

Critical Study, Analysis and Suggestion for Labor Productivity Improvement in Construction Industry

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ABSTRACT

The construction business relies heavily on productivity. It aids the construction sector's achievement of objectives, competitiveness, and stakeholder satisfaction as well as value claims. Different approaches for gauging labour productivity at various levels have been proposed in prior research investigations, but none of them have been demonstrated to be universally gratifying. The entire productivity of a construction project is affected by labour productivity, thus measuring it both qualitatively and statistically is crucial. As construction projects, which involve many complex elements like time and cost. This study uses a preliminary questionnaire to conduct a critical examination of the factors impacting labour productivity. Through the Relative Important Index, a survey and impact analysis of each factor affecting the project were produced. Moreover, one industrial building is selected for a case study and Using MSP Software, all of the building's data was analysed. After analysing 15 different elements, suggestions and guidelines were offered to boost labour productivity. This study aids project managers in taking into account labor-affecting aspects both throughout the project's planning and execution phases in order to gauge productivity.

Key Words: Labor Productivity, Construction Industry, Relative Important Index.

CHAPTER 1 INTRODUCTION

1.1 Preamble:

The largest industry in the world is construction. Construction is the sector that employs the most people, behind agriculture. The 3M Resources business primarily serves the construction sector. Resources used by 3M include people, equipment, and materials. These are the necessities for the sector. Manpower is the most valuable and significant resource in the construction sector. Construction labour productivity is what we would term productivity in the construction industry if we just took into account human capital.

Because labour costs account for between 30 and 50 percent of a project's overall cost, this is the most popular research topic. An important criterion used to assess the trends and degree of progress in the construction industry is labour productivity.

The fundamental issue in this sector is the availability of unskilled labour. They force us to deal with productivity loss, which has a direct impact on the project's cost and time overrun as well as the work's quality. An efficient framework must be established because construction projects are plagued by several issues and complicated elements like cost and timeline. This will increase the project's overall productivity. Labourers should be knowledgeable about the equipment, materials, and tools they utilise in order to increase production.

Existing research studies have recommended many approaches for gauging labour productivity at various levels, but none of them have been consistently successful. The quality and quantity of labour productivity measurements are crucial because they have an impact on the overall productivity of building projects.

This study uses a preliminary questionnaire survey to conduct a critical examination of the elements that affect labour productivity. The impact of each component on the project was calculated using the Relative Important Index. The Relative Important Index was used to quantify labour productivity on construction sites across fifteen different variables.

The planned activities showed a marked increase in productivity as a result of the suggestions and recommendations offered, increasing the site's total productivity. This study aids project managers in taking into account labor-affecting aspects both throughout the project's planning and execution phases in order to gauge productivity.

1.2 Definition of Labour Productivity

The term "Productivity" in construction is defined as the ratio of output and input. Output is the product that we construct any type of structure and input is the resources that we used for construction i.e., workers, material, or any type of machine we can use for construction.

1.3 Significance of labor productivity

The construction industry depends on various internal and external factors that affect the overall cost and time of the project. Thus, productivity has to be evenly poised to save money and time for the project. This can be achieved by continuously working on planning, scheduling, and monitoring the project. To get the anticipated response from project planning and monitoring for the execution, it is also necessary to take into account the major productivity-affecting factors at the project's initiation stage. These elements cause ongoing changes in productivity. It is very important to ensure that decrease in productivity does not affect the plan as well as schedule of the project.

1.4 Problem Statement for Labor Productivity

In any industry productivity loss is one of the serious as well as greatest problems. Different project costs, for example labor, material, and equipment, labor components are considered as of more risk. Whereas other equipment and materials are controlled by market cost and are beyond the control of project management. About 30% - 50% cost of the entire project is consider as Labor cost. Because they are most unpredictable than other project cost components, it is very important to study the effect of various factors on the L.P. labor Productivity is directly proportional to the labor cost.

Previous research indicates that Productivity decrease results from various factors which is beyond bad weather condition, changes in Drawings, and poor management. Due to above listed factors disturbance is produced which affects labor productivity, and it is not in the hand of contractor produces productivity loss.

1.5 Objectives of Research

The aim of this research focuses on the labor productivity loss in construction industry,

The Objectives are stated below –

- To assess the current situation and make a review for productivity improvement in the construction industry.
- To collect current data of Labor Productivity through multi-storied building and industrial building sites.
- To identify factors that affects Labor Productivity.
- To study the effect of time overrun and cost overrun.
- To give suggestive measures to improve Labor Productivity.

1.6 Methodology

- The following methodology will be adopted –
- Collection of preliminary information through literature surveys.
- Assessing the current situation of construction labor by questionnaire survey.
- Identify factors that affect the productivity of the labor.
- Defining the problem that affects the most.
- Analysis of questionnaire survey.
- Suggest best recommendations to increase labor productivity in construction Industry of Kolhapur Region.

CHAPTER 2 LITERATURE REVIEW

2.1 Review of labor productivity from the previous studies

Construction projects involve an interdisciplinary work environment. This includes project managers, architects, contractors, and vendor managers who are all working on a different level of the project platform. However, labour management plays a crucial role in how effectively interdisciplinary work is done. H Randolph Thomas et al. (1991) described the relationship between labor productivity and direct work report in work sampling. The conclusions were based on three premises: that less waiting results in more direct work, that more direct work results in higher labour productivity, and that higher productivity is achieved by less waiting. Data from 162 construction projects were statistically analyzed, and three curves were represented. The curves were Early, Normal, and Late timing situations on labor productivity affecting project was analyzed. Additionally, a residential construction site was taken into account, where the employment improvement (expanding the aspects of work that make workers happy) and the demotivators (aspects of work they dislike) were the major activities directly affecting the project's duration. Workers are persuaded by completing quality productive work, creating or building something, and improving productivity.

Dozzi and S.M. AbouRizk et al. (1993) described different types of methods like Work Sampling, Foreman Delay Survey method, Craftsmen Questionnaire method, Field rating method for measuring labor productivity on site. The goal of Nariman Ghodrati, Tak Wing Yiu, Suzanne Wilkinson, Mehdi Shahbazzpour et al. (2018) was to quantify how well management strategies like labour management, training, communication, supervision, and resource scheduling were implemented in order to increase labour productivity. The complete body of research depends on the statistical analysis of the high-level and low levels of implementation of management strategies.

2.2 Research papers reviews

[1] Gupta Vaishant, R. Kansal (Oct 2014) "Improvement of Construction Labor Productivity in Chambal Region" International Journal of Research in Engineering and Technology,

The author has attempted to summarize the top 10 factors that affect labor productivity in the Chambal region. For this work they consider the 15 factors from the following four groups as 1) Human/labor 2) technological 3) management 4) External. they ranked the top 10 factors in decreasing order to know the importance of factor that affects the most for this the Relative Importance Index method is used. Also, they can define 5 definitions of productivity and classify productivity into two types, 1) Total Factor Productivity (TFP) and 2) Partial Factor Productivity (PFP).

[2] Jamadagni Sneha, Birajdar B. V. (2015) "Productivity Improvement in Construction Industry" International Research Journal of Engineering and Technology Volume: 02 Issue: 08

This paper deal with the factors affecting the labor productivity of the construction industry in the Kolhapur region. To collect the data questionnaire survey is conducted a total of 38 factors were consider to check Productivity. That 38 factors are classified into 4 groups; External, management, human/labor, and technological group. For this, they used the Relative Importance Index method also the Chi-square test. In that calculation, a degree of freedom and Two-tailed P-value for all factors and factors were ranked. concluded with top 10 factors that affect the most and Lastly recommendations are suggested to improve the productivity of the construction industry.

[3] Mohammed Salleh Hammad, Abdelnaser Omran, Abdul Hamid Kadir pakir (2011) "Identifying Ways to Improve Productivity at the Construction Industry"

This paper deals with some ways to improve productivity in the construction industry in Libya. For this interview were carried out with the owner, contractor, and consultant. This paper concluded that the Contractor has the best knowledge and best industry practice to improve productivity. Also, the contractor can provide the training to the labor and provide supervision which helps to improve the labor productivity they state that interview is the best method for collection of data. For improvement they suggest the following points 1) Regular Meeting 2) Safety Planning 3) Training for crew 4) Analyze process in detail 5) provide better planning

[4] Paul Riya, Prof. Mrs. Adavi P. R. (Aug. 2013) "Affect of Labor Productivity on Project Performance" International Journal of Engineering Research & Technology (IJERT) Vol. 2 Issue 8,

Examined on-site labor productivity for this the factors classified into two groups 1st one is the labor characteristics include Quality of work, Job Knowledge, Dependability, analytical ability, communicative ability, ability to work under pressure and leadership. 2nd one is the Project work conditions, which include project size and complexity, job site accessibility, labor availability, equipment utilization, contractual agreements, local climates, etc.

From the above factors, they can analyze and conclude the ways to improve productivity which contain the following solution 1)Analyze the construction process in detail 2)Proper planning 3)Communication 4)Train supervisors 5)New Technologies 6) Health 7) Safety 8) Housekeeping 9)avoid overtime 10)core workforce.

[5] Shashank K, Dr. Sutapa Hazra, Kabindra Nath Pal (May 2014) "Analysis of Key Factors Affecting the Variation of Labor Productivity in Construction Projects" International Journal of Emerging Technology and Advanced Engineering, Volume 4, Issue 5

Identify and ranked the factors that affect labor productivity in Bangalore, India. The research used data from 53 questionnaires. The researcher conducts a reliability analysis, factors analysis, KMO and Bartlett's Test, Multiple Regression Analysis, Hypothesis Testing, these tests help to researcher concluded that the 6 groups out of 8 i.e., Quality, Managerial safety group, Material and equipment, Manpower, and motivation group. The Environmental and schedule group does not affect that much labor productivity. Also, they provide the Recommendation from which the construction industry can improve productivity.

