

Construction Workman Productivity Improvement

Rochit Pandey¹, Hiral Patel²

^{1,2} Construction Project Management

^{1,2} RICS-SBE, Amity University, Mumbai

Abstract- Productivity is defined as the amount of goods or services produced by a worker or group of workers in a given amount. In construction industry, it plays major role in success or failure of the project. Therefore, it becomes essential to identify/determine the major factors affecting productivity and its impact on the outcomes of the project. This paper objects to identify and assess the factors according to their impact and most influencing factors, with the use of Relative Importance Index (RII) method. 55 different factors were identified through literature review, which were ranked on Likert scale through questionnaire survey, based on their impact on productivity of labor and supervisor. Top 10 factors were Identified which had maximum effect on productivity which are, delay in arrival of material, morale, lack of safety precautions from labor, poor scheduling, change in design and drawing, sub soil ground condition, proper facilities for labor accommodation, lack of timely instruction from supervisors, aggressive nature, unexpected weather changes. The important steps to mitigate the factors are suggested in this paper to improve the productivity in workmen. the given solutions should be followed and on a regular basis and regular data collection should be done in a several intervals of time.

Keywords- Productivity, project, research, RII, Construction Project, factors, delay, groups, internal factors, external factors.

I. INTRODUCTION

Indian construction industry is one of the most prominent industry to Indian economy. Employing approximately 51 million people, it has become second largest employer in country after agriculture. It is expected to arise as the third largest industry globally by 2025. Its contribution to Indian GDP is 9% and is expected to reach to 13% by 2025. By 2022 Compound Annual Growth Rate (CAGR) of construction industry is projected to 15.7% to reach \$ 738.5 billion. 100 smart cities, five industrial corridors, six mega ports and number of commercial and residential units are to be constructed. To successfully complete these projects, we need a fully efficient workforce.

According to ministry of manpower, productivity of labor is real output of a worker, the amount of work a worker

or a group of workers can give in a period. Indian economy has grown in terms of number of workers, but the productivity only increases when each worker produces more. The change in productivity related to change in output as it will increase when output increases. In the current scenario, it is used as wage settlement tool to compensate workers to increase their output. Workforce productivity is not contribution of labor alone, it is a combined virtue of many factors including health and skills of workers, technology used, availability of resources and effective management and controlling practices

II. NEED FOR STUDY

Productivity is one of the major key player in the construction industry and it affects the construction in a major part. Several studies were carried out to determine the factors which affect the productivity of construction workman on construction site. Several had used RII methods to identify the most affecting factors among all the other factors, all the other studies just identified the factors and not given any solution to overcome them, this study not only identify the factors and give the suggestion to how to overcome top 10 factors from labor and supervisor's perspective.

III. OBJECTIVE

This work is executed with an objective to identify the factors which affects the productivity of construction workman and how to overcome them.

- To identify various factors affecting productivity and classify them into following categories *i.e.* internal, external, scheduling, site management, execution, site condition and weather-related factors.
- To analyze the factors based on responses of survey held.
- To propose mitigation factors to top 10 factors from labor and supervisor's perspective

IV. LITERATURE REVIEW

Objective was to identify the factors which affects the productivity of construction workman and how to overcome them.

4.1 Labor productivity

The term productivity is referred as how well the resources are used to achieve the desired project objectives (Durdyev, 2014). Moreover, labor productivity has been defined as number of units of work produced by an individual or a group of labors per man-hour (R.chitra & Kumari, 2018). It is virtue of skills, innovation, investment, competition and enterprise. The European Migration Network, Ireland published a report that defines and classified different type of shortage (Gusciute, et al., 2015). According to this report, shortages are expressed in proportion of total employment stock and based on it they have classified it into six different groups.

