An overview of a constructions productivity construction essay

Recently, construction productivity is on a long-term slide and it is recognized as industry challenge. System, people, materials, information and energy must flow effectively and efficiently to produce its objective at high productivity to complete construction at lowest possible cost with possible shortest timeframe (Picard, 2005).

Productivity is critically important in construction industry. Many researchers have expressed their concern over productivity in construction industry. Defining productivity is not a simple task to everybody. Different people will give different definition and understanding. Most of them agreed that marketable output was essentially the main measure used.

Increased productivity was a leading concern to all Committee stakeholders such as users, contractors, and construction labor unions and led by the owner. The construction users emphasized the need of collecting data directly relevant to productivity improvement. The Committee was concluded that the front-line construction foreman/supervisor would be a reliable source of information. These informants would be asked to provide their judgment of the greatest impediments to a productive construction project (Tucker, 2003).

Definition of productivity

Within these several decades, many researchers have defined the productivity term in their studies in a number of ways. The term productivity has different meanings to different people. Many individuals automatically think only of labor unions when the term “ productivity” is mentioned. Others associate capital expenditures with the term. Each of these interpretations is

only partly correct (Adrian, 1993). Many researchers have attempted to define precisely the meaning of productivity and below are some of it that referred from their studies:

Oglesby et al. (1989), presented that productivity can be defined as “ in-place value divided by inputs” . Some researchers have defined it as works-hours divided by the equivalent quantity of work. In construction, productivity normally can be understood as work quantity divided by man-hours (or work-hours) consumed to accomplish the work.

Productivity = Work Quantity

Man-hours

According to Dolman, Parham, & Zheng, (2007), productivity is a measure in order to know how much output is produced per unit of input.

Diewert & Lawrence, (2006) presented that productivity can be defined as the level of economic output per unit of input and also per worker. Productivity is important to the wealth and well-being of a nation and give efforts to improve productivity occur at all levels of society.

According to Hwang and Liu, (2005), productivity is an effective index that can indicate output of construction work quantity versus the input of resources. Productivity of a crew is directly impacts the cost and time needed to complete a task. By analyzing and forecasting productivity, project manager can be more effective to control and predict project time and cost throughout execution up to completion.

Thomas and Mathew, (1986) presented that no standardized productivity definition had been established in the construction industry. It is difficult to define a standard productivity measure because companies use their own systems which are not standardized. Association simply illustrates the productivity between an output and an input. The form has been widely used and existing in literature over the years in construction industry is;

Productivity = Input/Output

Prokopenko, (1987), defined the productivity as " effective and efficient utilization of all resources, labor, plant and materials".

According to Jugdev, et al.,(2001), productivity is a ratio between inputs and outputs. In calculating the productivity, it is important to specify the inputs and outputs that to be measured because there are many inputs such as labors, materials, equipments, tools, capital and design in construction system.

Uusi-Rauva and Hannula, (1996), presented that productivity can be defined as internal efficiency of the organization or other object to be measured. A more precise definition of productivity is the following: output divide by the input that is used to generate output. Output is consists of products or services and input is consists of materials, labor, capital, energy, etc. Productivity is not only affected by the quantities of inputs and outputs but also the qualities of inputs and outputs.

According to Halligan, et al., (1994), there are many ways to define productivity. In construction, it is usually taken to mean labor productivity which is units of work placed or produced per man-hour.

Teicholz, (2004), stated that productivity in construction industry was measured by constant contract dollars of new construction work per hourly work hour

The Bureau of Labor Statistics (BLS, 2009) of the U. S. Department of Labor was defines productivity into two type which are labor productivity and multifactor productivity. Labor productivity can be measures as output per hour of labor and it is used in over 40 industries including construction. Productivity can be calculated by dividing the quantity of work completed (Quantity) by number of labor hours used to complete the work (Man Hours). A productivity value represents performance of an operation with respect to time and cost, where activity duration and activity cost is directly affected by productivity.

