

Analysis of Labor Productivity in Construction Projects

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Abstract- *The construction industry has an essential part in developing countries. Construction industry is totally dependent on labor, so increasing labor productivity by using scientific methods is the need of today's highly growing world. Productivity is usually well-defined as the ratio of outputs to inputs. Labor productivity is one of the greatest significant factors that affect the physical growth of every construction plan. To achieve their jobs efficiently, construction labors must be aware with their duties and with the resources, tools, and machinery they use. Inefficient administration of construction labors can outcome in low production. Therefore, it is significant for contractors and construction chiefs to be aware with the methods leading to evaluation of efficiency of the construction labors in different crafts. To accomplish the revenue estimated from any construction project in general, it is significant to have a good controlling hand on the productivity factors that subsidize in the combined production composition, like labor, equipment, cash-flow, etc.*

Keywords- Cost, productivity, labor, construction, quality

I. INTRODUCTION

Every project has its individual beauty of finance and to grow up or to preserve the commercial aspects of the projects it very essential to concentrate performance of resources involved in the project. Productivity can be defined in many ways. In construction, productivity usually means labor productivity i.e. units of work positioned or manufactured per man-hour. The inverse of labor productivity, man-hours per unit (unit rate), is also usually used a.k.a. "Cost per Unit (CPU)". Productivity is defined as the ratio of outputs to inputs. Productivity in finances refers to measures of output from production procedures, per unit of input. Productivity might be considered of as a measure of the technical or engineering productivity of production. There are many factors that influence the productivity in construction industry. Labor productivity is one of the greatest significant aspects that disturb the physical growth of any construction project. To accomplish their jobs efficiently, construction labors must be aware with their duties and by the materials, tools, and machinery they use. Inefficient managing of

construction labors can outcome in low output. Therefore, it is significant for contractors and construction executives to be aware with the methods leading to evaluation of output of the construction labors in different crafts.

Productivity enables an organization to be modest, accomplish set goals, meet stakeholder value propositions and preserve strategic and economic health. At the industry level, productivity allows the sector to maintain satisfied clientele, attract investment, remain viable and contribute to the economic growth and good fortune of the nation.

II. PROBLEM STATEMENT

This work proposed a with the demand of labor and growth in labor rates, it is essential to have a look into entire construction activity and its impression on the overall project cost. It is necessary to advance the effectiveness of the production by means of raising the labor efficiency and productivity of the construction industry for the contribution to the progress of life, the progress of the overall economy and the improvement of the global competitiveness. This paper defines the significance of labor efficiency.

With the demand for labor and rise in labor rates, there is a requirement to have looked into entire construction activity and its impression on the project cost. The progressive economy has taken benefit in relations of mechanizing the construction operation by adding more content of prefab works, precast sections, introducing modular design concepts and adopting industries method of construction. In order to endure in such an industry, decision makers and project managers need to be able to ensure that their projects are being completed as productively as possible. In order for this to take place a new tool requirements to be developed to ensure maximum productivity from the beginning to the end of project. The objective of this research work is study of factors and to develop the labor productivity and to design an plan to increase production for construction activity.

III. OBJECTIVES

- Study and analysis the labor productivity in construction project base on shuttering, concrete and reinforcement as well.
- Analysis of labor productivity and reduction of cost in project.
- Reduction in overall duration of the project.
- To improve quality of project.
- Improvement in skills of labors.

IV. LITERATURE REVIEW

Abdulaziz M. Jarkas, Buildability Factors Influencing Concreting Labor Productivity, Journal Of Construction Engineering And Management © ASCE / January 2012 p.no. 89-97.

Global Construction perspective and Oxford Economics has predicted India will stand as the world's 3rd largest construction market by 2025. The country will have to gear up to add 11.5 million homes a year to become a US\$ 1 Trillion a year market by then. A significant number of international real estate companies have entered India as they see good investment opportunities emerging. More significantly, the Indian government has allowed 100% FDI in realty projects through the instinctive route. Accounting for 11% of India's GDP the construction industry employments over 32 million individuals and the urgent need for country's infrastructure development is contributing to rise in demand for construction workers.