- No shortage: this term is used where there is no imbalance in the labor market, where the demand is sufficiently met by the available labor and their skill set.
- Labor shortage: this situation arises where the number of individual are insufficient to fulfil the employment opportunities available.
- Skills shortage: a situation where there are deficient individuals with required skill level to achieve the demand.
- Low: when the shortage is less the 1% of total employment stock
- Medium: when the percentage is between 1% to 3% it falls into this category
- High: this situation occurs when the percentage rises above 3%

4.2 Calculation of productivity

Mostafa & Khaled (2011) identified six different models to calculate productivity out of which most widely used is the Activity-oriented Model. In this model the contractors define productivity using the equations given below. The output specified in the generic units for example; formwork in M², Steel Reinforcement work in M Ton, Concrete placement in M³. The productivity is calculated in terms of the output generated in a work-hour.

$$\text{Labour Productivity} = \frac{\text{Output}}{\text{Work Hour}}$$

4.3 Factors that affects productivity

The construction industry has focused on the skill of the labour, but the industry is challenged by many factors which has affected the productivity. R.chitra & Kumari (2018) have divided the factors into several categories and groups such as management group, human/labour group, external

group and management group and used RII (Relative Importance Index) to determine the major factors which impacts the productivity of the labours during construction. They concluded that working hours for labour should be 40 hours per week which makes one day working hours of about 8 hours, other conclusion is to deliver of payments of labour in time which motivates them to do the work on time and passionately. Another study was conducted by Gundecha (2012) reveals that construction projects suffers from a lot of problem during construction which are like internal, external factors, safety of workers and quality of work. Through his study carried to rate 40 different factors according to their importance index he concluded that organization should develop through proper training, from which workman can have a proper frame of vision, assessment and a well-known way to overcome a certain problem in construction site.

4.3 Relative Importance Index (RII)

For the analysis of the responses of the questionnaire was done by the Relative Importance Index (RII) method where all the ranking given to each factor were evaluated and their importance index were calculated using the equation given below (Hatkar & Hedao, 2016).

$$RII = \frac{\sum W}{A \times N}, (0 \leq RII \leq 1)$$

Where,

- W = the ranking respondents gave to each factor in range of 1 to 5, (1 for 'Low' and 5 for 'High');
- A = is the maximum ranking (in this research it is 5);
- N = The total number of respondents.

V. METHODOLOGY

Based on the literature review a questionnaire was prepared consisting of 53 different factors grouped under seven groups:

G1	Internal Factors
G2	External Factors
G3	Scheduling related factors
G4	Factors related to the changes during execution
G5	Factors related to the site condition and location
G6	Factors related to the risk of adverse environment or weather
G7	Factors related to site management

The factors were ranked by respondents on a 5-point Likert scale where, 1 and 5 signifies “no affect” and “major affect” respectively. The survey was carried out face to face to 106 workers and supervisors on different construction sites of Mumbai city. The results of the survey were evaluated statistically by RII method, each factor was ranked according to their RII scores. Based on ranking, top 10 factors were identified and different mitigative measures were suggested.

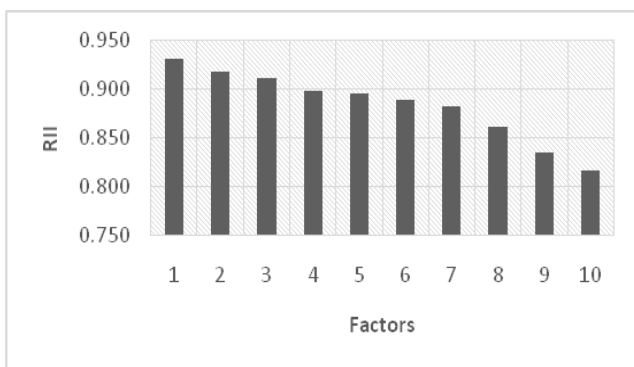
VI. RESULTS AND FINDINGS

The survey was carried out and total 106 workmen were surveyed, out of which 15 were supervisors and remaining 91 were from labor class itself. The assessment was done on both the categories and factors affecting productivity were identified respectively.

