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Labor productivity: Benchmarking and variability in Egyptian projects

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Abstract

New management thinking, like that of lean construction, has suggested many principles and techniques that can result in better labor and cost performance. This paper focuses on improving construction labor productivity in Egypt by applying two lean construction principles, namely benchmarking and reducing variability in labor productivity. Using labor productivity data from masonry activities on eleven building projects in Egypt, several measures of benchmarks of construction labor productivity are demonstrated, calculated, and then used to evaluate the productivity of bricklayers and identify the best and worst performing projects. The benchmarks include disruption index (DI), performance ratio (PR), and project management index (PMI). On the other hand reducing variability of labor productivity is another important lean construction principle. The labor productivity variability of the studied projects is calculated using the coefficient of productivity variation. The correlation between variability in labor productivity and project performance was also examined statistically. From the application of the two lean construction principles, it was concluded that the benchmarks of labor productivity (DI, PR, and PMI) were found to be reliable indicators of project labor performance. In addition, the variability in daily labor productivity was found to be an important delineator between good and poorly performing projects.

Keywords: Labor productivity; Lean construction; Benchmarking; Variability; Project performance; Egypt

1. Introduction

Many studies have attempted to improve construction labor productivity via different ways for examples: studying the factors affecting construction labor productivity [22,5,23,27,2]; measuring and evaluating labor productivity [3,1,14,21,13,28]; modeling construction labor productivity [7,6,4]; and comparing labor productivity based on economic considerations or costs [30].

In recent years, lean construction principles have received much attention as a modern way to improve construction performance and labor productivity. Benchmarking has become an important research function in the national and global construction market. In 1999 Thomas and Zavrski [29,30] developed the framework for international labor productivity benchmarks of selected construction activities. The application of these benchmarks can lead to evaluating the labor productivity and identifying the best and worst performing projects.

Poor management and other factors can induce unnecessary changeability in construction conditions that leads to variable performance. Reducing variability in labor productivity will result in improved labor performance [26]. Benchmarking and reducing variability of labor productivity are two of the most important lean construction principles that will be examined in this paper to show their impact on labor performance.

2. Study objectives

The objectives of this paper are to explain briefly two of the lean construction principles, namely benchmarking and

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reducing variability in labor productivity, to demonstrate the conceptual benchmarking model for construction labor productivity and implement the model in some construction projects in Egypt, and to examine the impact of variability in labor productivity on labor performance.

3. Lean construction

The word lean was defined by Howell [16] as "Give customers what they want, deliver it instantly, with no waste." One of the main objectives of lean production is to eliminate non value-adding activities, "waste", in production process [18]. According to Koskela [18], wastes include overproduction, waiting, transporting, inspection, inventories, moving, and making defective parts and products. In contrast to the craft and mass production, lean production combines the advantages of both. It provides volumes of a variety of products at a relatively low cost by using resources of multi–skilled workers at all levels of organization and highly flexible, increasingly automated machines [17]. Lean construction is a new way to manage construction. Lean construction results from the application of a new form of production management to construction [15].

4. Differences between traditional production and lean production

4.1. Conceptual basis of traditional production philosophy

Traditional production philosophy may be outlined as follows [18]:

(a) A production process is a *conversion* of inputs to an output.
(b) The conversion process can be divided into sub-processes, which also are conversion processes.
(c) The cost of the total process can be minimized by minimizing the cost of each sub-process.
(d) The value of the output of a process is associated with costs (or value) of inputs to that process.

Statements c and d suggested that in order to minimize costs, attention must be focused on cost management in each operations, subprocess or department. Value on the other hand is not very important. Value of the output can be raised by using better materials and more skilled specialists, the costs of which are higher. This model neglects flows between conversions. These flows consist of moving, waiting, and inspecting activities. Unfortunately, a major part of the total production costs is caused by flow activities rather than conversions.

4.2. Conceptual basis of lean production philosophy

The lean construction system sees production as a *flow* of material, information, equipment, and labor from raw material to the product (Fig. 1). In this flow, the material is converted, inspected, waiting or moving. Processing represents the conversion aspect of production; inspecting, moving and waiting represent the flow aspect of production [18]. In essence, the new model consists of *conversions and flows*. The overall efficiency of production is attributable to both the efficiency of the conversion activities performed, as well as the amount and efficiency of the flow activities. While all activities expend cost and time, only conversion activities are vale-adding activities. The core idea of lean construction is to reduce or eliminate non vale-adding activities and increase efficiency of value-adding activities.

5. Lean construction principles

According to Koskela [18], Ballard [8–11], Tommelein [31] and Thomas et al. [26], the principles of lean construction include:

(a) Practice just-in-time (JIT).
(b) Use pull-driven scheduling.
(c) Reduce variability in labor productivity.
(d) Improving flow reliability.
(e) Eliminate waste, and simplify the operation.
(f) Benchmark.

The following sections describe two of these principles, namely benchmarking and reducing variability in labor productivity.

6. Benchmarking

Benchmarking can be defined as "a systematic and continuous measurement process; a process of continuously

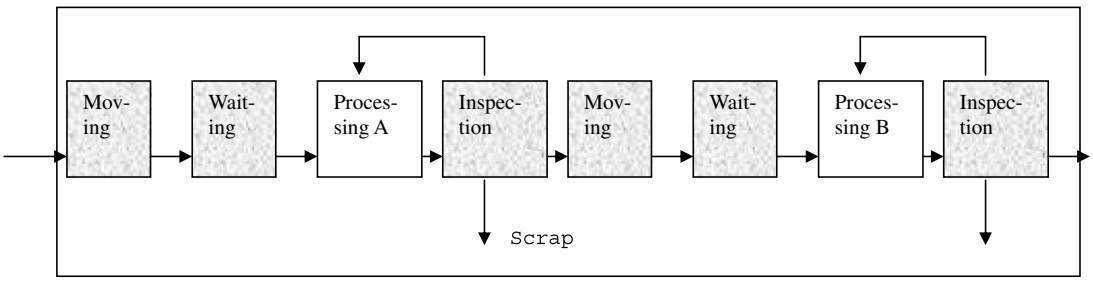

Fig. 1. Production as a flow process: simplistic illustration [18].