Duration (Hours) = Quantity of Works

(Quantity / Man Hours)

= Quantity of Works

Productivity

The formula above indicates how critical the reliability of the productivity factors in estimation time.

Measurement of productivity

There is controversy surrounding productivity that rooted in the differences in data collection. It is due to incorrect in assuming productivity measured uniformly and that all published productivity values have the same basis (Whiteside, 2006)

Overall conception of productivity is difficult to express or to measure. It is sometimes expressed either in terms of output from labor or from services or from capital invested. These parts of expressions often do not give an accurate picture of the overall position. Although, there are measurements of some or all of the inputs and outputs of the industry but they still failed to combine these measurements into any satisfactory measure of efficiency. In fact, the ratio is easy to compute if the unit uses a single input to produce a single output (Choy, 2008).

According to Whiteside, (2006), production is average direct labor hours to install a unit material. He also stressed that in perfect world, perfect productivity (1. 0) will be accomplished in 40-hour work week, with everyone taking all of their holidays and vacation days planned. It is regarding to all the engineering drawings must be 100% complete, there would be no delays of any kind, everyone would work safely, everything would fit perfectly at the first time, the weather would be 70 degrees Fahrenheit and there would be no litigation at the end of the project. But, we do not live in perfect world and true productivity is often poorly understood. The first challenge in understanding productivity is lacking of common terms. The definition of hours identified as “ direct labor” should be consistent. Second is too much focus in determining productivity which is incorrectly placed on the individual worker. Productivity is something to do with the worker because many workers work at the same rates. The main thing should be focused in productivity measurement is proper or complete planning. It is because like-out-sequence work will contribute to lower productivity due to the rework hours required to complete the original task. The final challenge is how to

make productivity comparison when the data used in productivity studies before have the same basis. Productivity is not based on wage rates or cost data alone and it is improper to combine wage rate, hours and material quantities to make productivity comparison.

According to Hwang and Liu, (2009), construction productivity studies have centered on the identification of factors that influence productivity and quantification of the impact of such factor on productivity. As a result, there were various qualitative and quantitative factors have been discovered and various methods for productivity have been presented. Majority of those methods are based on relationships between productivity and factors. Based on Thomas and Yiakoumis (1987), they stated that theory underlying the factor model is the work of crew is affected by a number of factors. If the cumulative effect of these disturbances can be mathematically represented, then the expected actual productivity can be estimate. But, it is not always feasible to quantify the impact of various factors and represent the relationships mathematically. Another limitation is the value of many related factors in future is not available and thus, they have to be estimated. In fact, some of the factors can be correlated with others which the correlation may be higher or lower under different situations.

There is several research efforts have been devoted to developing models. The models that being used in the construction industry are such as below:

According to Sonmez and Rowings, (1998); Portas and AbouRizk, (1997), recommended Neutral Network (NN) techniques which have been used to develop method of productivity prediction.

Everett and Farghal, (1994), recommended learning curves that for various activities.

Abdelhamid and Everett, (1999), have applied time series analysis to evaluate hoisting performance comparing the CRANIUM technology with the conventional technique.

According to Brockwell and Davis, (2002), ARMA (autoregressive moving average) models are used to model time-lagged relationship of self-correlated observations within a single series.

Cumulative Average and Simple Moving Average that wisely used to model a single time series

Exponential Smoothing produce forecasts of weighted value of past observation with exponentially decreasing weights (NIST, 2006).

Although there are numbers of publications exist on construction productivity, there is no agreed upon definition of work activities nor a standard productivity measurement system. Most of researchers have concluded that it is difficult to obtain a standard method to measure construction labor productivity because of project complexity and unique characteristics of the construction projects (Oglesby et al. 1989). The uniqueness and non repetitive of operation in construction projects make it is difficult to develop a standard productivity definition and measure (Sweis, 2000).