[6] Shehata M. E., El-Gohary K. M. (3 March 2012) "Towards improving construction labor productivity and projects' performance", Alexandria Engineering Journal 50 321-330.

The Construction industry is a labor-intensive industry so this researcher studied about the productivity of labor and overall project performance. In this research, they state that there is no standard definition for labor productivity. In this research they guide us for improvement of labor productivity and for the improvement of the project performance also they state the loss of productivity in the construction productivity. In this paper, they talk about the definition of labor productivity, factors affecting productivity, measurement, aspects, and different techniques to measuring I

[7] Shinde V. J. and Dr. Hedao M. N. (November 2017) "A Review On Productivity Improvement In Construction Industry" International Research Journal of Engineering and Technology (IRJET) Volume: 04 Issue:11

Conduct a survey in the construction Industry. For this prepare a questioner of 69 questions. In this questioner, Factors are added from management, labor, and external group.

In the methodology, they can calculate baseline productivity, performance ratio, time study (timesheet), coefficient of variation, And relative importance factor, and last, the result and conclusion obtained filled the gap, helps to improve Kuwait labor productivity. Concluded that baseline gives the actual position of productivity with the help of survey find out the most impacting factors and perfect remedies are provided to minimize their effect. This helps to save time and cost for the construction industry.

[8] Venkatesh M.P and Saravana Natarajan P.S (November 2019) "Improvement of Manpower and Equipment Productivity in Indian Construction Projects" International Journal of Applied Engineering Research Volume 14

Examine on-site labor productivity in the Indian construction project to the improvement of manpower and equipment productivity for that they do a detailed literature survey and background study. Measure the construction productivity at 3 levels-

- Task-level
- Project-level
- Industry-level

For calculation of task-level productivity following 3 Methods are used to calculate Task Productivity, (1) RS Mean Method, (2) CII Method, (3) Productivity Index Method.

CHAPTER 3

CURRENT STATUS OF LABOR PRODUCTIVITY IN INDIA

3.1 General

This chapter studied the actual condition of the labor and their situation in the construction industry. How their life and situation affect the productivity directly.

3.2 General scenario of indian construction industry

The construction industry is the second largest employer after the agriculture sector, employing more than 35 million people. It is categorized as follow-

- Industrial Construction,
- Commercial construction,
- Residential Construction,
- Infrastructure,
- Energy and Utility constructions, •
Transportation Construction.

The Indian construction industry is an important sector of the national economy, contributing a major part of the Gross Domestic Product (GDP). The share of the construction sector as part of Indian GDP has reached up to 9% in the financial year 2017-2018. The Indian construction industry is expected to register a growth of 13% in the real term in 2021 following a decline of 12.4% in 2020. It is expected to be 1 trillion US\$, by the year 2030 India would be the third-largest construction market globally, as India's urban GDP is expected to reach 7.5 trillion US\$.

Following are some of the reasons, due to which construction market in India is on the Rise –

- Rapid urbanization increases the demand for infrastructure. •
Rising household income
- Investment purpose
- The rise in the number of nuclear families

As per CEIC labor productivity growth data is updated yearly from December 1992 to December 2021, averaging at 5.24%. In December 2019 labor productivity dropped by 2.63%. It is high in December 2016 the value is 9.15% and low in December 2002 value is 1.29%. They calculate labor Productivity from GDP per person employed.

Nearly equal to 15 million jobs lost in May 2021, due to covid 19 pandemic situation. The construction industry took the biggest loss in employment during April-May 2021, reported by the CMIE Economic Outlook. Most of the job in this industry is informal.

Earlier, job losses were concentrated in younger groups. However, these time job losses are concentrated in the elder age group. It is seen that 15 – 29 years did not see any job losses in this covid situation during April – May 2021. But age group of 30-39 years loss of 5.9 million jobs, and those of 40 years of age or more lost

18.7 million jobs. Now it is important to increase the productivity of the remaining labor to complete our project in time and to save the time overrun and cost overrun.

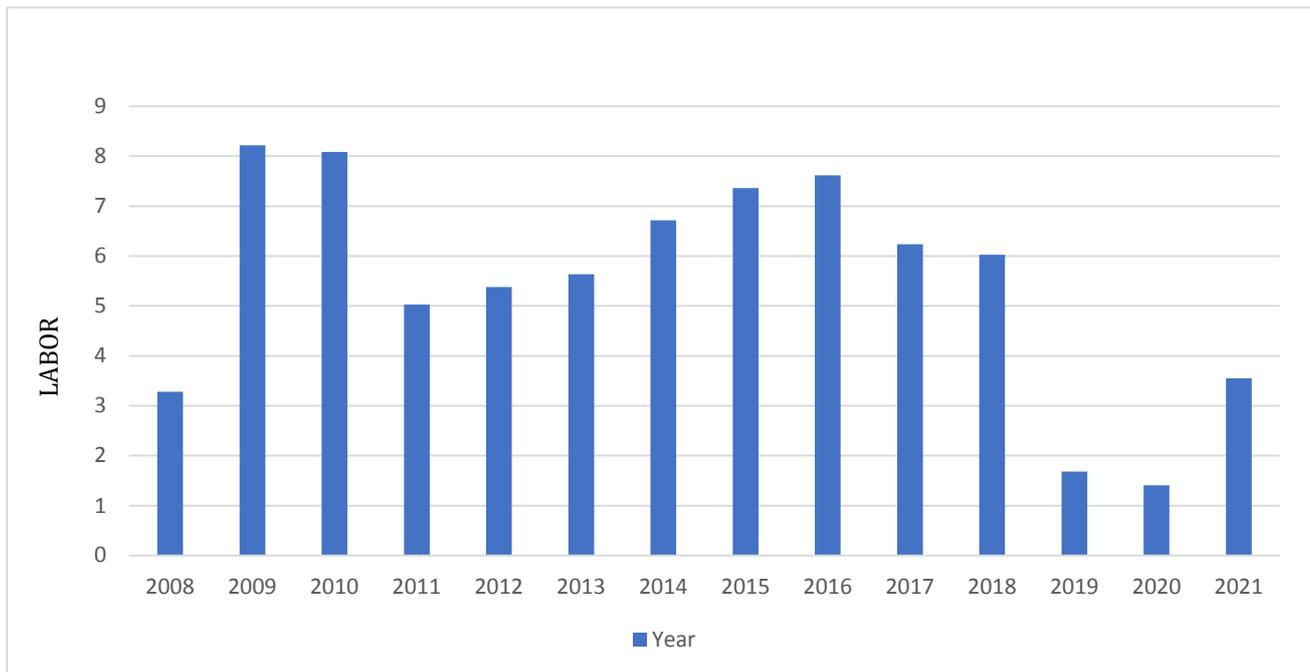


Chart. 3.1 India’s labor productivity growth from 2008 to 2021

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CHAPTER 4 QUESTIONNAIRE SURVEY AND STATISTICAL METHOD

4.1 General

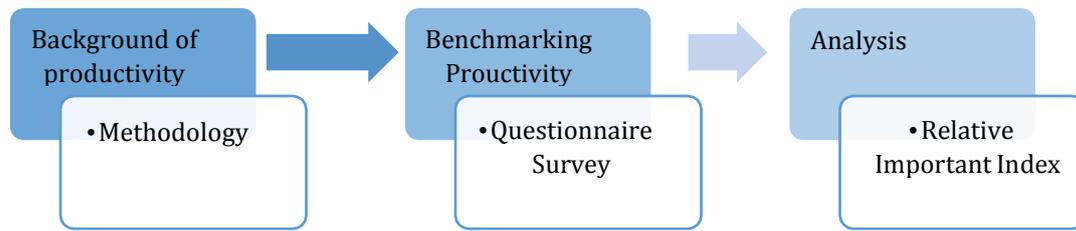
In the previous chapter, the Literature Review on labor productivity in the construction industry is being studied. Now in this chapter, we can concentrate on the methodology for the project work execution and explains the effective use of methods for measuring labor productivity, collection of data. In addition, the chapter also details the method used for the critical analysis of factors affecting productivity on the construction site.

4.2 Project survey planning

The basic aim of the survey is collecting information on various factors affecting labor productivity in Kolhapur region construction industry. At the time of the survey, research purpose was fully explained to the respondents. Also, Instruction and guideline were provided, to reduce errors.

4.3 Methodology

The following methodology was adopted for critical analysis of factors and suggestions for improvement of labor productivity.



Flow Chart 4.1 Projects Work Methodology Plan

The background and benchmarking of labor productivity completely depend on the method opted for measuring. The research first considers the factors affecting the most for productivity through various research studies. From figure 3.1, it is understood that a questionnaire survey is designed to find the rank of factors affecting the most through the Relative Important Index.

4.4 Benchmarking productivity

This section explains the detailed application of the method and its effective use in measuring labor productivity.

4.5 Factors affecting productivity

The questionnaire is designed by consideration of factors affecting the most labor productivity through pre-existing literature and studied model. The following figure 3.2 shows the factors considered in the design of the questionnaire.

