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Applicability of Just-In-Time Technique in Residential Construction Projects in Pune City

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Abstract – Abstract – Residential construction projects arethe major part of overall construction industry. Cost, schedule overruns and rework are common in this industry and therefore various construction management practices can be applied in residential construction projects. Hence this area has been focused for the study. This study concerned about how just in time technique can be applied at the residential construction projects in Pune city.Hence the purpose of this paper was to investigate the applicability of JIT and current situations on the construction site through questionnaire survey, site observations and interviews. This survey helped to understand and identify barriers and difficulties that may be encountered in the implementation of just in time technique and propose effective and efficient means of technique to be adopted by the construction projects in Pune city.

Key words: Just-in-Time Technique, Material management process, Residential construction projects.

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1. INTRODUCTION

Maharashtra accounts for nearly 25 per cent of the total investments attracted by the real estate and construction industry in India, showed a recent study by industry body ASSOCHAM (The Associated Chambers of Commerce & Industry of India). Moreover, the construction industry, considered one of the key sources of employment, income and growth. Housing sector is expected to contribute around 11 per cent to India's GDP by 2020. Most residential construction projects in Pune are affected by several factors that have a major impact on the efficiency of the workforce by reducing their productivity. This affects quality, time and costs of the project.

The reason for that is often poor management of materials, equipment and tools. Proper management of these three important components could increase the productivity significantly. These components should be accurately managed on site, in order for the projects to be successful.Much focus is recently located on projects to be accomplished within the specified project duration.

1.1 Just-in-Time Technique Philosophy:

The Just-in-Time technique is an effective management technique that can determine the success or failure of any construction project. This technique manages the flow of materials, components, tools and associated information regarding ongoing project.JIT endeavours to accomplish smooth generation by giving, the right materials, in the right amounts and quality, just in time for production, and by assuring that the materials are delivered to the site on the actual day of use. Successful implementation of Just-in-time technique could be capable of lessen numerous elements such as inventory level, storage space, manufacturing unit overhead, manufacturing costs, rectification works so that it will lead to improvement in quality.

1.2 Aim and Objectives of the Study:

Aim: The aim of this study is to understand the level of awareness and to find out key issues to implement just in time technique concepts in the residential construction industry of Pune city.

OBJECTIVES:

a. To prepare the questionnaire to check an applicability of theJust-in-Time (JIT) technique in residential construction projects in Pune city.

b. To investigate the applicability of JIT and current situations on the construction site through questionnaire survey.

c. To understand and identify barriers and difficulties that may be encountered in the implementation of just in time technique.

2. LITERATURE REVIEW

2.1 "The Applicability of Just-In-Time in United Arab Emirates Construction Projects" by Mohamed Ali and Dr. Salwa Beheiy.

Some previous research papers in context of construction industry in UAE shows that delays and overruns in construction projects in UAE are prevalent. Therefore, to find out main reasons to delays in materials delivery to construction sites in the United Arab Emirates (UAE), and to discover the applicability of the Just-in-Time (JIT) technique in the UAE construction culture to help to overcome materials delivery delays were the main aim and objective of this research paper. To achieve this target, a proper questionnaire regarding to the many reasons of material delays and the applicability of just-in-time technique in construction industry was developed. The main aim of JIT materials management system in construction project is to optimize materials delivery timing and to minimize inventory quantities. After running the analysis, one result extracted from the survey is that a large portion of respondents agreed that JIT can be applied in United Arab Emirates Construction Projects. This gives a positive sign that Just-in-Time (JIT) can assure construction fluidity in terms of managing materials procurement process in construction projects.

2.2 "Scheduling of composite bridge components transportation in Just in Time system" by Wojciech Bożejko, Zdzisław Hejducki, Mariusz Uchroński, Mieczysław Wodecki.

This paper presents a mathematical model, the theoretical basis and an outline of a computer module system supporting scheduling of transportation and assembly of composite beam bridge structures implemented in the just in time system (called JIT for short). In the optimization procedures there were used algorithms based on the tabu search method. Authors also states that application of fast approximate algorithms for scheduling of construction projects allows us to obtain high quality solutions (in terms of the value of the objective function) in a short time.

2.3 "Assessing the Environmental Impacts of Lean Supply System: A Case Study of Rebar Supply in High-Rise Condominium Construction Projects" by Bae, Jin-Woo1 and Kim, Yong-Woo.

