Analysing Methods of Construction Productivity

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Abstract- *Construction productivity is the concept which gives us the all over growth of the construction firm. There are so many factors on which productivity depends, such as, equipment which is using at site, skills of workers, no. of hours and days they are working and the main aspect is labour force. In this project I am going to study in detail the labour productivity in construction industry. In this paper we will get to know various methods of analyzing labour productivity.*

Keywords- growth, labour productivity, main aspect.

I. INTRODUCTION

Productivity issues are categorized into macro- and micro-level. macro level consists contracting methods, labour legislation, and labour organization; while micro-level consists management and operation of a project on the job site.

To improve productivity, we should measure it. And we must be able to measure the effect of changes adopted on methods, effort, and systems. The measured values of productivity then must be compared either to those used to assmble the estimate and maintaining the production standards. Performance factor, production rate, unit person-hour (p-h) rate etc are the terms usend for construction productivity. Traditionally, productivity is the ratio of input/output, i.e., the ratio of the input of that resource to real output. To restate this definition for use in the construction industry: labour productivity is the physical progress achieved. The two most important measures of construction productivity are:

1. Effectiveness of the labour in construction process;
2. The relative efficiency of labour required at a given time and place.

II. METHODS USED IN CONSTRUCTION PRODUCTIVITY MEASUREMENT

1.1 Field rating:

Field rating is used to estimate the level of activity of a construction operation. The method simply classifies the observed worker in "working" or "nonworking" and "working" fraction is used for calculating effectiveness. Random sample is collected by observing workers on the site. After that field rating is calculated as total observations in the "working" category divided by the total number of observations, plus 10% to account for foreman and supervisory activity as follows:

Field rating = total observations of working/ total number of observations+ 10%

The number must be approximately over 60% for a job to be satisfactory. It does not give any idea about sources of problems or inefficiencies. It only suggests that there is something wrong.

1.2 Work sampling:

Work sampling is nothing but the statistical sampling theory and is a little bit more complex method than field rating. It aims to observe an operation for a limited time and from the observations intend about operation productivity. Time spent on collecting data must be limited for adopting this method.

To fulfill this, the following things must be adopted:

1. Productive, semi-productive (involved in supporting the main activity), and non-productive are three modes of workers in which we are classifying them.
2. Develop a data collection form that accessibility of tallying the observations on site.
3. Take random observations of workers in a operation which is given in the field. The observation should show the workers' activity mode, i.e., productive, non-productive, or semi-productive. Random, for all practical purposes, the care is taken about not a single worker is observed repeatedly or replaced by any other worker.
4. Record all observations on the sheet. Tick under the correct mode of activity observed.
5. Summing all tick marks under each mode and calculate the percentage of activity.

1.3 Five-minute rating:

The five-minute rating technique is not based on statistical sampling theory. The method consists only observing an operation for a short time. The observations do not result in a enough sample to support work sampling. The method does, however, provide some insight as to the effectiveness of the crew and can identify areas where more observation is required.

The following procedure is used for the 5-minute rating technique:

1. Select the members of the crew to be observed.
2. Observe the crews on there working. For the observation interval calculate whether the crew member is active for over half the interval. If yes then mark the observation cell with an "x"; if not, leave it empty.
3. Summing all the "x" observations for the entire table and divide the sum by the total number of observations.

II. FOREMAN DELAY SURVEY

Foreman Delay Survey (FDS) gives a questionnaire which is to be filled out by the job foreman at the end of a working day according to a particular survey schedule, e.g., one work day in each week.To identify the number of hours of a day lost due to delays this questionnaire is prepared. FDSs are divided into rework and delay. After filling the forms all the information is converted in the form of percentages and action is taken to reduce delays and properly dealing with it. Analyzing the sources of delay during construction it is relatively low cost method. It is easy to stylized and implemented.

2.2 Craftsman questionnaire:

Craftsman questionnaire (CQ) is a questionnaire-oriented technique is adopted to address issues and concerns that relate to a craftsman's productivity and motivation. The basic objective is to distribute a simple questionnaire. It goals to identify major factors that fotbid the productivity of craftsmen and estimate the p-hs lost per craftsman per week due to specific causes.

The questionnaire may comprise 50 short related to material availability and site layout, equipment and tool availability, rework items and causes of rework, management interference and inspection, and suggestions for improving the process. The questionnaire asks for the hours lost per week per craftsman on each area of concern listed. This is often schedulded with personal interviews with some of the craftsmen to consolidate the responses and test the level of seriousness. After the collection of questionnaires, results are calculated and statistics reported to all concerned in a form.

III. THE METHOD PRODUCTIVITY DELAY MODEL

The method productivity delay model (MPDM) combines both time study and productivity measurement (Adrian and Boyer, 1976). MPDM depends on having an observer collect data, on a special form, related to the cycle time of a leading resource on the operation.The nature of the delays during the period of observation is observed. A set of computations is carried out that calculates the productivity of the operation, indicates the major sources of delay, and gives other useful statistics after completing the data collection.

MPDM is an effective way of measuring productivity on site and the delays that sap it. It is less confusing when implemented on an electronic spreadsheet. MPDM provides more information than any other work sampling techniques. For stipulating the user with a measure of productivity, it can also identify sources of delay and their relative contribution to the lack of productivity.

IV. CHARTING TECHNIQUES: CREW-BALANCE CHARTS

Crew balance charts are a method of comparing interrelationships between various crew members and equipment required to complete a task. This method is adapted to such cyclical tasks as placing concrete. The ordinate of the chart expresses time in a percentage of the total cycle time or the actual time of day. Each bar is again divided vertically to indicate the time required for each activity involved in the task cycle, including idle, non-productive, and ineffective time.

