are mainly unnecessary redoing/rectifying efforts of incorrectly implemented processes or activities.

[4 Bon-Gang Hwang, Stephen R. Thomas, Carl T. Haas, and Carlos H. Caldas, "Measuring the Impact of Rework on Construction Cost Performance" Journal Of Construction Engineering And Management © ASCE / March 2009

Rework continues to affect both cost and schedule performance throughout the construction industry. In addition, it identifies the sources of this rework, permitting further analyses and the development of rework reduction initiatives. The impacts of rework differ according to project characteristics and that the sources of rework having the greatest impact are not significantly different among project categories. By recognizing the impacts of rework and its sources, the construction industry can reduce rework and ultimately improve project cost performance.

(5) EkambaramPalaneeswaran; "Reducing rework to enhance project performance levels". Proceedings of one day seminar on "Recent development in project management in Hong-Kong"(12 May 2006)
Rework in construction projects is referred to as unnecessary effort of doing a process or activity that was incorrectly implemented in the first instance. In construction projects the rework can be result from the array of factors such as errors, failure, changes, omissions, poor communication and poor coordination. Rework adversely affects on project performance and productivity.
Uncontrolled rework occurrences in construction projects have serious impacts on project performance. The endemic rework occurrences as well as their impacting influences performance and productivity aspects should not be viewed as inevitable. The undesired outcomes related to rework can be substantially improved through developing of adequate awareness as well as structured systems for rework management.

(6) Di Zhang, Carl T.Haas, Paul M. Goodrum, H. Caldas, and Robin Granger;Construction Small-Projects Rework Reduction for Capital Facilities Journal of Construction Engineering and Management ASCE / December 2012 / 1377
Rework is a persistent problem in construction. Reducing field rework is widely regarded as an effective way of improvingconstruction performance in terms of productivity, cost, and schedule. This paper presents a generalized model for a rework reduction program (RRP), which is intended to reduce rework by managing a continuous improvement loop with four functional processes:
(1) rework tracking and cause classification, (2) evaluation of rework and its causes, (3) corrective action planning, and (4) integration of changes into the total management system. Analysis is conducted

to examine and verify the functional mechanisms and effectiveness of thegeneralized model, by investigating a rework reduction program implemented in practice for a series of dozens of small projects executed by three contractors that represents the generalized model, and by analyzing the impact trends on rework in terms of frequency, cost, and laborhours over a considerable time period.
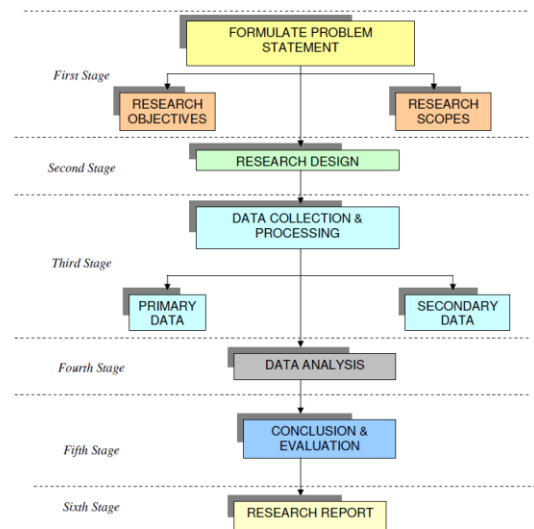
III Project methodology

Figure 1 - Project methodology flow chart

1. First stage - Formulation Problem Statement
- In formulation of the problem statement for this study, extensive preliminary literature studies are required.
- The concepts of "Rework Construction" are required to be further explored and examined before forming the aims, objectives and scopes.
- Sources of references will include journals, technical reports, proceedings, publishing on the Internet and books.
- The aims, objectives and scopes will then be established together with the discussion in order to formulate the direction of the thesis.

2.Second stage –Project Design
- The site visits for observation and study of the construction activities and the non value adding tasks performed.
- Proper collection and compilation of the data hence collected.

3 Third stage –Data Collection

- The method of data collection to be adopted includes:

a. Observation from project site visits

b. Interviews of people from the construction industry by means of questionnaire survey.