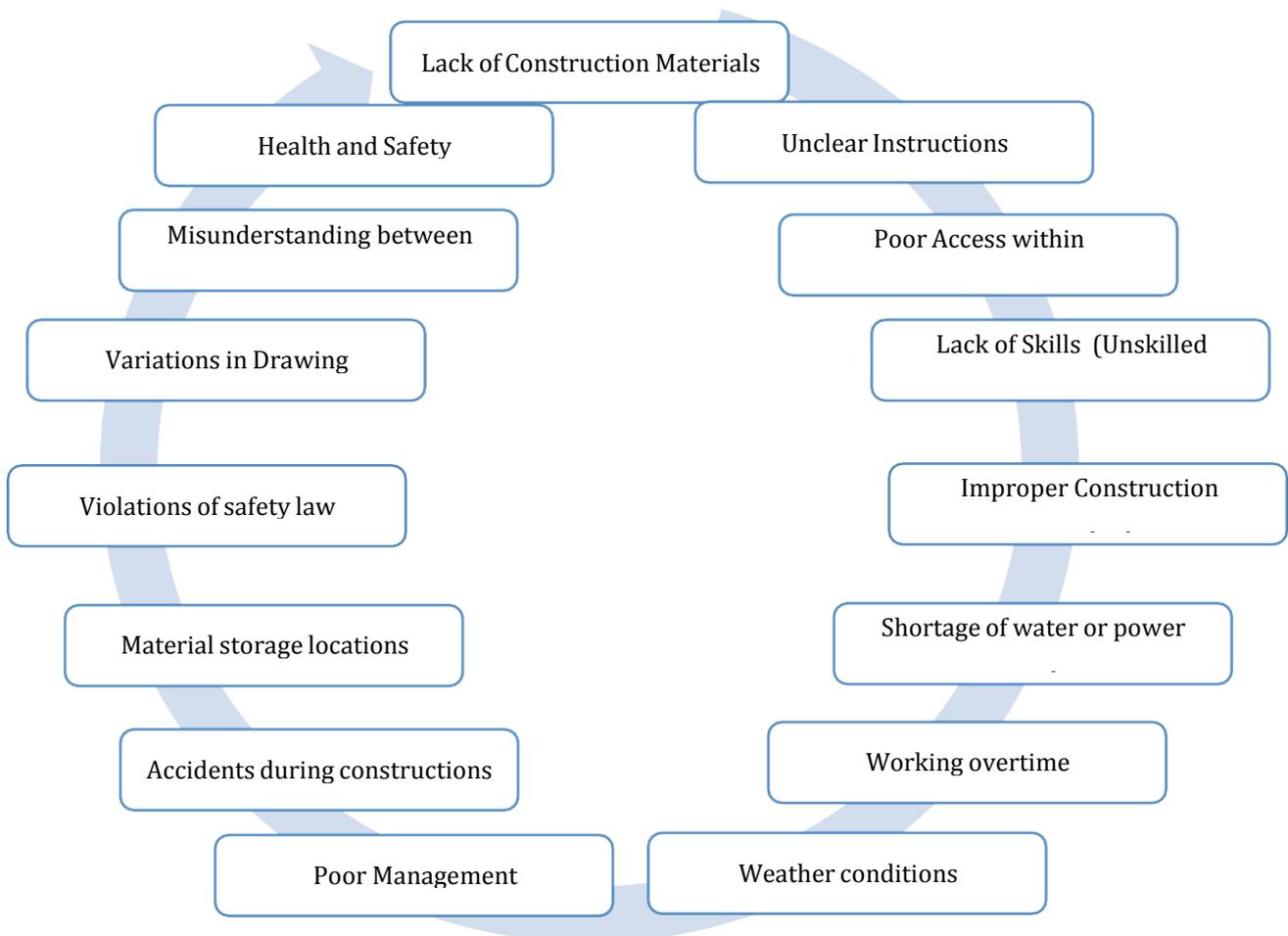


Fig. 4.1 Factors Framework

4.6 Description of labor productivity factors

Management Factors affecting Labor Productivity

1. Lack of Construction Material

Material Shortage was ranked 1st in the management group. 40% - 60% of total project cost is contributed to the material required for project. To improve the labor productivity it is essential to know about the construction material required on site at the time of the construction. Past Researcher indicate that required consideration is not given to material resource management, also its bad effect on labor productivity on site. It is hard to complete site task without the availability of the required material.

2. Poor Access within a Construction site

At the designing stage of the project have to decide on safe access to the site and safe access to all the site activities. The designer should be aware of and access the risk from the principal hazards like

- Struck by falling objects; lowering, slinging of loads in confined space
- Struck by moving machinery and plant; inadequate height, clearance, visibility.

Because of the risks and hazards situations, there is a chance of accidents and it directly affects the time and cost of the project.

3. Shortage of water and power supply

The shortage of water and power supply is a growing problem across the world. As we need the water and the power supply for the most types of machinery and equipment for the speedy work and to maintain the quality of the work. Shortages reduce average output by about five percent, but because most inputs can be stored during outages, productivity losses are much smaller. Sites without generators have much larger losses, and because of economies of scale in generator capacity, shortages more severely affect small plants (Hunt Allcott, 2014)

4. Poor Management

The important factor that leads to low productivity in the construction site is poor management. It is very important to implement productive ways of doing things but it is seen that manager does not take steps for productive work, and its effect on productivity as worker feels that their work is not recognized by site engineer, they don't give their 100% at the site and its effect on productivity.

5. Storage Location

The storage location is under the management group. The construction labor productivity is highly affected by unsuitability of material storage location. This outcome has further maintained that the required size of materials storage has a noteworthy influence on masonry productivity. To overcome this has to move machines or workers from their original place to long distance. This results in waste of time on site. Also, material, therefore productivity will decrease.

4.7 LABOR/HUMAN FACTORS AFFECTING LABOR PRODUCTIVITY

1. Lack of skills (Unskilled labor):

Labor skill is the 1st and important factor from the Labor/Human group. Temporary employment with different contractors develops different methodologies and work habits in labor. Besides, contractors do not anticipate an extended association with workers thus they are willing to develop labor as they do not want to train workers for competing businesses. Poorly trained and untrained laborers have affected the quality, time, and cost of the project directly.

2. Improper construction method:

The construction technique employed is at the discretion of the contractor and depends on the resources available to him. Expertise plays a pivotal role in choosing the construction method and execution of the system. Severe disruption can arise when the workforce is not familiar with the construction method. Design oversight may provoke this factor as contractor input is not always present in assessing the constructability of a project. It is important to adopt proper construction methods for better productivity.

3. Working overtime:

This factor is under the labor group which affects labor productivity directly. Working overtime is a negative factor. Due to Working overtime various problems such as reduction in safety and an increase in absenteeism happened. The extra work under overtime is usually the paid time and half of the regular wages. If the worker can work in the time without overtime the productivity is perfect and the time increases productivity decreases.

4.8 TECHNICAL / CLIENT FACTORS AFFECTING LABOR PRODUCTIVITY

1. Variation in drawings

It is common for the project construction phase to begin before a design has been completed; this frequently results in variations due to constructability problems owing to the design or existing in-situ construction.

Thomas and Napolitan (1995) calculated an estimated 30% loss in efficiency when alterations are being performed. Whenever changes are made it is important to give the additional time so that resources and manpower can be updated as per the change.

2. Unclear Instructions

This factor is under the client group. Relaying information from client to management and from management to labor and vice versa is challenging for both parties but it is essential on the job site. Inaccurate or ambiguous instruction has been identified as a particular concern for laborers. Important for any project's success is setting up the communication between site management, labor, and the client.

For example, if the communication plan is full of errors, then project staff will be unavailable or unable to communicate for part of the project. The opposite of this situation is also dangerous: too much communication leads to data overload, meaning that useful information is lost amidst a sea of irrelevant information. High-quality project communication is preferred and provides accurate, complete, and timely information that instills calmness and a sense of being in control.

3. Misunderstanding between Owner and Contractor

Everything must be clear between the owner and the contracts because if the communication is clear between these two parties then the only contractor can give instructions to the labor and the employees, and the work is online as per instructions. If there is a Misunderstanding between the Owner and Contractor then it will affect the work of the labor and the productivity of the labor decreases.

4.9 EXTERNAL FACTORS AFFECTING LABOR PRODUCTIVITY

1. Weather Conditions

Weather conditions affect productivity most because there are so many changes in the season, as construction is scheduled to take advantage of the dry season, wet weather is unavoidable and can reduce output on-site. labor usually becomes uncooperative during rainy weather and workers use the occasion to be absent or leave early despite the condition not directly affect their tasks. Rain is that external factor that is related to bad weather conditions that decreases labor productivity, some activities are happened outside such as formwork, concrete casting, external tiling, and external painting etc. bad weather condition sometimes stop the work.

worker's efficiency and productivity drop as the temperature drops. workers who move frequently from place to place at severely affected by low temperature. Under extremely low conditions, efficiency and productivity can drop 50% or greater. People may become uneasy and lazy in the heat. People have been seen to have trouble breathing, feel exhausted, etc. in hot weather. These elements may also have an introducing effect on labour productivity.

2. Accidents during Construction

The construction industry is most unpredictable and unsafe industry as compare to other industries. The some of the causes of accidents are related to the unique nature of the industry, such as poor safety management, human behavior, and, difficult work on-site conditions., The working environment is constantly changing in the construction industry so that risk changes daily. Because of this if the accidents happen then it directly affects the time, cost, and quality of the work. Violation of safety laws

It is very important to follow all the safety rules and regulations, but it is seen that when the site is big and the workers are more the rate of violation is also more and it directly affects the productivity of the labor because as they don't follow the safety laws, the accidents and problems are going to happen and started to decrease in the productivity. To overcome this have to conduct regular inspection, required to train employees, tag, lock or remove all unsafe equipment or tools, provide lighting and illumination for all work areas.

3. Health and safety

This is the important factor from the external factor group. The health of the employees is important because it is directly affected the productivity of the labor. If the labor is a week or feel illness then the productivity is directly decreased, and it affects on time and cost of the project also the quality of the project.

For more understanding we decided to do field visits and collect the data regarding labor productivity, a survey form (Attached in Appendix A) was generated through the Questionnaire. Our target was Industrial buildings and multi- storied buildings. Therefore, we started from the Industrial buildings from Kolhapur region to collect the data. We have visited 5 ongoing construction sites of Industrial buildings. As per the questionnaire survey prepared, we have collected data for industrial building construction based upon selected factors.

For better approximate evaluation purposes of labor productivity in the construction industry, we have selected field experts/professionals who have industrial experience of more than four years. The questionnaire survey format of labor productivity consists of 15 response factors, including initial information, defining Likert scale for the collection of data from Industrial as well as multi-storied buildings of Kolhapur region.

While designing the Questionnaire survey form, special measures were considered that are listed below

- The preliminary text was introduced for explaining the survey project to the respondent.
- Easy way of Communication for the respondents, to give their review and suggestions about the conduct.
- Logical questions were avoided to procure responses and reduced drop- rate time.