The authors explore the validity of this statement. They investigate the environmental impacts of prefabrication with just-in-time (JIT) delivery on reinforced bar using a building construction case study. The results suggest that prefabrication with JIT delivery consumes less energy but emits more CO2. The study also finds that delivery batch size per truck as well as delivery distance are important factors. Authors concluded that the environmental impact of the delivery and fabrication method of construction materials is a significant issue in the sustainable construction. In this paper, the authors investigated the on-site fabrication with non-JIT delivery and the prefabrication with JIT delivery by comparing energy consumption, CO2 emission, and material loss in a case study.

2.4 "JIT in developing countries-a case study of the Turkish prefabrication sector" by Emel Laptali Orala, Gulgun Mustkoglub, Ercan Erdisc.

The literature shows that the poor supply and demand conditions and the unstable economic environments are the main obstacles for JIT application in developing countries. Other factors include; high costs of; imported technology, training, maintenance and the quality systems, low costs of labour and, the cultural values based on both high power distance and uncertainty avoidance. The Turkish prefabrication sector was analysed as a case study. A questionnaire survey and a number of interviews were undertaken with Turkish prefabrication companies. Frequency, Thurston's Paired Comparisons and correlation coe9cient analysis were used to evaluate the questionnaire results. The results unexpectedly showed that inaction was not an obstacle against implementation of JIT by Turkish prefabrication companies, as it had a trivial e <ect on the companies' supply chain policies. Additionally, unlike in most developing countries material supply conditions were satisfactory. The 2nancial di9culties and the demand uncertainties were determined to be the main obstacles for the implementation of JIT in the Turkish prefabrication sector.

2.5 "Lean Homebuilding: Lessons Learned from a Precast Concrete Panelizer" by Isabelina Nahmens and Michael A. Mullens.

This paper serves as are source to prefabricated construction managers who are attempting to implement lean thinking to improve their production operations by eliminating waste. Lean is both a general way of thinking and a specific production management approach that emphasizes using less of everything to satisfy the customer by delivering the highest quality at the lowest cost in the shortest time. While providing an overview of lean principles, this paper focuses on two fundamental lean concepts, standardization and continuous flow. To develop these concepts, this paper uses a case-study approach to describe the experiences of a large homebuilder.

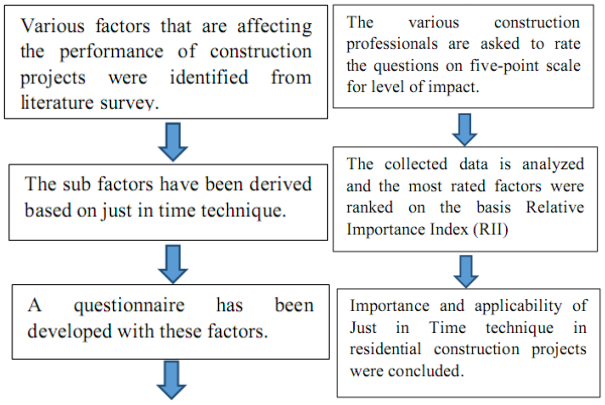
2.6 "Just-In-Time Management of Precast Concrete Components" by Low Sui Pheng and Choong Joo Chuan.

By means of a survey and interviews, this paper helps a precast concrete supplier examine if contractors are ready to adopt the JIT philosophy for receiving and installing precast concrete components on-site. Lessons are drawn from the empirical findings to determine how contractors can prepare for JIT management of precast concrete components. The findings suggest that the contractors are, by and large, obscured by price and have generally overlooked the bigger picture of total costs. Only a minority of the respondents show an interest in JIT deliveries as a cost-saving management system. Conversely, the premasters are better prepared to provide logistical support for JIT deliveries.

3. METHODOLOGY

The research methodology was used to achieve the objectives of the project. This study involves identifying various factors that are affecting the performance of construction projects taken from literature survey. Then sub factors are derived and a questionnaire was formulated. The construction industry experts from various construction firms in Pune city are asked to rate the factors with five-point scale in the questionnaire. The most rated factors where ranked on the basis Relative Importance Index (RII).