4 Fourth stage – Data Analysis

- Comprehensive analysis will be carried out on the data collected via descriptive and inferential statistics.

.5 Fifth stage –Conclusion

- This phase will evaluate and conclude the results from the data analysis and conclude by answering the thesis objectives with the findings from the data collected and analyzed.

- Attach with constructive recommendations for further researches.

6 Sixth stage –Project theses Report

- This will involve substantial submission of write up, organizing the data format and outline.

- Constant discussion with the superiors throughout the write up processes, until the approval of draft, amendment draft and finally the Final Manuscript.
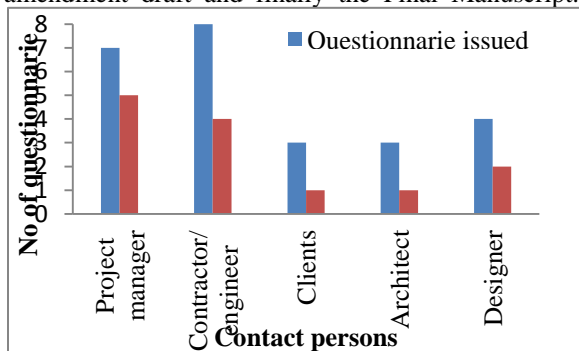
The questionnaires set are given to the respondents. The respondent has to tick the appropriate option. 07 questionnaires were given to project managers from which 05 were returned representing 71.42% response.08 questionnaires were issued to the contractors/engineers 04 were received representing 50% rate of return.03 questionnaires were issued to clients andonly 01 were received representing 33.33% rate of return.03 questionnaires were issued to the architect out of them 01 were received representing 33.33%rate of return. Finally 02 answered questionnaires were received from the designer out of 04 questionnaire representing 50%

rate of return.E-mail was send for the companies which are faraway.All these are represented in table below.

Contact groups	Questionnaire issued	Responses	% of Response
Project manager	07	05	71.42
Contractor/Engineer	08	04	50
Client	03	01	33.33
Architect	03	01	33.33
Designer	04	02	50

Total number of questionnaires issued: **25**

Gross total response:**13**

Overall response rate :$(13/25) \times 100 =$**52%**

Figure 3.1 Response rate of issued questionnaire during survey

(IV) Data analysis

The statistical methods which were used in analyzing the data obtained from of respondents on the causes of construction reworks. Data collected through questionnaire survey from Pune and nearby area and analyzed. Work will be analyzed based on the data provided by Stake holders. Data for study is gathered through structured questionnaire. The other method of data attainment is through consultation with experts and people who work in involved organization by email contact: telephone interviews as well as face to face interviews.

Formulae used.

A) **Mean score ranking** $=$

$$\frac{Sum\ of\ weight\ by\ respondent}{sum\ of\ no\ of\ respondent}$$

1= Strongly agree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly agree

Sample calculation

For cause Lack of knowledge and experience of design and construction process the sample calculation is as follows

A)Mean score ranking

$$= \frac{Sum\ of\ weight\ by\ respondent}{sum\ of\ no\ of\ respondent}$$

$$= \frac{1(6)+2(3)+3(1)+4(1)+5(2)}{13}$$

$$= \frac{29}{13}$$

$$= \mathbf{2.2307}$$

B) Frequency Index

$$= \frac{3N1+2N2+N3}{3(N1+N2+N3)}$$

N1= no. of respondent who answered high

N2 = no. of respondent who answered medium

N3 = no. of respondent who answered low

Sample calculation

For cause Lack of knowledge and experience of design and construction process the sample calculation is as follows

Frequency Index

$$= \frac{3N1+2N2+N3}{3(N1+N2+N3)}$$

$$= \frac{3*2+2*4+7}{3(2+4+7)}$$

$$= \frac{21}{39}$$

=**0.53**

Case study

Detail Mean score rank and frequency index of cause according with respective cause -

In this results detail description about all the factors are discussed. The factors which are considered as cause of rework are studied in detail and based on that the mean score rank and its frequency index is found out.