Care was taken that initial questions do not influence negative impact on subsequent questions.

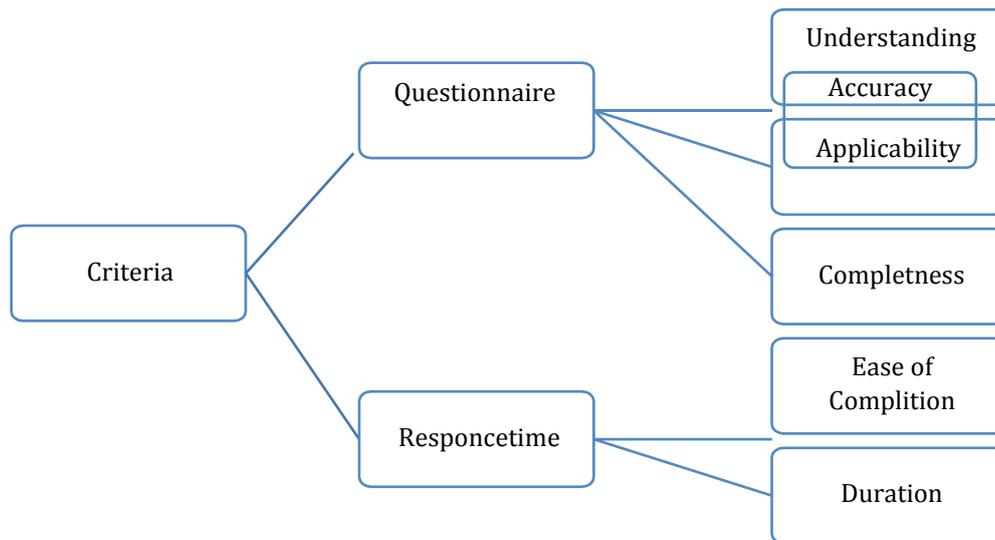


Chart: - 4.2 Criteria for Questionnaire design Process

Flowchart 4.2 despite the criteria that were considered during the design of a questionnaire survey. The following figure showed a snap of questionnaire survey from Google forms that were shared with construction industry professionals.

Section-1: Contains the questions regarding the general information of the construction organization.

Section 2: Consists of 15 factors, both the snap of sample section 1 and section 2 are shown below:

Carefulness and productivity were achieved by examining the accuracy and completeness of the related questions, taking into consideration the previous studies. Great care was taken to assure respondents get precise duration to respond to the questionnaire.

The average time required to complete the questioner is 5 to 7 minutes. Max. Duration of 10 days was allocated to complete the questionnaire. The questionnaire is simple and easy to understand for the respondents. We classify these responses into four groups depending on the type of building construction, they were as follows.

The total 15 responses are classified into 2 building types, see table. () These responses from industry experts were further used for analysis using the RII method. But we calculated the RII only for 3 groups which are 1. Commercial, and 2. Residential because as mentioned in the objective we have to study multistoried buildings and Industrial buildings. In other buildings, it includes roads, bridges, irrigation, etc.

Sr. No.	Building/InfrastructuresType	No. of Respondents
1	Commercial	3
2	Residential	12
Total		15

Table 4.2: No. of Respondents for Building/Infrastructures

4.10 STATISTICAL METHODS USED TO CALCULATE LABOR PRODUCTIVITY

There are numerous methods to measure labor productivity on site. However, the specific method to be chosen depends on the resources and project executing the team's efficiency. The different types of method that can be used are given below.

- Work Sampling Method.
- Foreman Delay Survey Method.
- Field Rating Method.

- Craftsmen Questionnaire.
- Five-Minute Rating.
- Method of Productivity Delay Model.
- Charting Techniques.
- Simulation Modelling and Analysis.
- Field Surveys.
- Relative Importance Index.

4.11 RELATIVE IMPORTANT INDEX

To facilitate the study, a plan was made for collecting site data and creating an examining process and numerical values. For clear understanding of all the applicable definitions, and guidance that were used in collecting data, it was necessary to provide straightforward communication to respondents.

- Calculating Relative Importance Index (RII).
- Ranking of the various factors according to their significance, and Ranking
- Analyze the factors in the questionnaire are significant or no-significant.

The Relative Importance Index (RII) was used to decide various professional's opinions of the RII in the

RII Sheet					
Name - _____ Name of Company - _____ Mail id - _____ No. of Workers in the Company - _____ Site Location - _____ Type of Building Construction - _____					
Sr. No.	Delay Factor Description	Likert Scale of Four ordinal Measures			
		1	2	3	4
1					
2					
.					
15					

construction project. RII is calculated as stated below.

Table 4.5: RII Sheet for data Collection

$$RII (\%) = \frac{4(N4) + 3(N3) + 2(N2) + 1(N1)}{4(N4 + N3 + N2 + N1)} \times 100$$

Adopted scale is Four-point scale ranging from 1 (Not Applicable) to 4 (Directly affect) and it is transformed to relative importance indices (RII) for each factor as follows.

Where,

N1 = number of respondents who voted for Not Applicable

N2= number of respondents who voted for Does not affect

N3= number of respondents who voted for Somewhat affect

N4= number of respondents who voted for Directly affect

N is the weighting given to each factor by the respondents (ranging from 1 to 4). The RII value had a range from 1 to 4, the higher the value of RII, the more important was the factor affecting labor productivity. the RII was used to rank (R) the different factors affecting labor productivity.

CHAPTER 5 DATA COLLECTION AND RESPONDENTS' ANALYSIS USING RII METHOD

5.1 General

In the last chapter of the Survey Design and Methods, we have studied the actual work we have to carry out to collect the data and different methods used to calculate that data. Now in this chapter, we discuss the method which we used to analyze that data and also check the rank of the factors.

5.2 ADOPTED METHOD - RELATIVE IMPORTANCE INDEX

The results of the analysis on factors affecting labor productivity were obtained using the Relative Important Index. The factors discussed in the earlier point were drawn into a questionnaire survey with a metric scale. The range lies from 1-4 dissipating its importance shown in table (5.1) The questionnaire survey was sent to the construction industry, to get responses and feedback from the professionals.

Sr.No.	Explanation	Index	Range
1	0% delay contributing factor. Estimating factor is not affected by these factors at all.	Not Applicable	1
2	1 - 30 % delay contributing factor. Total delay is slightly affected	Does not Affect	2
3	31 - 60 % delay contributing factor. Total delay is moderately affected	Somewhat affect	3
4	60 - 100 % delay contributing factor. Total delay is directly affected	Directly Affect	4

Table 5.1: Scale used for Data Measurement

The relative importance index (RII) for all factors was calculated. Meanwhile, the group index was calculated by taking the average of factors in each group. The maximum value of the RII is 100 when all respondents answered, "very high effect" and the minimum value of the index is 0 when all respondents answered, "affects with a little degree". Since the results are obtained as decimal numbers instead of integer numbers, a specific scale should be established. Thus, 5 expressions are defined by the intervals of 20 to classify the affected level (see Table 5.2).

