

# **A Review of Challenges Associated with Productivity in Construction**

**Behzad Abbasnejad**

<sup>1</sup>*Division of Construction Management, Department of Civil and Environmental Engineering, Chalmers University of Technology, SE-412 96, Gothenburg, Sweden*

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**Abstract:-** The concept of productivity has been debated for several decades without finding common definitions that are generally accepted in the construction sector. In addition, there are still some other challenges originated from various sources that negatively affect productivity in construction. In this paper, by means of a thorough literature review, it is tried to highlight the major issues regarding construction productivity to give construction managers and practitioners a broader insight about the problems associated with construction productivity and increase their awareness about the productivity challenges in construction. This paper indicates that due to the presence of a large number of challenges concerning construction productivity originated from various sources, it is necessary to use different solutions and approaches to tackle them.

**Keywords:-** Construction productivity, Construction management, Productivity challenges, Productivity definitions, Construction industry.

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## **I. INTRODUCTION**

The concept of productivity has been debated for several decades without finding common definitions that are generally accepted in the construction sector. Different people define it differently. Moreover, there are still some other challenges originated from various sources.

Given the demonstrated large impact of construction on the nation's macroeconomic objectives, effective construction research becomes vital to the economy. Key drivers for change in construction can only be valid when the major challenges and the areas needs further improvement can be recognized.

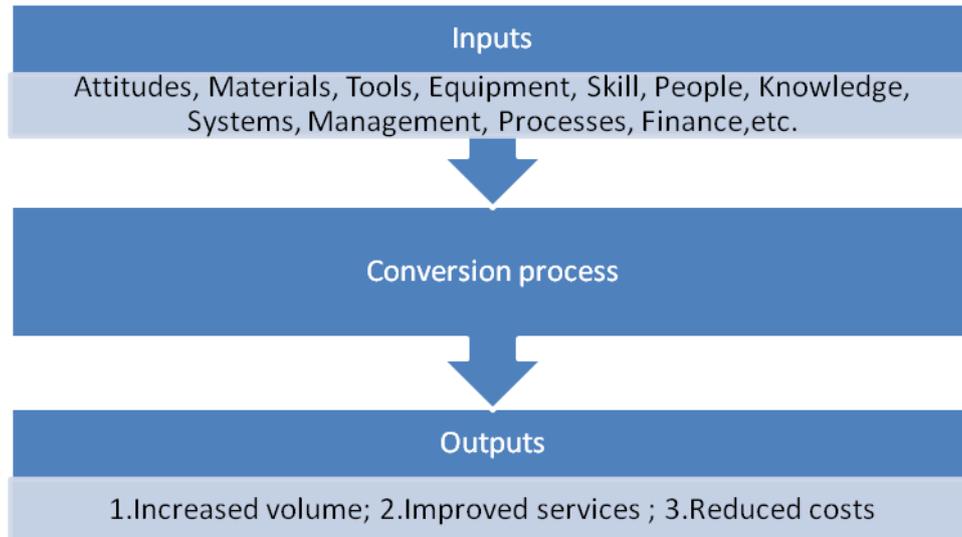
Therefore, the aim of this paper is to highlight most significant challenges and provide a foundation for future research and for establishing a starting point for researchers. Also the results of this paper are beneficial for construction managers and organizations to better realize the problems and the areas need further investment and attention.

## **II. REVIEW OF PRODUCTIVITY CHALLENGES IN CONSTRUCTION**

There is no consensus among researchers and managers in the construction industry regarding what is meant by "productivity". Different people may define productivity based on different things [1]–[8]. In the literature, it is evident that defining productivity ranges from measuring outputs to combination of efficiency and effectiveness, to rates of turnover and absenteeism, to measure of client or consumer satisfaction and to intangibles such as disruption in workflow, loyalty and job satisfaction. Notwithstanding variations in definition and interpretation, basically the concept of productivity is defined by considering the relationship between output and input as real output per unit of all inputs [1]. One or more inputs go through the conversion process to produce the outputs [Fig. 1].

Further category regarding definitions of productivity in the literature is based on the relation between efficiency and effectiveness which is known as the engineering definition of productivity [15]. Accordingly, productivity defines as the combination of both efficiency and effectiveness [2], [8]–[15]. Traditionally, efficiency is considered as the ratio of output over input. It has also been defined as "do things the right way". In the industry, anyone must use resources and employ conversion processes as efficiently as possible. Efficiency relates to all inputs- raw materials, processes, time, etc. On the other hand, effectiveness is defined as "doing things rightly", i.e. achieving the goals and getting the desired results (outputs/goals) [15]. Reference [11] argues that some level of both efficiency and effectiveness is necessary for obtaining productivity and if either one is missing, productivity cannot be fully achieved.

The third definition of productivity explains productivity beyond just efficiency and effectiveness to include any action or behavior by the employee that cause the organization to function better [15]–[16]. This definition is very extensive and could include such organizational aspects as innovation, turnover and employee engagement [15].



**Fig. 1:** Productivity: input, conversion process and output

In the construction industry, many organizations and managers are trying to measure their productivity in order to pay attention to their use of resources by measuring how productive they are, finding ways to optimize resource use and finding ways to increase efficiency in their operations, while maintaining or improving their results and creating value for the customers [17].