Current measurement of productivity in construction industry

Our labor productivity experts specialize in labor productivity analysis and may utilize the following industry-recognized methodologies, where appropriate:

Measured Mile Analysis

Work Sampling

Comparable Work Study

General and Specialty Industry Studies (Mechanical Contractors Association of America [MCAA], Construction Industry Institute [CII], Business Roundtable, etc.)

Total Cost Method

Modified Total Cost Method

Time and Motion Studies

The selection of a particular productivity analysis methodology is depends on the project facts, the nature of the events being analyzed, the nature and extent of available labor data and may vary from project to project. Each of the above-referenced productivity analysis methodologies has inherent its own advantages and disadvantages. Interface Consulting has extensive experience handling construction labor productivity claims and construction claims consultants are skilled at tailoring productivity analysis approach to suit a project’s needs and constraints (ICII, 2009).

Factors influence productivity in construction

According to Tucker, (2003), he presented the most factors that can affect the construction productivity especially on site as below:

Design: specifications, drawings, documents have to be improved

Field support for timely responses; have architect/engineer on site with field competency

Coordinate Design/Review

Timely RFI’s/RFP’s (Request For Information’s/Request For Proposal’s)

Construction/Project management competency

He also suggested that productivity improvement should be done based on this area:

Constructability of the design documents with input of major contractors on schedule

quality and realism

Coordination among major contractors

Pre-project planning

Communication and teamwork between owners, design professionals, contractors and labor

Improvement of the construction management process.

Parisi, (2008) presented that potential factors influence the construction productivity are many, including out-of-sequence work; skilled labor shortages; worker crowding/congested work areas; interference of trades; owner interference; design problems and defects; contractor’s inadequate management/supervision; failure to properly staff the project; overtime; and acceleration.

Lim et al (1995) studied factors affecting productivity in the construction industry in Singapore. Their findings indicated that the most important problems affecting

productivity were: difficulty with recruitment of supervisors; difficulty with recruitment of workers; high rate of labour turnover; absenteeism from the work site; and communication problems with foreign workers. Olomolaiye et al (1996) studied factors affecting productivity of craftsmen in Indonesia, with their findings indicating

craftsmen in Indonesia spent 75 % of their time working productively. Five specific productivity problems were identified: ie lack of materials; rework; absenteeism; lack of equipment; and tools.

Kane et al (cited in Herbsman et al, 1990) classified factors affecting construction productivity into two main groups: technological factors and administrative factors.

The technological factors encompass those related mostly to the design of the project; the administrative group factors relate to the management and construction of the project. Technological factors comprise sub-groups such

as design factors, material factors and location factors. Administrative factors comprise sub-groups, such as construction methods and procedural factors, equipment factors, labour factors, and social factors. Heizer and Render (1990) classified factors influencing site productivity into 3 groups: labour characteristic factors; project work conditions factors; and nonproductive activities. Olomolaiye et al (1998) stated that factors affecting construction productivity are rarely constant, and may vary from country to country, from project to project, and even within the same project, depending on circumstances. They classified factors influencing construction productivity into 2 categories: external and internal, representing those outside the control of the firm’s management, and those originating within the firm.. External factors included the nature of the industry, construction client knowledge of construction procedure, weather, and level of economic development. Internal factors included management, technology, labour, and labour unions. Enshassi et al 2006, Enshassi et al 2007, and Al Haddad 2007 stated that among the problems which the Palestinian construction industry is facing are material supply schedules and project scheduling techniques. Although a number of training courses were conducted to local contractors, these training efforts did not focus enough on the abilities to use project scheduling techniques such as Microsoft project and Primavera. Therefore training effort should also be tailored to improve methods of studying productivity and ways of productivity improvement on construction sites.

The important productivity rate in project scheduling

The duration of construction project is a key factor to consider before starting a new project which is it can be determine project success of failure. Despite the uncertainty and risk level is very high in construction industry, current construction planning which is more relies on traditional deterministic scheduling method is still not clearly ascertain the level of uncertainty involved in the project. Subsequently, it can prolong a project's duration and cannot be completed within the allocation time of the project (Lee, et al., 2009).