A. Client related factors –

In client related factors rework arises due to lack of client's involvement in project. The client thought that the work is assigned to the contractor and he will do everything. The first rank according to mean score rank in this area is poor communication with design consultant and that for frequency index is lack of client involvement in project.

Causes of rework in client related factors	Mean Score Rank	Frequency
Lack of knowledge and experience of design and construction process	2.23	0.57
Lack of funding allocated for site investigation	2.69	0.54
Lack of client involvement in project	2.62	**0.72**
Inadequate briefing	3.00	0.59
Poor communication with design consultant	**3.38**	0.59
Inadequacies in contract documents	3.31	0.67

Table: 5.1 Ranking of causes of rework in client related factors
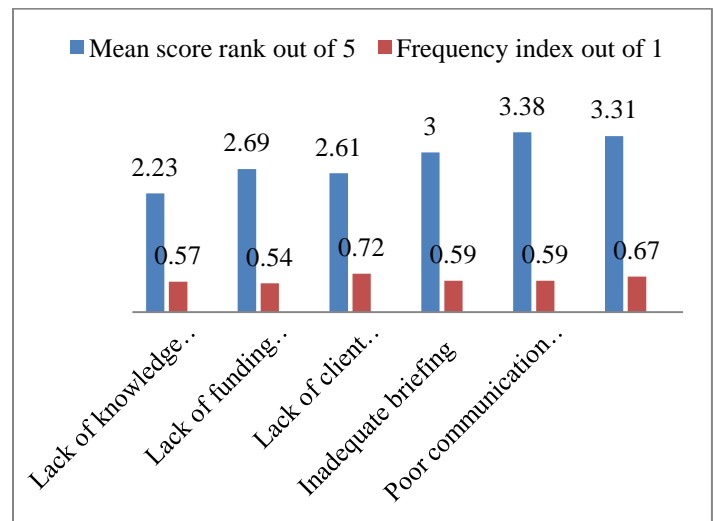

Figure: 5.1 Ranking of causes of rework in client related factors.

C. Contractor related factor-

The quality of work and workmanship is totally related with contractor. Due to lack of knowledge labour performs work in wrong way and then rework occurs. First ranked cause of rework in contractor related factor is inadequate managerial/supervisory skill according to mean score rank and according to frequency index is use of poor quality of materials.

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Causes of rework in contractorrelated factors	Mean Score Rank	Frequency
Poor workmanship	3.38	0.85
Inadequate managerial/ supervisory skill	4.23	0.77
Use of poor quality material	3.69	**0.87**
Use of unskilled labour for execution	**4.15**	0.77

Table: 5.3 Ranking of causes of rework in contractor related factor
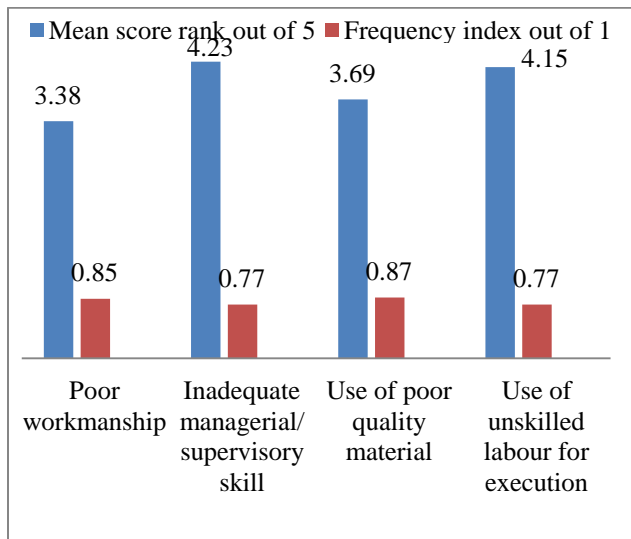
RESULT AND CONCLUSION

In this results detail description about all the factors are discussed. Cause of rework are studied in detail and based on that the mean score rank and its frequency index is found out.

Client related factors –

The first rank according to mean score rank in this area is poor communication with design consultant and that for frequency index is lack of client involvement in project.

C. Contractor related factor-

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