6.1 Factor affecting labor productivity

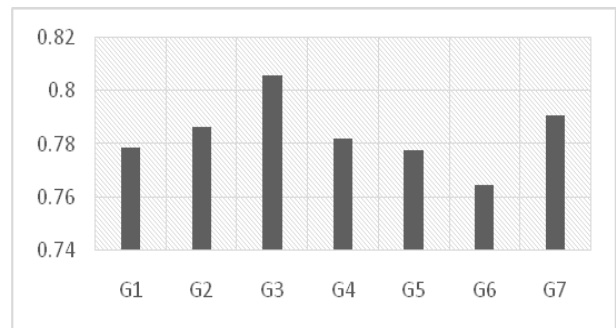
Following table depicts the top 10 factors that affects the labor productivity that were calculated based on their RII values of each factor and the fig 1 depicts the same.

Rank	Factors	Group	RII
1	Poor scheduling	G3	0.932
2	Proper facilities for labour accommodation	G7	0.919
3	Delay in arrival of material	G2	0.912
4	Unexpected weather changes	G6	0.899
5	Change in design and drawing	G4	0.897
6	Earthquake	G6	0.890
7	Sub soil ground condition	G5	0.884
8	Lack of safety precautions from labour	G7	0.862
9	Overlooking of critical activities	G3	0.835
10	Improper storage of toxic materials	G5	0.818



From the above chart we can infer that **poor scheduling** is the most common and important factor that affects the productivity of labor.

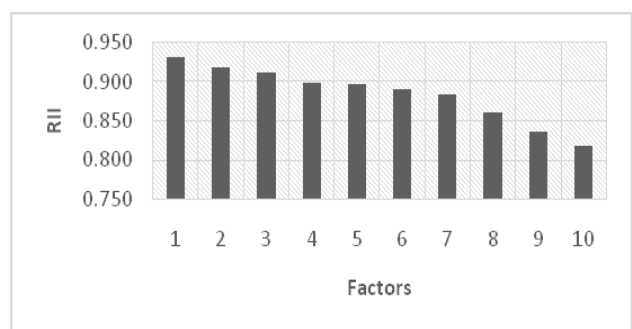
Fig. 2 shows the relative importance of each factor group that influences productivity of labor, which clearly states that G3 *i.e.* Schedule related factors have the most effect on productivity.



6.2 Factor affecting supervisor’s productivity.

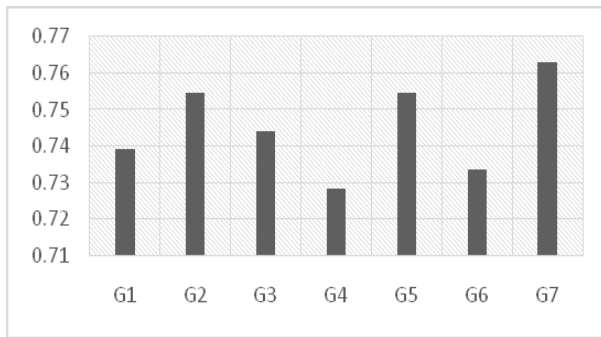
Table 3 describes the top 10 factors that affects productivity of supervisor.

Rank	Factors	Group	RII
1	Delay in arrival of material	G2	0.880
2	Morale	G1	0.867
3	Lack of safety precautions from labour	G7	0.853
4	Poor scheduling	G3	0.840
5	Change in design and drawing	G4	0.840
6	Sub soil ground condition	G5	0.827
7	Proper facilities for labour accommodation	G7	0.827
8	Lack of timely instruction from supervisor	G7	0.827
9	Aggressive Nature	G1	0.813
10	Unexpected weather changes	G6	0.813



From the above chart it is observed that delay in arrival of materials have affected the productivity of supervisor the most.

Fig. 4 depicts that G7- factors related to site management is the major factor group concerning supervisor’s productivity.