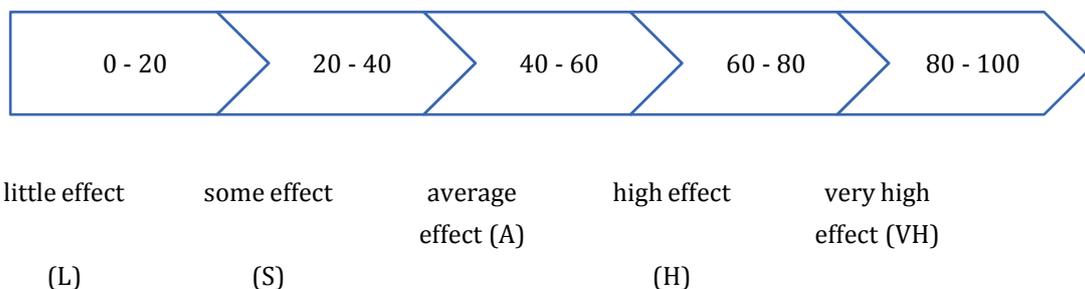


Table 5.2 Scale used for Ranking of Factors

5.3 DATA COLLECTED, RESPONDENTS ANALYSIS AND FACTORS AFFECTING LABOR PRODUCTIVITY FOR RESIDENTIAL BUILDING & COMMERCIAL

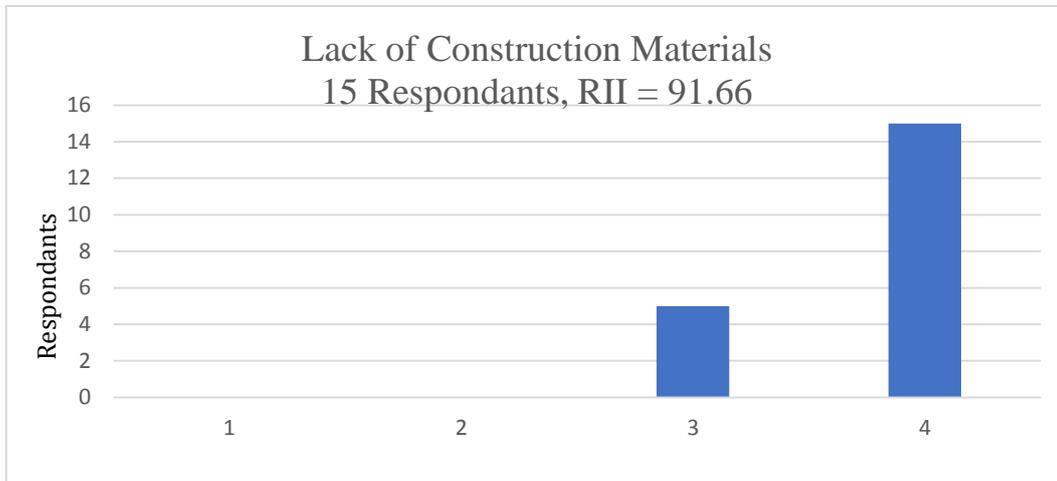


Chart 5.1: Scale for lack of construction materials

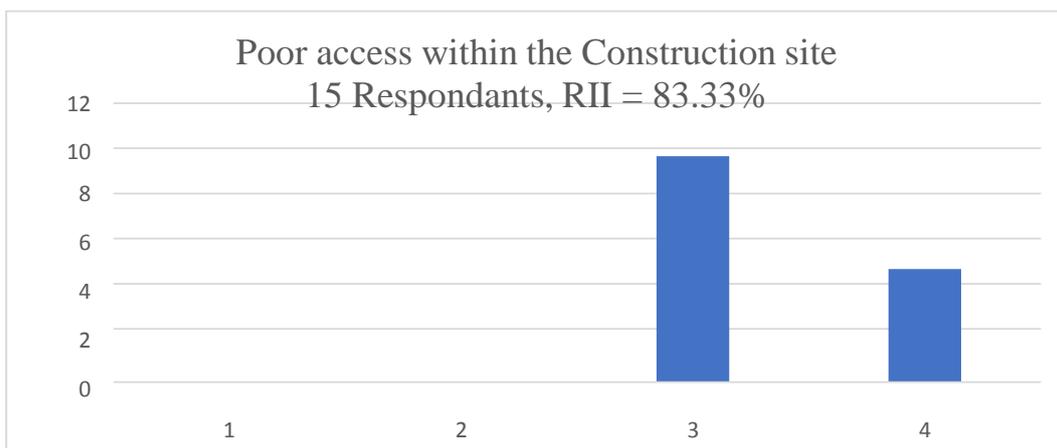


Chart 5.2: Scale for Unclear Instructions

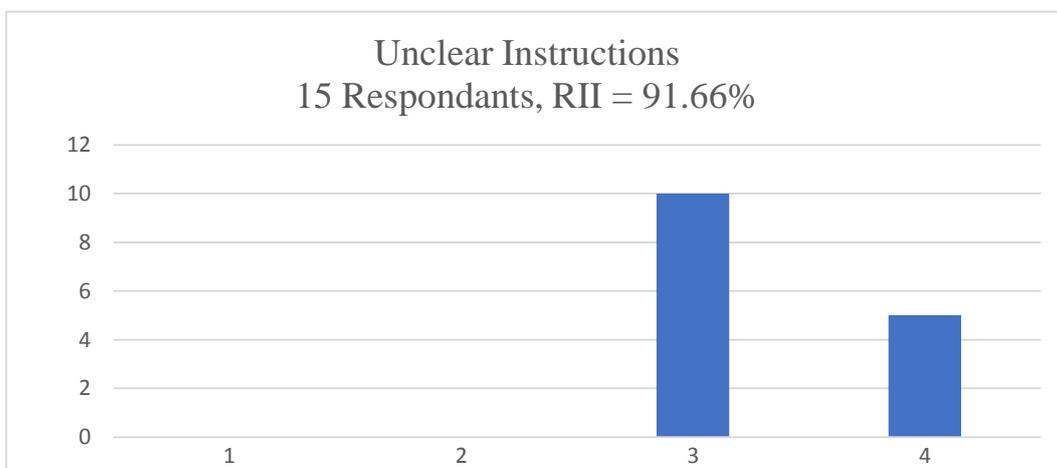


Chart 5.3: Scale for Poor access within the Construction site

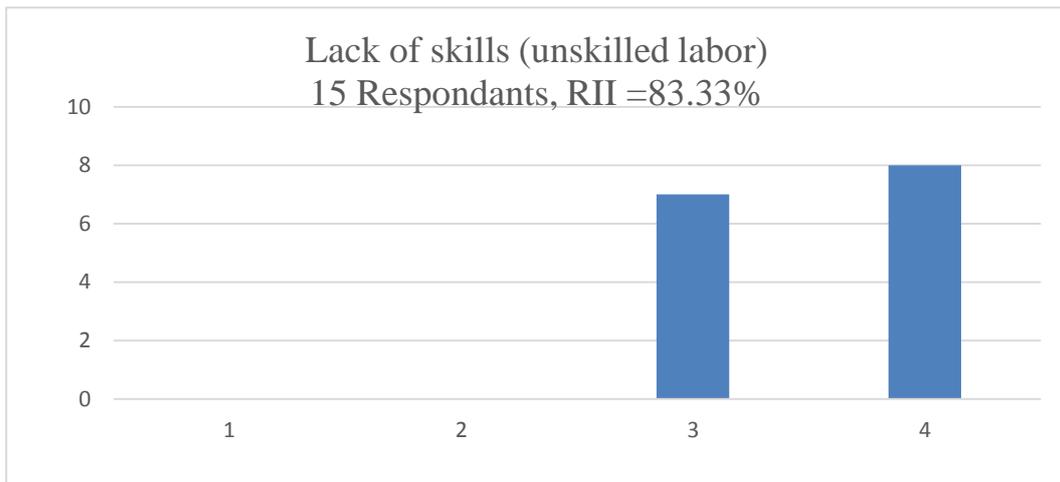


Chart 5.4: Scale for Lack of skills (unskilled labor)