It is best to show only those elements that are important to the problem at present, because a crew balance chart may become scattered with unnecessary information, which decrease its effectiveness. From a crew balance chart, the user can find interrelationships by comparing activities along a horizontal line as the time scale is the same for each crew member. In this way, inefficient crew size or organization is caught out and recovery actions are taken. By analyzing a crew balance chart, the user is encouraged to intellect more efficient methods of performing the task. Reorganization of the crew is all that required or a different method may be in order.

V. SIMULATION MODELING AND ANALYSIS

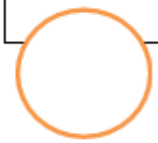
Simulation in the reference of this discussion is defined as "building a mathematical/ logical model of a system and experimenting with it on a computer" (Pritsker 1986). This publication shows simulation only for the CYCLONE methodology.

5.1 The basic phases of construction process simulation

The simulation process has two basic phases: modeling and experimentation. CYCLONE gives the modeling elements and methods that a person who is making can use to represent a construction operation in much the same way as a scheduler can build a Critical Path Method (CPM) network for a construction project, i.e., by specifying activities, and their logical relationships, durations and resource requirements. While using CYCLONE, the modeler goals on their sources involved and their interactions. Source may be in one of two states: active or idle. An active state of a resource is shown by a square; the idle state, by a circle. In the model, the resource can move between the two states and thus from one activity to the other. The whole idea of simulation rotates around the dynamic movement of resources. It is vital to distinguish between this method and a static system like CPM.

5.2 Building a CYCLONE model

A CYCLONE model is made by using the CYCLONE elements. Its rules are as follows:

CYCLONE Element	DESCRIPTION AND RULES FOR MODELING BUILDING.
NORMAL 	The NORMAL is not a controlled task. Any resource that arrives at a NORMAL is given access and is immediately processed. It Can be headed by all other CYCLONE elements except for a QUEue node. Can be followed by all other elements except for a COMBI.
COMBI 	A task that is controlled by the availability of more than one type of resource. A resource coming at a COMBI will have to wait until all other required resources are available before it is given access to the task. Can be preceded by QUEue nodes only. Can be followed by all other elements except COMB Is.
QUEue 	A QUEue node is a waiting area for a resource. Therefore it is used only when a task was restrained. A resource arriving at a QUEue node will stay in the node until a COMB I was ready to process it. A QUEue node had one other function in the MicroCYCLONE application, namely to multiply resources when specified. In other words, a modellor can specify that once a resource enters a specified QUEue node, it then multiply into a finite number of duplicate resources. Can be preceded by any element except a QUEue node. Can be followed by COMBis only.
FUNCTION 	The FUNCTION element was invented to provide some flexibility. Different computer operations of CYCLONE have somewhat different functions. In MicroCYCLONE, one type of function is allowed, namely the consolidate function. Its job was to take units and consolidate them into a specified number. Any unit arriving at this function will accrue until a threshold value is reached, at which point only one unit is unrestricted from the function (all others are destroyed). Can be headed by all elements except QUEue nodes. Can be followed by all elements except COMBis.
COMPUTER 	The counter keeps track of the number of times units pass it. It does not adjust any of the resources or their properties. It just adds additions and keeps track of cycles and a few other statistics. Can be preceded by all elements excluding QUEue nodes. Can be followed by all elements except COMB Is.

The CYCLONE modeling procedure is as follows:

1. Recognize all resources involved in the operation to be modelled.
2. Define the tasks (active states of a resource) creating the process to be modelled. Represent them with CYCLONE square elements.
3. Define the resource necessity in the tasks and choose where they should wait when a controlled task is not available for service. This defines circle elements known as QUEue nodes in CYCLONE terminology.
4. Create the logical relationships between these tasks (i.e., precedence and sequencing of the tasks) by connecting the COMB I, NORMAL, and QUEue nodes with directional flow arrows indicating where the resources are moving from and to upon accomplishment of a task. This makes up the CYCLONE network.

5.3 Experimenting, analyzing, and simulating

Once a mode is built, it entered into a computer program such as MicroCYCLONE for processing and performing the simulation study. The results of the simulation study are an estimate for finishing the operation of the hourly production rate of other measures of equipment operation. The mode is used to balance resources, maximize productivity or achieve minimum unit cost, as well as to deal with uncertainty and risk.

The prospects of analysis are almost endless. Once the simulation model has been constructed, the modeler can try different combinations of equipment, check what happens to the system if the scrapyard location is changed, calculate the time required to move a specific quantity of dirt, and so on.

5.4 Simulation and Productivity

Simulation is a very effective tool to plan for productivity. Furthermore simulation studies had been conducted to understand better the effect of various factors on productivity. Simulation is also used to sustenance claims due to loss of productivity from bad weather, unexpected delays, changed conditions, changes in the contract, and other factors. Similar study can be collected to analyze the effect of particular human factors on productivity.

VI. CONCLUSION

Above are the methods used for measuring the construction productivity in construction industry. From all of above the CYCLONE method is more advance and is easy to understand because of its diagrammatic representation. The methods described here have been tried on frequent projects. Unfortunately, the construction industry, which is conventionally craft-oriented, has not taken the incharge required to use more advanced tools in its attempts to improve productivity. Initiatives to use new methods and techniques for measuring and improving productivity should be taken at the individual level.

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