Construction projects are subjected to changes which it require constant performance monitoring and follow-up schedule updates. Project manager must take proactive attitude to analyze project data and to predict potential problems and delay in order to make timely decisions and to reduce the negative impact on cost and schedule (Hwang and Liu, 2005).

Planning in construction is a complex and iterative process. A plan usually is prepared based on the estimates by the participant's actual commitment. Therefore, construction productivity plan plays a significant role in the process. Based on Parisi, (2008), in estimating labor, there are several key factors that should be considered:

Productivity of its field forces

Union labor agreements and requirements

Past experience with the owner, designer, and construction manager

Labor availability

Specialty trades

Therefore, if the actual construction work deviates from the anticipated plan, once the contract is signed and the project is underway, several situations may result as below:

The job may take more time because the progress is not being made at the rate projected in the original baseline schedule and thus, project completion must be extended. (In such cases, acceleration of the remaining activities may be implemented to recover time)

More hours of labor may be required to install the work items because materials are not being installed by the contractor’s workforce at the productivity rates (the anticipated quantities of material to be installed per hour) same as estimated in the original bid.

An overrun of both time and labor may occur.

In order to succeed, the companies must make a phase affirmative action into the total management of productivity through a formalized, documented process such as depicted in Figure 2. 0. The process should be started with historical productivity analysis. The knowledge that gained from this processes should then be utilized to forecast and manage future productivity. The supervisor that involved in this process must implement and monitor the predetermined productivity values. Only then the companies can be more competitive and successful in today’s global market

Figure 2. 0: A model to manage construction productivity

Construction industry seemed as low sector when there is low technology and low skilled employments occur. According to Saad, (2002), in order to raise level of construction productivity, it is recommended that the projects should have the following features:

High degree of standardization

Design is preferred to use pre-fabricated units or pre-assemble forming system

Building system should be easy and simple to construct and repetitive

Well managed construction methods with details planning and specification

High level of mechanized methods and skilled workers

Roof works

Roof is a basic human need is for shelter, which for most of us consists of a few walls and a roof over our heads. Roofs come in many shapes and sizes. One of the main reasons for having a roof is to keep out rainwater and snow. The selection of roof is based on the following characteristics:

Stability

Protection from the sun, weather, wind and rain

Durablity

Heat resistance

Brightness and ventilation

Beauty

Construction of roof must be strong and able to support the load and stressed that going to happen. The load that is attributable to roof, firstly is dead load which is the weight of the roof trusses, roof covering; secondly is live load which is consists of tools, equipment, workers, rain water and lastly is wind load. Wind is a major stress to the roof which is difficult to forecast accurately.

Roof stability is depends on the support such as roof trusses, column, walls, beams and foundation of the building.

Design of roof also takes into account the respective functions of the building. Building for residential and office should have a comfortable situation in terms of condition, light, air and dam parts sounds. Industrial buildings and warehouses may require heat insulation on the roof to maintain the same conditioning in buildings. Traffic in the building to allow use of the pillars supporting the roof of the short-range distance. Roof for theater and stadium, must be supported by long span of roof trusses and the support in the middle will distrupt the view and noise and sound effect protection from the audience.

Productivity work to be consider in roof works

The productivity works to be considered in this study as below:

Installation of roof trusses (cold form)

Installation of insulation

Installation of roof covering (concrete roof tiles and metal decking)

No. of workers in group

Daily Productivity (m2)

METHOD

PRODUCTIVITY OF ONE WORKING DAY

Handling

Half Mechanized

Full Mechanized

Summary

From the literature review of the productivity in construction is important especially to provide accurate duration of task in building project scheduling.

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FACTORS AFFECTING LABOUR PRODUCTIVITY IN BUILDING

PROJECTS IN THE GAZA STRIP

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