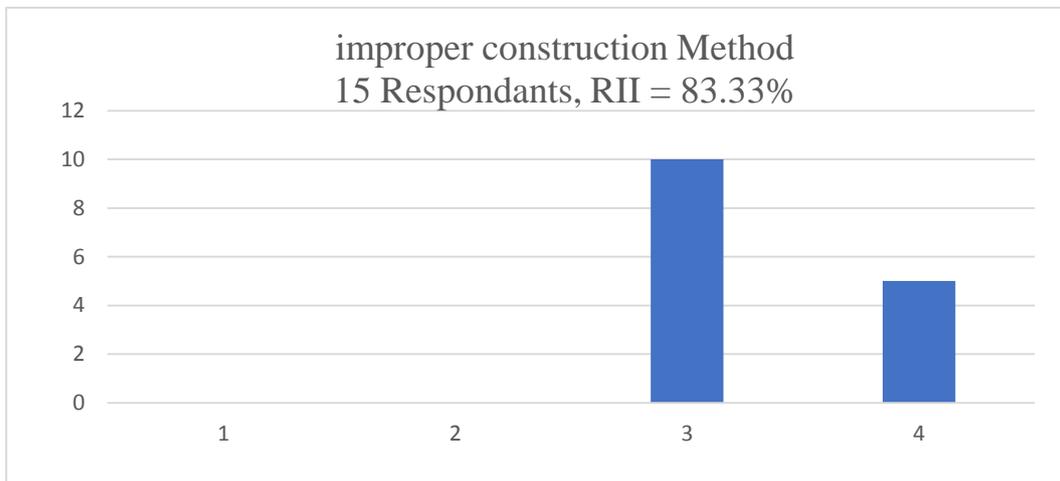


Chart 5.5: Scale for improper construction Method

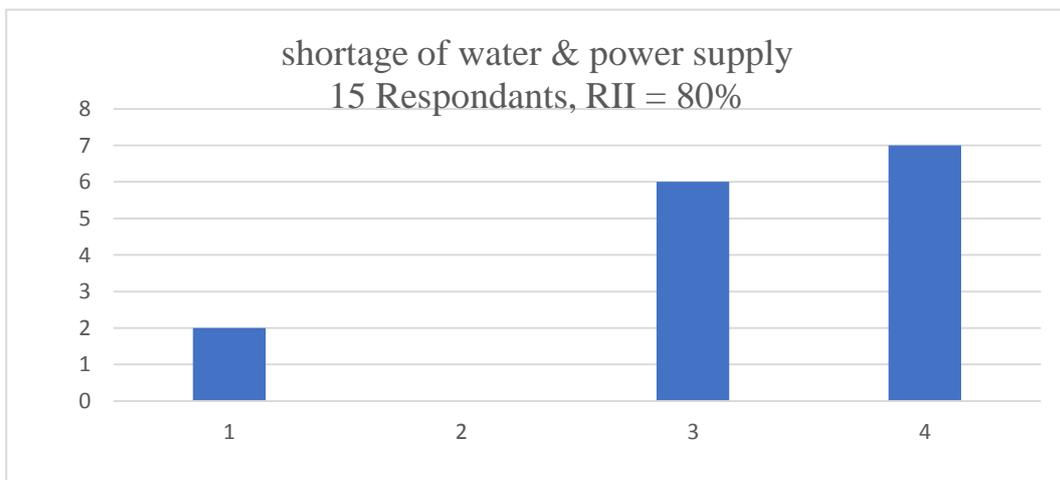


Chart 5.6: Scale for shortage of water & power supply

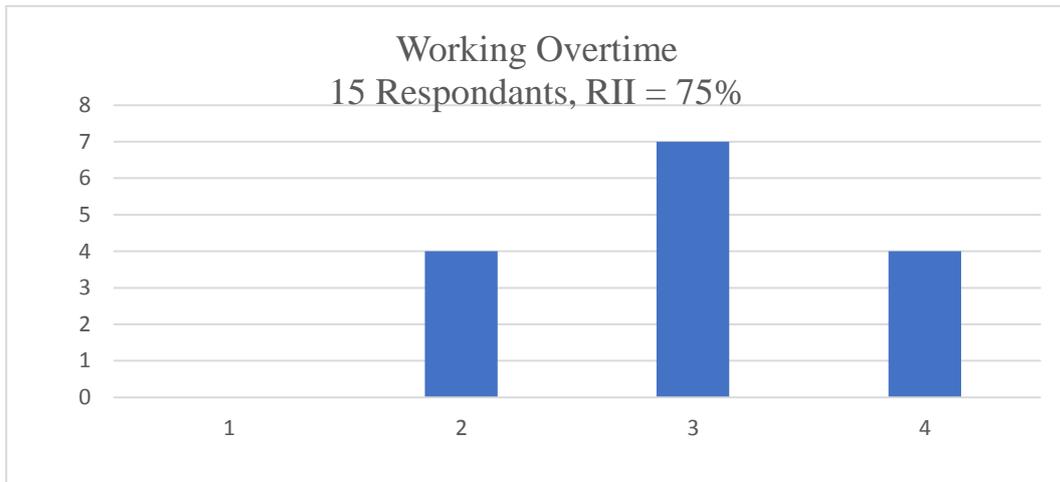


Chart 5.7: Scale: working overtime

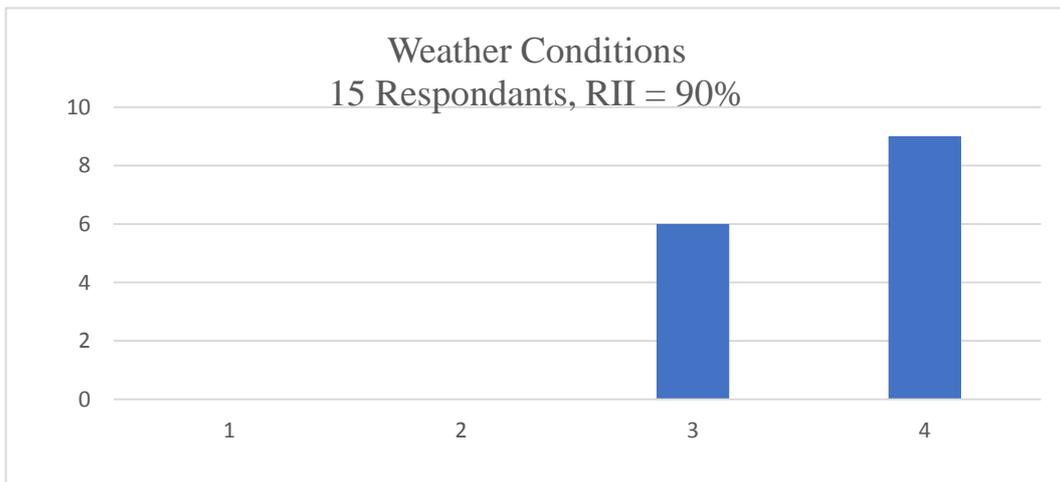


Chart 5.8: Scale for Weather Conditions

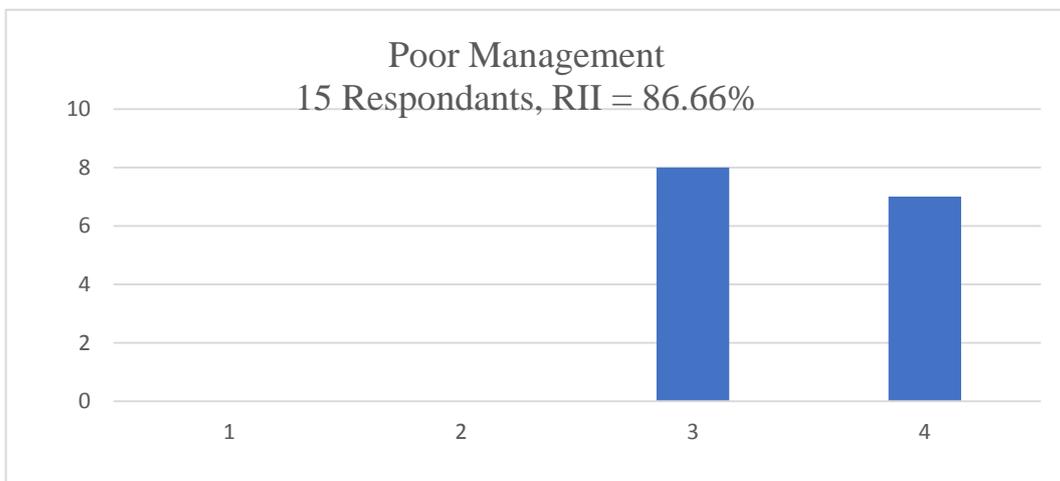


Chart 5.9: Scale for Poor Management

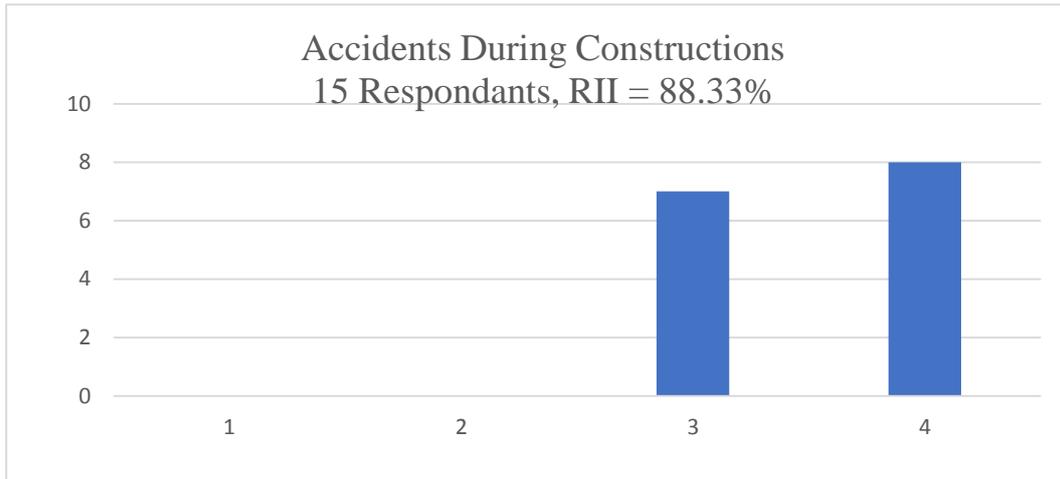


Chart 5.10: Scale for Accidents During Constructions

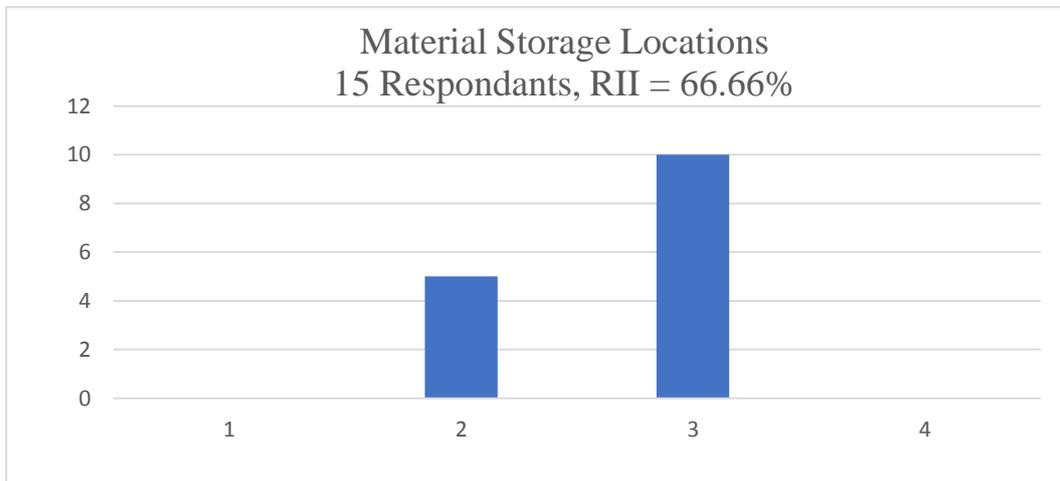


Chart 5.11: Figure – Scale for Material Storage Locations

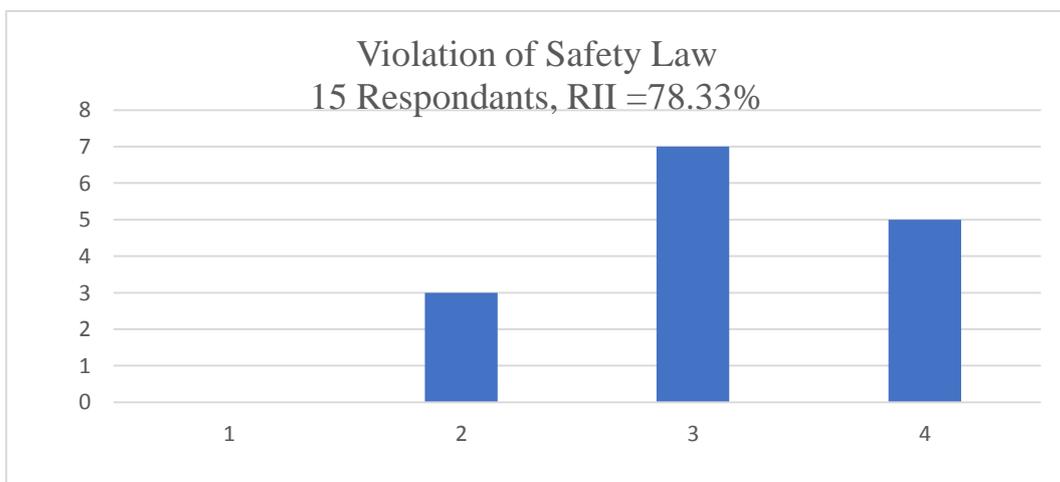


Chart 5.12: Scale for Violation of Safety Law

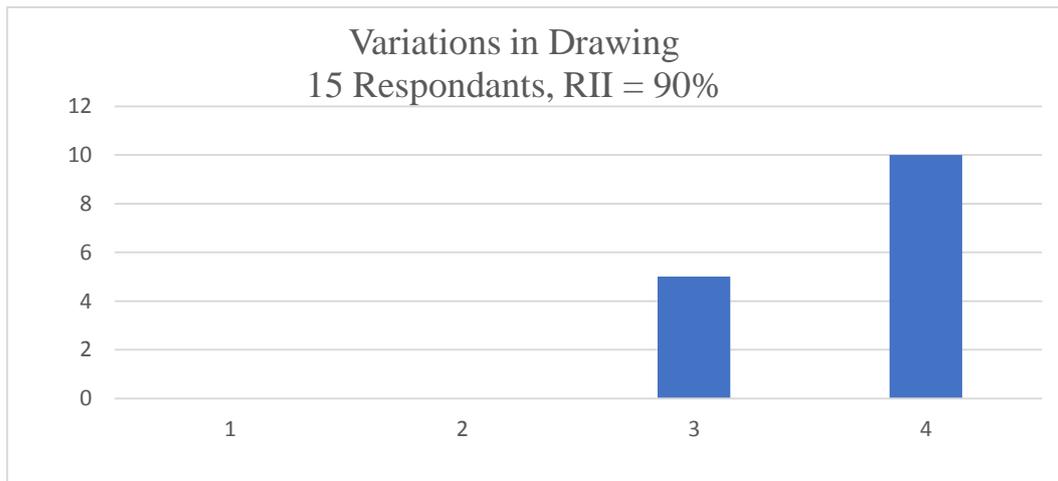


Chart 5.13: Scale for Variations in Drawing

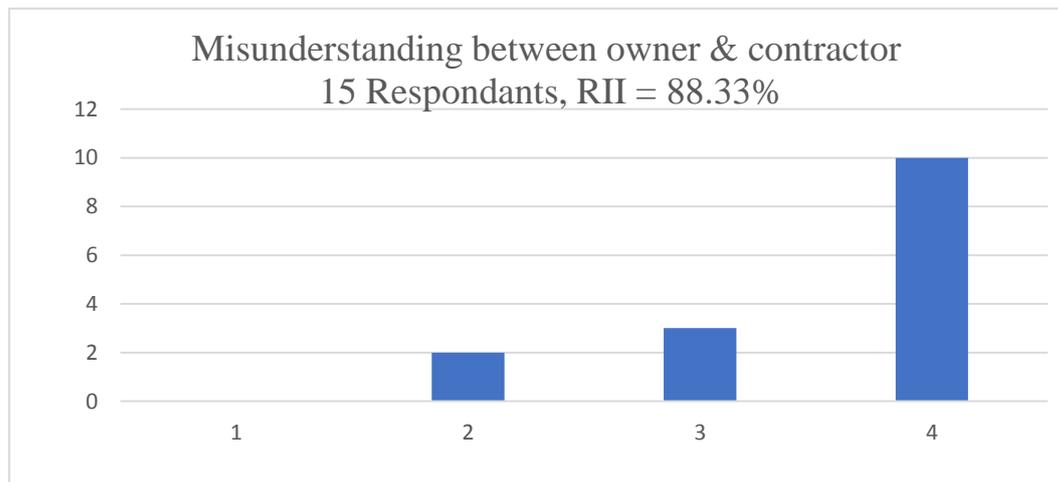


Chart 5.14: Scale for Misunderstanding between Owner and Contractor

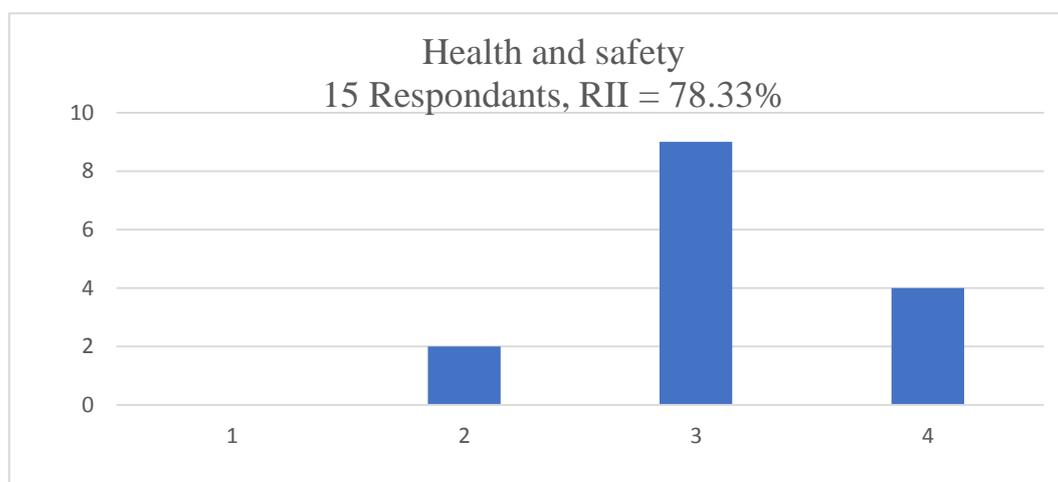


Chart 5.15: Scale for Health and Safety

Sr. No.	Factors	RII	Rank
1	Lack of Construction Materials	91.66	1
2	Weather Conditions	90	2
3	Variation in drawing	90	3
4	Improper construction method	83.33	4
5	Accident during construction	88.33	5
6	Misunderstanding between owner & contractor	88.33	6
7	Lack of Skills (Unskilled Labor)	88.33	7
8	Poor management	86.66	8
9	Poor Access Within Construction Site	83.33	9
10	Unclear instruction	83.33	10