PAVLOSMETALLINOS,EXPANDEDOLIGOPOLIZATION OF THE GREEK PUBLIC WORKS MARKET THROUGH THE FRAMEWORK OF LAW, JOURNAL OF LEGAL AFFAIRS AND DISPUTE RESOLUTION IN ENGINEERING AND CONSTRUCTION © ASCE / MAY 2013

This prospects witnessed, the construction industry is mired in problems. It has capability constraints, absence of finance, mechanization, trained manpower at the workers' level and performance at managerial levels are way below international standards. The recruitment of construction workers is through a long chain of middlemen (contractors and subcontractors) or roadside recruitment (street corners/Nakas), where workers wait each morning to be picked by contractors and many of these small and medium level contractors have no capacity to upgrade.

G.CARMONA; J. L. MOLINA; J. BROMLEY, OBJECT-ORIENTED BAYESIAN NETWORKS FOR

PARTICIPATORY WATER MANAGEMENT: TWO CASE STUDIES IN SPAIN, JOURNAL OF WATER RESOURCES PLANNING AND MANAGEMENT © ASCE / JULY/AUGUST 2011 VOLUME 137

proposed the sections in the Construction commerce cover, residential, public, commercial and industrial buildings, highways, bridges, tunnels, Roads, sewers, etc. Besides the general, lower construction skills, other specialized skill sets such as carpentry, plumbing, electrical work and painting are very much essential for the industry. As per G. Carmona and J. L. Molina some percentage of India's labor strength that includes construction workers is employed in the unorganized sector, exposed to exploitation, job and wage insecurity with no legal protection. To further enhance to their woes, there is no appropriate addressing of quality, skills, education, and employability for higher wages, safety, environment and social aspects of these workers.

AWAD S. HANNA, MURAT GUNDUZ, IMPACT OF CHANGE ORDERS ON SMALL LABOR-INTENSIVE PROJECTS, JOURNAL OF CONSTRUCTION ENGINEERING AND MANAGEMENT©ASCE/ SEPTEMBER/OCTOBER 2004, VOLUME 5, PG.NO 130

The huge market instability and uncertainty has negatively impacted the opportunities and prevented expansion and development facilities. Most of them are not registered with the Labor Commission and therefore do not have any legal entitlement, with no provisions like social security and remunerations in terms of labor welfare, pension and insurance schemes, financial aids or loans for children education and medical needs or even misfortune and death claims.

GEORGE OTIM, FIONA NAKACWA, MICHAEL KYAKULA, COST CONTROL TECHNIQUES USED ON BUILDING CONSTRUCTION SITES IN UGANDA, SECOND INTERNATIONAL CONFERENCEON ADVANCES IN ENGINEERING AND TECHNOLOGY, Pg.no367-373

This paper proposed a construction requires extensive manual labor. Human performance and productivity are reliant on one another. Therefore, the most frequently used measure of productivity is the constant measurement of construction work done per work hour.

V. PRODUCTIVITY IN CONSTRUCTION

Improved productivity in the construction can be viewed from two perspectives, the consumer and the

contractor. From the factors studies, improved productivity lowers costs, reduces time, increases cost, and achieves better returns on investments. From the contractor's perception, improved productivity leads to a more satisfied customer, while also providing a competitive advantage, and in return leading to faster turnover and increased profits. The definition for productivity with regards to construction is the measurement of the output of construction goods and services per unit of labor as explained below:

$$\text{Labor Productivity} = \text{Output} / \text{Labor Cost or} \quad \text{---- (1)}$$

$$\text{Labor Productivity} = \text{Output} / \text{Work Hours} \quad \text{---- (2)}$$

In case the input is a combination of various factors, productivity is termed as

Total Factor Productivity is measured as

$$\text{Total Factor Productivity} = \text{Total Output} / \text{Labor} + \text{Material} + \text{Equipment} + \text{Energy} + \text{Capital} \quad \text{---- (3)}$$

Thomas stated "Because disruptions adversely affect labor productivity, the best productivity occurs when there are few or no disruptions. This best productivity is called the baseline productivity." The baseline productivity is calculated by applying the following steps to the daily productivity values:

- Determine the number of workdays that comprise 10% of the over-all workdays.
- The contents of the baseline subset are the n workdays that have the highest daily production or output.
- For these days, note the daily productivity.
- The baseline productivity is the median of the daily productivity values in the baseline subset."

Factors Affecting Labor Productivity

Productivity is the outcome of several interrelated factors. Discussed below are some factors affecting labor productivity and are reviewed from past studies.

Time: During construction projects, there are tasks which causes a loss of productivity. Past study shows productivity decreases with working overtime. The most regularly stated reasons are fatigue; improved absenteeism; reduced morale; reduced supervision effectiveness; poor workmanship, resultant in higher rework; increased accidents.