VII. SUGGESTIONS

From the analysis top 10 factors that affects productivity of both the workmen group i.e. labor and supervisor were identified. Following suggestion of mitigative measures have been proposed which can help to improve

7.1 Mitigative measures for labor productivity

- **Poor Scheduling:** It can be improved by considering each possible aspect which can affects the productivity. Like if construction site is away from city and they need material after do days, so during scheduling two plus three days should be taken, which can help when material gets delay, construction or scheduling should not get affected.
- **Proper Facilities for labor accommodation:** To overcome this situation, proper number of labor should be counted and have an estimation of how much more labor can be added in this, which can help to maintain the space in the labor colony and help to keep it neat and clean because having an extra space for the labor will help to keep extra amount of medicines and extra facilities which can help the other labors as well
- **Delay in arrival of material:** To overcome this factor, PM should not wait for the material to end, material should be ordered earlier to eliminate this factor.
- **Unexpected Weather changes and Earthquake:** PM should get their labor ready for any situation either it is uncertain weather changes or calamities, proper training should be given to each and every single labor on site. What should be there role at that point of time, what are the steps they have to take all these should be known to them.
- **Changes in design and drawing:** All the details regarding the plan should be available during design and drawing. All the plans should be complete, plans should be well coordinated
- **Sub soil condition:** Soil testing should be done before the starting of the project in a well-mannered way because the main component of soil like its size of the particles, the plasticity, the amount of water (water table) and how the

building is going to survive on this ground all this should be well known, before the starting of the construction.

- **Lack of safety precautions from labor:** Safety precaution is very important, there are several methods which can help us to eliminate this problem, first is correct labor info which includes correct positions of the labor, number of workers, work shifts and their timing. Second would be accident evaluation, this part includes the total number of accidents taken place before, which can help us to determine number of probable accidents which can take place. Type of injuries and reason for accidents should also be keep in check.
- **Overlooking of critical activities:** Critical activities cannot be avoided as they are important for the completion of the construction site, as they cannot be overlooked because they are important for the project and there overlooking can cause damage to the project and its duration as well.
- **Improper storage of toxic materials** there are many ways which can help to improve the proper storage of toxic material, all the material should be color label and they should be arranged according to their toxic level, in different storage rooms with authorized entry only. Its waste should be dumped in a specific time period and at a specific place, as approved.

7.2 Mitigative measures for supervisor's productivity

- **Delay in arrival of material:** a resource forecast schedule should be prepared, and the materials should be available during execution.
- **Morale:** there are several factors which affects the morale of the workman which can be organization, the nature of work, satisfaction level, suspension level, self-concept, age of employee, all these should be recorded, and work should be given according to all these details. Several activities should be organized at several intervals of time, which can help to maintain the interest of work and morale as well.
- **Lack of safety precautions from labor:** Safety precaution is very important, there are several methods which can help us to eliminate this problem, first is correct labor info which includes correct positions of the labor, number of workers, work shifts and their timing. Second would be accident evaluation, this part includes the total number of accidents taken place before, which can help us to determine number of probable accidents which can take place. Type of injuries and reason for accidents should also be keep in check.
- **Poor scheduling:** It can be improved by considering each possible aspect which can affects the productivity. Like if construction site is away from city and they need material after do days, so during scheduling two plus three days

should be taken, which can help when material gets delay, construction or scheduling should not get affected.

- Change in design and drawing: All the details regarding the plan should be available during design and drawing. All the plans should be complete, plans should be well coordinated
- Sub soil condition: Soil testing should be done before the starting of the project in a well-mannered way because the main component of soil like its size of the particles, the plasticity, the amount of water (water table) and how the building is going to survive on this ground all this should be well known, before the starting of the construction.
- Proper Facilities for labor accommodation: To overcome this situation, proper number of labor should be counted and have an estimation of how much more labor can be added in this, which can help to maintain the space in the labor colony and help to keep it neat and clean because having an extra space for the labor will help to keep extra amount of medicines and extra facilities which can help the other labors as well.
- Lack of timely instruction from supervisors: to overcome this factor, site coordination among the project participants are important, similarly somethings cannot be neglected or eliminated from site just like conflicts between the worker at site. It can be improve by, proper scheduling and proper distribution of work among the supervisors and asking them for timely submission of WPR and DPR (weekly progress report and daily progress report), which will force them to check the work timely and if it not correct they have to give proper instruction to the labor so that the work can be done perfect on first time.
- Aggressive Nature: Fluctuation in human nature is normal but can affect the nature of work and relationship between the worker and their superiors, it can be overcome by not giving so much of stress to the workers and dividing the work between the workers. Regular blood pressure check-up can help to maintain the stress level of the workers and to keep it in check.
- Unexpected Weather changes: project manager should get their labor ready for any situation either it is uncertain weather changes or calamities, proper training should be given to each single labor on site. What should be there role at that point of time, what are the steps they must take all these should be known to them.