11	Shortage of water	80	11
12	Violation of safety law	78.33	12
13	Health And Safety	78.33	13
14	Working overtime	75	14
15	Material storage location	66.66	15

Table 5.3: Rank wise Factors Affecting Labor productivity for Residential Building

Outcome: It is seen that when surveyed the residential building site, the building sites are smaller as compared to Commercial Buildings, and Industrial Buildings. Therefore, the factors that affect the productivity of labor are different than the big site factors. The topmost factors are improper construction methods, Misunderstanding Between Owner and Contractors, Unclear Instructions, poor management, lack of skills, Accidents during Construction, variation in drawing, shortage of water and power supply, and material storage location. All the factors have the RII above the 80.00%.

CHAPTER 6 CASE STUDY ANALYSIS OF DECCAN ELECTRO INDUSTRIAL PROJECT

6.1 Details of the work

Project:

Expansion Work "Deccan Electro Works Pvt. Ltd. Plot No. 76, MIDC Gokul Shirgav.

Consultant:

Dr. V. M. Shete, Architect and Engineer, A/p – Nagaon (Phata), Tal. Hathkananagale, Dist. Kolhapur.

Sr. No.	Description of the work	Particulars
1	Total Plot Area	2100 Sq. m.
2	Existing Building	237.52 Sq. m.
3	Proposed Building 'A'	525 Sq. m.
	Proposed Building 'B'	154 Sq. m.
	Proposed Building 'C'	72.68 Sq. m.
4	Total Built-up Area	989.80 Sq. m.
5	FSI Consumed	0.47 (Under 0.5)