The procedure followed in this study is as follows:



Flow Chart 1: Research Process

3.1 Data Collection:

Sixty surveys from professionals in various construction projects from Pune were collected. A questionnaire, based on factors affecting the performance of construction projectwere used to survey and gathered the data for the analysis. Various factors were ranked on the basis Relative Importance Index (RII). From the ranking obtained, it can be stated that this technique can be effectively implemented in residential construction projects to reduced wastes and improve productivity.

3.2 Questionnaire Design:

The questionnaire was designed in such a way that factors affecting the performance of construction project were derived and formulated into main and sub points. The questionnaire was divided into two main sections, whichincluded:

a. Details about respondents and company.

b. Factors affecting the performance of construction project.

3.3 Data Analysis:

The survey is conducted by asking the construction professionals to rate the factors on five-point scale. Number of experts participated in the survey is sixty. Based on the ratings given by the professionals the rating is analyzed using MS Excel 2016 and the following steps are done:

a. Each factor is aggregated based on the rating.

b. Mean value for each factor is found out and each factor is then ranked in ascending order.

1- To assess this questionnaire five point Likert-scale of 1-5 was used, where scale of 1-Not important/Never

2- Slightly important;

3- Average;

4- Highly important;

5- Extremely important.

All the respondents were asked to rank each factor as per degree of importance or severity of factor. The identified factors were then ranked on the basis of Relative Importance Index (RII). (Zeba et al., 2015) The equation used for RII is:

Relative Importance Index = Σ (Pi*Ui)/ (N*n)

Where,

Pi: Respondent's rating

Ui: Number of respondents placing identical rating

N: Sample size

n: Highest value on Likert scale

4. RESULTS:

4.1 Position of Responder:

Extracted information from questionnaires can be presented as follows. Survey questionnaire was designed in two sections. The first section included questions regarding the experience and background of the respondent and his company. This section helps to get an idea about responder's position in this field.

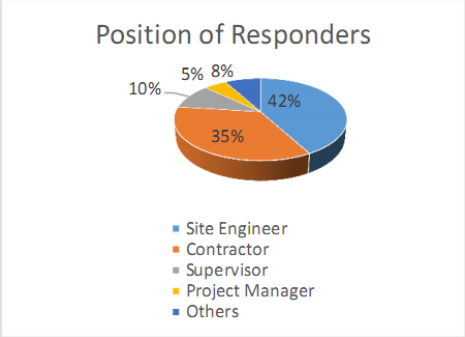


Figure 4.1: Position of Responder

4.2 Working Experience:

Working experience in construction industry responders experience was most effecting factor when doing this kind of survey. Therefore, in this questionnaire form responder's experience was categorized as follow.

1. < 5 years -32
2. 5-10 years -21
3. 10-15 years- 3
4. > 15 years -2

4.3 Factors affecting the Performance of project:

This part of questionnaire consists of 10 main factors which affects the performance and efficiency of construction projects. Also from the result of analysis of this part, key issues of implementation of just in time technique has been found. The RII for all factors was calculated by above shown formula. The mean of RII of various factors leading to each factor calculated as shown in Table 1, 2, 3,4,5,6,7,8,9 and 10.

A. Analysis result of factors related to project:

Table 4.3.1 RII for factors related to project Mean value of RII: 0.63

Sr. No.	Factors related to Project	RII
1	Type of Project	0.69
2	Project Size	0.59
3	Location of Project	0.54
4	Capital Cost of the Project	0.87
5	Site risk factors	0.52
6	Quality assurance	0.56
7	Contractors past experience	0.69
8	Contractors past performance	0.6

B. Analysis result of factors related to clients:

Table 4.3.2RII for factors related to Client. Mean Value of RII: 0.57

Sr. No.	Factors related to Client	RII
1	Client's nature and culture (public or private)	0.67
2	Client reputation	0.47
3	Client's experience in procurement of materials	0.56
4	Client's trust in other parties	0.6

C. Analysis result of factors related to Cost:

Table 4.3.3 Mean of RII for factors related to Cost. Mean value of RII: 0.61

Sr. No.	Factors related to Cost	RII
1	Price competition	0.60
2	Design cost	0.7
3	Consultant fees	0.55
4	Material Cost	0.59

D. Analysis result of factors related to Time:

Table 4.3.4RII for factors related to Time Mean value of RII: 0.64

Sr. No.	Factors related to Time	RII
1	Minimize design time	0.59
2	Time constrains of project	0.66
3	Time control	0.54
4	Delays in obtaining environmental approval	0.62
5	Delay in the project completion time	0.73
6	Delivery time schedule	0.70