Safety: Accidents have high impacts on labor productivity. Various accident types occur at the site, such as an accident triggering death and resulting in a total work stoppage for a

sum of days. An accident that causes an wounded person to be hospitalized outcomes in a work reduction of the crew for which the injured employee worked. Minor accidents resulting from nails and steel wires can halt work and, thus, reduction productivity.

Supervision: Generally, projects come across certain design, drawings and description variations during construction. If drawings or disclaimers are with faults and uncertain productivity is expected to reduction since laborers in the field are uncertain about what requirements to be done. As a result, task may be delayed, or have to be completely stopped and postpone it until clear instruction. There is a 30% loss of productivity when work modifications are being achieved.

Natural Factors: natural factors disturbing labor productivity together from study are weather conditions of the project site and geographical conditions. Others materials such as water, fuel, and minerals also affect productivity. Productivity is found to be highly affected if weather recorded are too be extreme.

Date collection and Analysis

In this work data is collected from construction site for shuttering work, reinforcement and concreting. Data is collected in the standard format in the form of bar chart. Scheduling is done for the period of two years. After monitoring the shuttering activity, it is observed that initially there is delay in the work from scheduled time. For avoiding this delay by using labor productivity theory standard time required is calculated, action plan is designed and applied on site. Figure 1 shows the analysis of shuttering for project, in which the column shows achieved target, planned target, and construction standard productivity. To achieve continuous improvement following action plan is followed-

- a. Work methodology statement discussion with team before starting of the activity.
- b. Planning of tools which are required for the job and its advance procurement before starting of activity.
- c. Activity planning and study of its criticality after receiving of drawings.
- d. Manpower calculation as per productivity norms.
- e. Material rotation planning for effective utilization of available resource.
- f. Use of tower cranes and lifting machineries for handling of machineries.
- g. Providing proper work front.
- h. Subletting job on task work basis.
- i. Time motion analysis helps us for finding out loop holes in system.

- j. Appreciation for good work and timely completion of given target.
- k. Job based hand skill training is important in productivity improvement.

After applying this plan, there is continuous improvement in shuttering, concrete as well as reinforcement work as shown in Figure 1, 2 and 3 same.

VI. RESULTS AND DISCUSSION

After studying the above stated factors labor productivity approach is apply on construction site for increasing production to avoid delay and cost. The over-all cost of construction work contains the cost of formwork also. In this work a detail of shuttering, concrete and reinforcement work is presented. Construction of formwork includes substantial expenditure in terms of cost of material, cost of labor for fabrication, creation and removal of formwork and time element. To achieve continuous improvement following action plan is followed-

- Work methodology statement discussion with team before starting of the activity.
- Planning of tools required for the job and its advance procurement before starting of activity.
- Activity planning and study of its criticality after receiving of drawings.
- Manpower calculation as per productivity norms stated in Gilbert’s theory.
- Material rotation planning for effective utilization of available resource.
- Use of tower cranes and lifting machineries for handling of machineries.
- Providing proper work front.
- Subletting job on task work basis.
- Time motion analysis helps us for finding out loop holes in the system.
- Appreciation for good work and timely completion of given target.
- Job based hand skill training plays important role in productivity improvement.

1 Shuttering Work Analysis:

Table 1: Shuttering Productivity Analysis

S.No	Shuttering Achieved	Shuttering Planned	Shuttering Standard
1	0.98	1.2	2
2	1.35	1.5	2
3	1.48	1.6	2
4	1.51	1.75	2
5	1.55	1.85	2
6	1.6	1.85	2
7	1.65	1.85	2
8	1.7	1.85	2
9	1.75	1.85	2
10	1.82	1.85	2
11	1.85	1.85	2
12	1.84	1.85	2
13	1.85	1.85	2
14	1.86	1.85	2
15	1.87	1.85	2
16	1.88	1.85	2
17	1.89	1.85	2
18	1.9	1.85	2
19	1.91	1.85	2
20	1.92	1.85	2
21	1.93	1.85	2
22	1.94	1.85	2
23	1.95	1.85	2
24	1.95	1.85	2
25	1.95	1.85	2

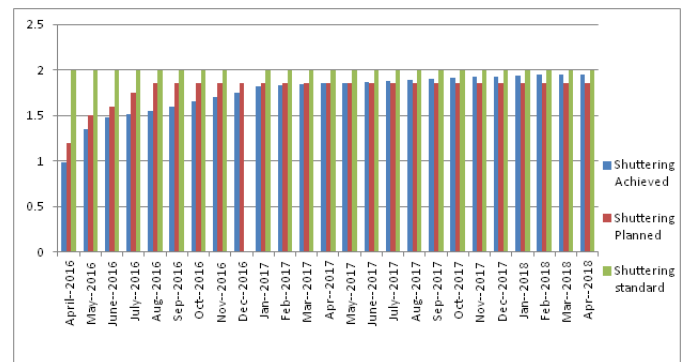


Figure 1: Analysis of shuttering work.