6.	Project Cost (Estimated)	Rs. 50,90000
	Material Cost	Rs. 44,38400
	Labor Cost	Rs. 6,51600

Table 6.1: Details of the Industrial Building

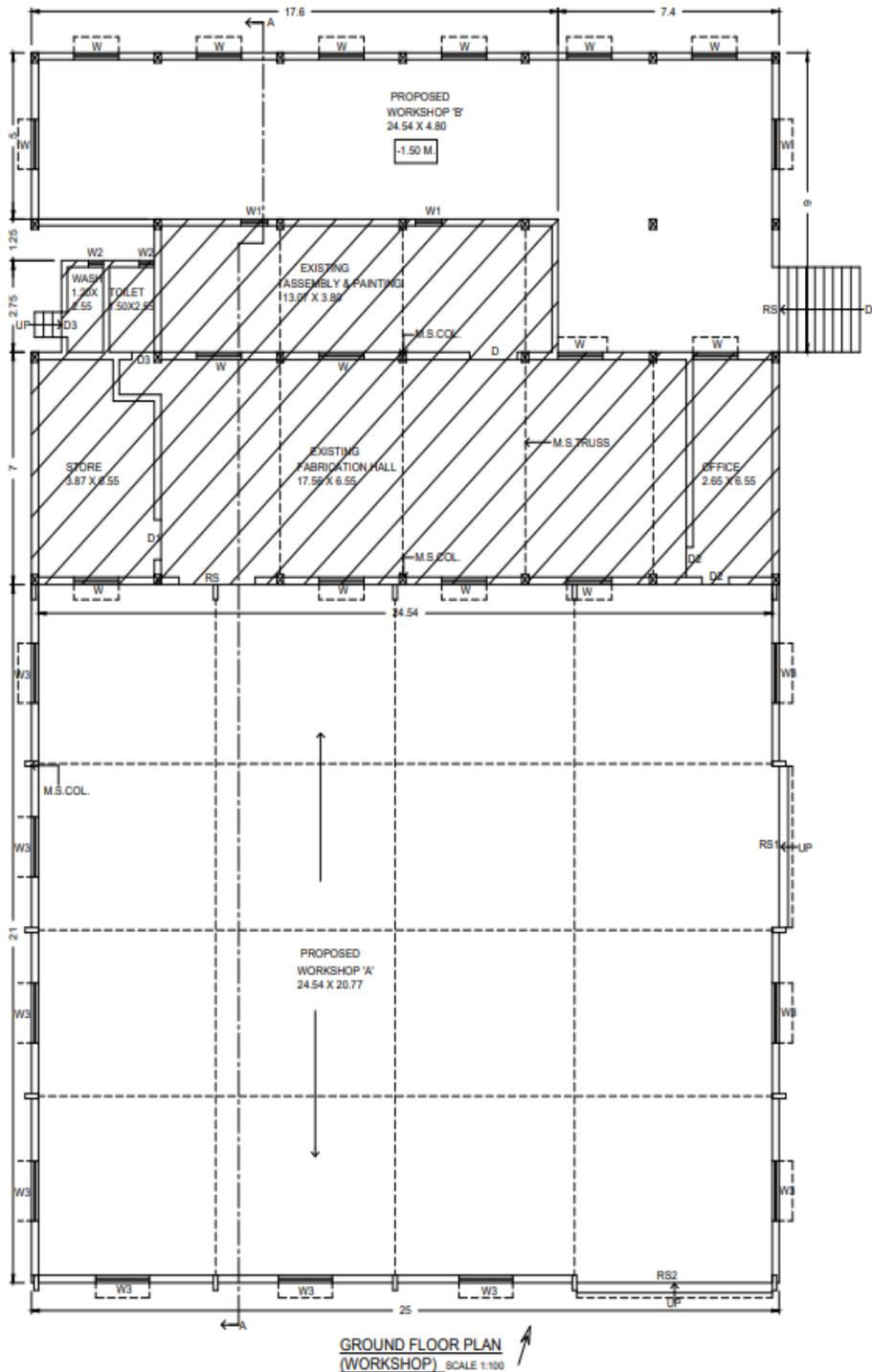


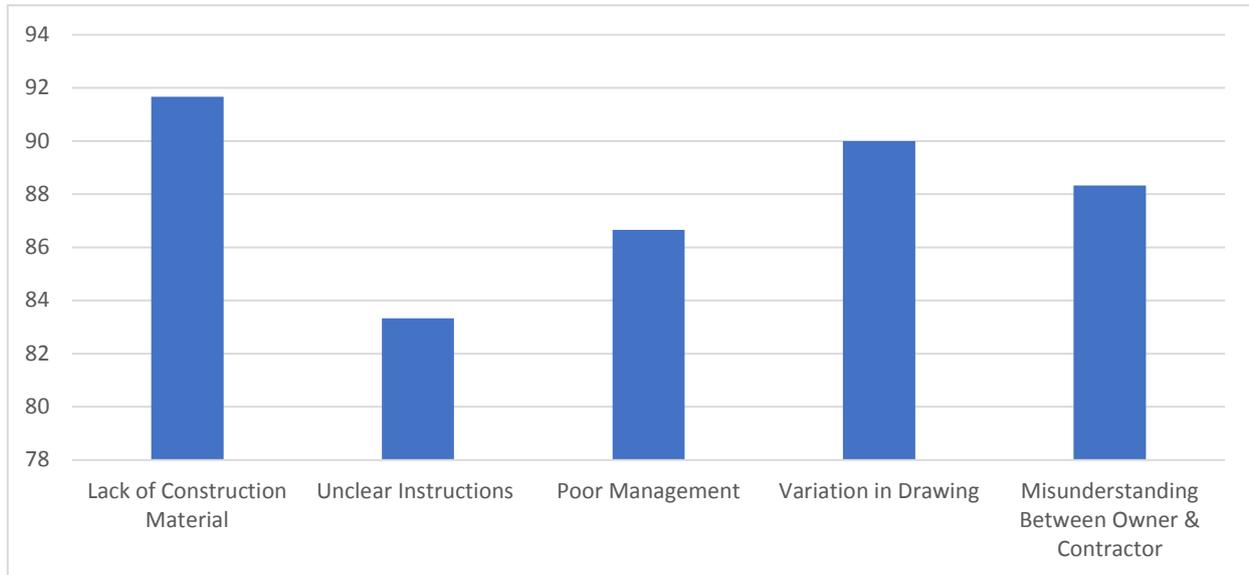
Figure 6.1: Plan of Industrial Building

CHAPTER 7 RESULT AND DISCUSSION

7.1 General

The previous Chapter studied the calculations of RII and discussion of the respondent's feedback. In this chapter, we can discuss the results, and also discuss the top factors which affect productivity most.

7.2 Factors that affect the productivity most



- Lack of Construction Material

Bar Chart 7.1 – Factors that affect productivity most

The above graph shows the RII for factor unclear instruction. industrial and residential buildings have respectively 83.92 and 89.13 RII which is a very high effect, and commercial buildings have RII 62.5 high effect.

It shows that providing clear instruction to the labor is very important for proper work planning if the instructions are not clear it leads to less productivity and a double workload. Providing clear instructions is the responsibility of the site manager as well as the client. The client has to brief all the expectations to the contractor so that they can conduct all the work as per the brief, and it helps to minimize the mistakes and maximize productivity.

- Unclear Instructions

For the Residential Building, the most affected factor is improper construction method with RII 90.21 which is very high, RII of an industrial building is 83.92, and commercial have 79.16 which is a high effect.

It is observed that small-size projects are more affected than big projects concerning productivity with Improper construction Methods. Homebuilders, particularly in small construction are too sluggish in their approach to new methods and techniques than the big-size projects. In small projects, builders do not use new techniques. So, they face the problem like poor workmanship, low standards, longer project duration, completion delay, and massive cost overruns in small projects but in big size projects because of new techniques and methods it helps to improve productivity and its shows in a commercial and industrial type of building its RII is very high and however due to absence of such method of construction. Productivity may hamper and, in a way, it will hamper the time, cost, as well as quality of the project.

- Poor Management

The RII of factor poor management for all the types of the building is under the very high effect. The RII of industrial, Commercial, and Residential buildings is respectively 82.14, 83.33, and 83.69.

The poor management of the site has a very bad impact on productivity. It includes the overall management of the construction site. Include storage location of material, provided facilities of the labor, etc. site manager has the responsibility to do proper management of the work and conduct the all work smoothly for better productivity.

- **Variations in Drawings**

The RII of factor Variation in Drawing for industrial, and Residential buildings is under very high effect respectively 83.92 and 89.13 The RII of Commercial buildings is 62.5 which is under High effect.

In the residential building, the owner of the building is a very important person because as per his suggestions we have to construct a building, and if he needs changes, we have to change the drawing as per his instruction and it leads to low productivity of the labor. Heavy instruction to the labor leads to confusion and they make mistakes on site it directly effects on time and the cost of the project.

- **Misunderstanding between Owner and Contractor**

The RII of factor Misunderstanding between owner and Contractor

for all the types of the building the is under the very high effect. The RII of industrial, Commercial, and Residential buildings is Respectively 83.92, 83.33, and 90.21.

Everything must be clear between the owner and the contracts because if the communication is clear between these two parties, then the only contractor can give instructions to the labor and the employees, and the work speedy and save time and cost. If there is a Misunderstanding between the Owner and Contractor then it will affect the work of the labor and the productivity of the labor decreases also directly affect the time and cost of the project.

CHAPTER 8 RECOMMENDATION AND CONCLUSION

8.1 General

This research is to find out the cause of probable factors affecting labor productivity in construction Industry in Kolhapur region. The research results are meant to analysis and the ranking of various selected factors in above methodology chapter, is calculated using RII.

In this chapter most affected factors whose RII is above 80% is mentioned below as their intensity of affecting is very high.

The research concluded that among several factors that affect productivity in different construction sites are as follow

8.2 WAYS TO IMPROVE PRODUCTIVITY AT THE CONSTRUCTION SITE

Based on the outcome of the study, following are the some of the recommendations which were found to be important for improving labor productivity in the construction industry.

1 Residential & commercial Building

The following factors affect most residential buildings because their range of RII is very high, it is between 80 to 100.

- i. Improper Construction method (83.33)
- ii. Misunderstanding between owner and contractor (88.33)
- iii. Unclear Instructions (83.33)
- iv. Poor Management (86.66)
- v. Lack of Skills (Unskilled Labor) (88.33)
- vi. Accidents During Constructions (88.33)
- vii. Variations In Drawing (90)
- viii. Shortage of Water & Power Supply 80)
- ix. Material Storage Locations (66.66)

2 Analyze the entire construction process in detail.

To improve the productivity on Site Company should analyze the detailed process of the project to identify what type of problem may occur at the time of construction. To avoid the problem company can compare and analyze different type of project which is similar and is in compilation stage. As we know, labor cost is 30 to 50% of the total project cost. needs to study which type of labor is required to complete the project in time and productivity can be achieved.

3 Proper planning

To complete the project on schedule required proper planning of the project to needed on point requirement of the number of laborers, material, and types of equipment. It is necessary to develop a realistic benchmark for laborers to complete the target as per the schedule of the project.

4 Communication

To increase productivity on-site communication is the most important thing between laborers, supervisors, site managers, and other employees. To improve its communication should be two ways, but in most of the companies, communication happened only one-way i.e. from top-level to bottom-level. Productivity is dependent on laborers mostly to improve the productivity top-level employees have to communicate with bottom level workers and listen their suggestions and company should arrange reward system for positive suggestions which help to improve productivity.

5 Training for supervisors and labors

Most of the laborers are uneducated and unskilled as they are hired directly from the villages. Even the supervisors are also freshers and need training. we have to arrange a training program for fresher's and laborers to improve their skills and communication language should be common as understood by everyone for easy understanding. Training means educating labor and other staff for quality and quantitative work which helps to improve productivity on site.

6 Adopting new technologies

Small and medium-scale companies are still using the traditional ways of construction. If laborers are not familiar with new techniques or equipment then they hesitate to use it, and it directly affects productivity. If we use the latest techniques and equipment, it will save them time and also increase the productivity of the labor.

7 Health and safety

The health and safety of all the employees is an important consideration in all the stages of the project. To avoid problems regarding health and safety have to provide training, better information, and proper instructions. Also, the Industry should provide jackets, rubber shoes, helmets safety belts, and other protective shields to workers. Along with that provision of basic facilities like the provision of latrine and urinals, accommodation, first aid, access to canteen facilities on-site help to improve labor productivity of laborers.

8 Housekeeping

Project housekeeping means cleanliness and orderliness on the project site. When the project site is disorganized and full of cluttered, workers have to work around the mess, and time is wasted in searching for some equipment parts. Because of this labor loss their productivity. Orderliness means keeping material in stock and placement of material near the worksite. This helps to improve labor productivity.

8.3 FUTURE SCOPE

The current research study is limited to the different types of buildings, i.e., Industrial buildings, Commercial buildings, and Residential Buildings. Future studies could be done on other types of construction sites like infrastructure, dams, or roads, etc.

On other hand also we can study for the different factor groups other than these four and perform Sensitivity analysis to improve the productivity and minimizing delays on the construction site to avoid the cost overrun and time overrun.

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