E. Analysis result of factors affecting construction process and it's efficiency:

Table 4.3.5 RII for factors affecting construction process and its efficiency Mean Value of RII: 0.67

Sr. No.	factors affecting construction process and it's efficiency	RII
1	Temporary demand	0.67
2	Increase in price of materials	0.74
3	Specialized labour for fixation	0.70
4	Disputes between labours	0.59
5	Changing sequences in construction activity	0.74
6	Non availability of resources	0.75
7	Type of Procurement system	0.51
8	Material procured without planning	0.70
9	Delay in approval	0.56
10	Data related to inventory	0.75

F. Analysis result of factors related to improvement of construction work effectiveness:

Table 4.3.6 RII for factors related to improvement of construction work effectiveness. Mean Value of RII: 0.74

Sr. No.	Factors related to improvement of construction work effectiveness	RII
1	Team goals and objectives	0.79
2	Team relationship	0.85
3	Team leadership	0.76
4	Team communication	0.69
5	Trust and values	0.59
6	Team roles and responsibilities	0.76
7	relations with suppliers	0.75
8	Delivery time	0.81
9	Delivery quantity	0.78
10	Training to willingness of workers to learn new techniques	0.63

G. Analysis result of Problems associated with received materials from suppliers

Table 4.3.7 RII for Problems associated with received materials from suppliers. Mean Value of RII: 0.70

Sr. No.	Problems associated with received materials from suppliers	RII
1	Lack of conformance to requirements	0.68
2	Damaged materials	0.73
3	Inspection in good arrival	0.75
4	Incorrect type of materials delivered	0.74
5	Incorrect sizes delivered	0.61
6	Incorrect quantities delivered	0.73

H. Analysis result of criteria to maintain stock for materials:

Table 4.3.8 RII for criteria to maintain stock for materials Mean Value of RII: 0.76

Sr. No.	criteria to maintain stock for materials	RII
1	Availability of fund	0.83
2	Market condition	0.82
3	Site location	0.80
4	Climatic condition	0.74
5	Project cost	0.81
6	Do you use/prefer JIT delivery	0.73
7	Need for stock management	0.76
8	Maintaining safety in storing	0.77
9	Measurement system to quantify the unused ordered material	0.65

I. Analysis result of Methods to categorize materials:

Table 4.3.9 RII for criteria to maintain stock for materials Mean Value of RII: 0.77

Sr. No.	Methods to categorize materials	RII
1	ABC Analysis	0.79
2	EOQ Analysis	0.84
3	VED Analysis	0.7

J. Analysis result of Relationship with Supplier:

Table 4.3.10 Relationship with supplier Mean Value of RII: 0.8

Sr. No.	Relationship with supplier	RII
1	Vendor selection process	0.8
2	Distance from project site to vendor shop	0.8

Based on the RII analysis, prioritizing of various factors has been done by providing the ranks to respective factor depending on its severity in construction project. From that one can understand the importance of implementation of Just in Time technique in residential construction projects in Pune city.

Table 4.3.11: prioritizing of various factors based on RII mean rank.

Factors	RII Mean	Rank
Factors related to Project	0.63	8
Factors related to Client	0.57	10
Factors related to Cost	0.61	9
Factors related to Time	0.64	7
Factors affecting construction process and its efficiency	0.67	6
Factors related to improvement of construction work effectiveness	0.74	4
Problems associated with received materials from suppliers	0.70	5
criteria to maintain stock for materials	0.76	3
Methods to categorize materials	0.77	2
Relationship with supplier	0.80	1

CONCLUSION:

From the above results conclusions can be made that:

1. Questionnaire related to many factors affecting construction work progress was prepared by studying the literature based on JIT technique.

2. By observing analysis of the questionnaire survey, there are some factors which severely affect the cost, schedule and time of construction projects.

3. Factors such as contractor- supplier relationship, classification and categorization of materials, criteria to maintain stock for materials, construction process efficiency and effectiveness play vital role in material procurement process in any residential construction project.

4. Hence, to reduce the severity of these affecting factors and to improve effectiveness of construction project, just in Time (JIT) technique can be applied as it can deal with these factors.

5. Even if construction and manufacturing are different types of industries but Just in Time technique with some advancements can be applicable to construction projects.

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