VIII. CONCLUSION

From the analysis of responses from questionnaire survey we identified top 10 factors that affects productivity for each workmen group were identified. These factors tell us about the major problems workers are facing during

construction, as both the categories different tasks and responsibilities to carry out, their opinion differs from each other, we cannot blame any individual group for the delay. The improvement of productivity needs to become a wholesome effort of everyone in organization. If we want to overcome this obstacle we have to cooperate with each other and try to ignore all the other factors and aim towards the success of the project. Mitigative measures for each factor have been proposed in this paper. Following are the various factors:

- Factors affecting labor productivity
 1. Poor Scheduling
 2. Proper Facilities for labor accommodation
 3. Delay in arrival of material
 4. Unexpected weather changes
 5. Change is design and drawing
 6. Earthquake
 7. Sub Soil ground condition
 8. Lack of safety precautions from labor
 9. Overlooking of critical activities
 10. Improper storage of toxic materials
- Factors affecting supervisor's productivity
 1. Delay in arrival of material
 2. Morale
 3. Lack of safety precautions from labor
 4. Poor scheduling
 5. Change in design and drawing
 6. Sub Soil ground condition
 7. Proper facilities for labor accommodation
 8. Lack of timely instruction from supervisors
 9. Aggressive Nature
 10. Unexpected weather changes

IX. FUTURE SCOPE

For the future, the scope of the research can be extended by increasing the sample size taking into consideration variety of projects. This study can be extended by integrating various concepts like lean 7 Mudras, Building Information Modelling (BIM) and advance work packaging.

REFERENCES

- [1] Aynur KAZAZ, S. U. T. A. B. E., 2016. Factors affecting labor productivity perspective of craft workers. Factors affecting labor productivity perspective of craft workers, p. 7.

- [2] Craig Lindsay, L. M. D. O. f. N. S., n.d. Labor Productivity. Labor Productivity , p. 447.
- [3] Durdyev, S., 2014. LABOR PRODUCTIVITY IMPROVEMENT:Impact Levels of the On-site Constraints.
- [4] EgleGusciute, E. Q. a. A. B., Nov 2015. Determining Labor and Skills Shortage and Need for Labor Migration in Ireland. Determining Labor and Skills Shortage and Need for Labor Migration in Ireland, pp. 0-86.
- [5] Gundecha, M. M., 2012. STUDY OF FACTORS AFFECTING LABOR PRODUCTIVITY AT A BUILDING CONSTRUCTION PROJECT IN USA.
- [6] International Labor Conference, 2., 2008. Conclusions on skills for improved productivty, employment growth and development. Conclusions on skills for improved productivty, employment growth and development, p. 24.
- [7] Mamata Rajgor, C. P. P. D. P. C. B. D., 2016. RII &IMPI: EFFECTIVE TECHNIQUES FOR FINDING DELAY IN PROJECT.
- [8] Mostafa E. Shehata, K. M. E.-G., 2012. Towards improvingconstruction labor productivity and projects performance.
- [9] Mr.A.A.Attar, P. A. P. D., n.d. Study of VArious Factors Affecting Labor Productivity and Methods to Improve It. Study of VArious Factors Affecting Labor Productivity and Methods to Improve It, p. 14.
- [10]Murali K, S. R. G. T. G., 2016. ANALYSIS OF FACTORS AFFECTING LABOR PRODUCTIVITY IN CONSTRUCTION.
- [11]R. Chitra, R. K., n.d. ANALYSIS OF FACTORS AFFECTING ON LABOR PRODUCTIVITY IN.
- [12]Sneha Jamadagni, P., 2015. Productivity Improvement In Construction Industry. Productivity Improvement In Construction Industry.