2 Concrete work Analysis

The below Table 2 and Figure 2 shows the how concrete productivity has increased when projects becomes old, and labors gets the expertise of work or job knowledge.

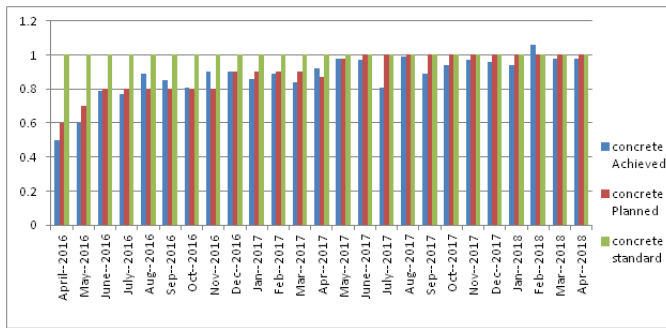


Figure 2: Analysis of concrete work.

Table 2: Concrete Productivity Analysis

S/No	Concrete Achieved	Concrete Planned	Concrete Standard
1	0.50	0.60	1.00
2	0.60	0.70	1.00
3	0.79	0.80	1.00
4	0.77	0.80	1.00
5	0.89	0.80	1.00
6	0.85	0.80	1.00
7	0.81	0.80	1.00
8	0.90	0.80	1.00
9	0.90	0.90	1.00
10	0.86	0.90	1.00
11	0.89	0.90	1.00
12	0.84	0.90	1.00
13	0.92	0.90	1.00
14	0.87	1.00	1.00
15	0.98	1.00	1.00
16	0.97	1.00	1.00
17	0.81	1.00	1.00
18	0.99	1.00	1.00
19	0.89	1.00	1.00
20	0.94	1.00	1.00
21	0.97	1.00	1.00
22	0.96	1.00	1.00
23	0.94	1.00	1.00
24	1.06	1.00	1.00
25	0.98	1.00	1.00

3. Reinforcement Work Analysis

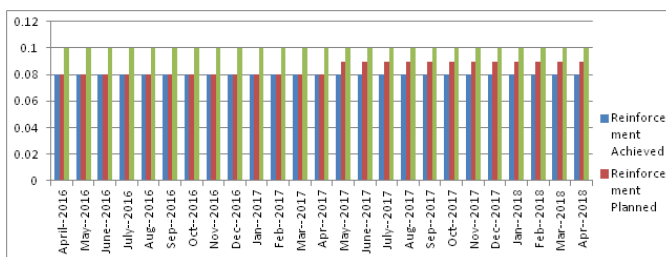


Figure 3: Analysis of Reinforcement work.

Table 2: Reinforcement Productivity Analysis

S/No	Reinforcement Achieved	Reinforcement Planned	Reinforcement Standard
1	0.08	0.08	0.10
2	0.08	0.08	0.10
3	0.08	0.08	0.10
4	0.08	0.08	0.10
5	0.08	0.08	0.10
6	0.08	0.08	0.10
7	0.08	0.08	0.10
8	0.08	0.08	0.10
9	0.08	0.08	0.10
10	0.08	0.08	0.10
11	0.08	0.08	0.10
12	0.08	0.08	0.10
13	0.08	0.08	0.10
14	0.08	0.09	0.10
15	0.08	0.09	0.10
16	0.08	0.09	0.10
17	0.08	0.09	0.10
18	0.08	0.09	0.10
19	0.08	0.09	0.10
20	0.08	0.09	0.10
21	0.08	0.09	0.10
22	0.08	0.09	0.10
23	0.08	0.09	0.10
24	0.08	0.09	0.10
25	0.08	0.09	0.10

VII. CONCLUSION

After studying the parameters affecting the labor productivity collected from the data can conclude the following points:.

- Labor productivity for the construction project is increased.
- The overall time duration for completion of project is reduced.
- Labor productivity is very important aspect for completion of construction projects.
- Calculation of cost of overall product can be done in future.

VIII. ACKNOWLEDGEMENT

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