However, this extensive literature review shows that there are several challenges that impede or at least reduce the effects of measuring productivity in the construction industry. Many researchers have indicated that construction industry has a low productivity in comparison with manufacturing industry because it is project-based. This vulnerability, combined with difficulties associated with measuring, tracking and controlling site productivity (due to the challenges such as disruptions, etc) creates an extremely challenging task for contracting parties and construction managers in the industry to tackle with. The difficulties involved are also intensified by confusions regarding the definition of productivity and lack of a common definition for productivity, hence negatively affect construction productivity.

Parts of the challenges regarding productivity may derive from the confusion regarding the various definitions of this term. One of the challenges, for instance, is that in most of the definitions of productivity the terms “inputs” and “outputs” are placed at the center. However, defining productivity by considering inputs and outputs creates perplexity. The explanation is that the observer has many different choices with respect to the scope and nature of both the outputs and resources considered [Fig. 1]. For example, outputs might be measured in terms of delivered product or functionality, while resources might be measured in terms of effort or monetary value [4]. Further challenge concerning the estimation of productivity by considering input and output is discussed by [5]. They argue that most of the managers and practitioners in the construction industry estimate the productivity simply by considering output/labor input ratios and overlook the other drivers of construction productivity.

There is yet another challenge regarding the definition of productivity in the literature which is originated due to similarity among productivity and the other related terms. What is found baffling and challenging is the fact that the measure of productivity is often conflated with the measure of the similar terms such as performance and quality control in the mind of many researchers, managers and practitioners in this industry. Productivity has not to be confused with concepts such as profitability, performance, efficiency, and effectiveness [6], [8], [10], [12]–[15]. Even though all of these concepts are, more or less, related to productivity, none of them fully equivalent the dynamic and broad nature of productivity [6], [10], [12]–[19].

There are also some other challenges that derive from the project-basing characteristics of construction industry. The project-based nature of the industry implies that the organizing of the construction processes and projects is temporary, unique and fragmented. These features impede the industry to have a systematic product development which is the major reason of obtaining productivity in other industries [7]. This feature also imposes further challenge regarding knowledge transfer. The knowledge, as one of the most important resources of productivity, is broken and cannot be transferred properly [3] whereas due to the separated design and construction stages, there is a need for high level of knowledge and skill from construction workers [7]. Reference [13] also claims that the characteristics of being temporary in organizing of construction processes and shortage of solid data gathering pose difficulties for benchmarking task which can help the construction industry to improve productivity through the comparison with best practices.

Several researchers discussed that further challenges occur since the term productivity has been used to refer to various organizational levels. For example, [7] argues that there is an inconsistency between increasing productivity at individual projects and total productivity of the industry. While some managers tend to increase productivity just in their own project, others aim to increase it at the industry as a whole. Reference [9] indicated a comprehensive admiration of the importance of promoting total productivity. His idea is that “maximizing total productivity at the industry is more important than achieving high productivity in the component parts”.

Further challenge is discussed by [14] about the difficulties of measuring productivity at sites. He states that several measures in the sites at the construction industry are based on the qualitative data by observational means. The problem with these kinds of measuring productivity is that they are highly susceptible to the subjective interpretation and bias of the data collector. However, using quantitative data with clear definition of measurable variables reduces the data collection errors.

Some researchers identified the lack of standardized processes as the main challenge for having low productivity in the construction industry in comparison with manufacturing industry. For example, [18] discusses that lack of standardized processes and presence of many variability in the construction processes lead to the different quality, delivery time and cost of the processes. In comparison, manufacturing products are driven through standardized processes which lead to a reduction in ambiguities, time and waste. Thus, decreasing the variability at all levels of the construction process have the potential to increase the productivity. Reference [5] has discussed that focusing on partial processes to increase productivity at the construction industry pose further challenge. They argument is that this leads to subjective estimation of productivity. Thus, in order to increase productivity, attentions should be on the whole processes involved in the production of constructions.

There are also some other productivity issues concerning labor productivity which can be negatively affected by numerous factors [20]-[21]. Some of the most common cited factors include:

- Mismanagement
- Site access restrictions
- Defective plans and specs
- Changes in tasks or construction means and methods
- Unforeseen site conditions
- Work task starts and stoppages
- Unachievable bid estimates
- Labor shortages
- Rework and comebacks
- Test or inspection delays
- Overtime and shift work
- Internal or external interference
- Adverse weather conditions

As this literature review indicates, there are numerous challenges regarding productivity in construction. However, these factors can be classified into four broad categories as follows:

1. Factors related to productivity definition
2. Industry related factors
3. Project related factors
4. Labor related factors
5. Management related factors

### **III. DISCUSSION AND CONCLUDING REMARKS**

In this review paper, it is tried to raise the consciousness among construction academia and managers concerning productivity issues in construction by selecting peer-review journal and conference articles evaluating them into one full paper. Hopefully, the findings of this paper also provide an excellent starting point for researchers beginning to do research in this topic. In fact, this review paper provides a guide for necessary steps required to improve construction productivity and accordingly, the project performance.

It is tried to highlights key challenges about productivity in construction, though there might be other challenges. Therefore, it can provide clues as to where future research is heading or recommend areas on which to focus.

It is evident from the literature that there are different challenges associated with construction productivity. So, different solutions and approaches such as managerial and technological ones are needed to tackle them and managers should be well aware of the fact that only using some of these approaches cannot be fully effective to solve the problems.

Managers and practitioners in construction industry can utilize different approaches such as BIM, Total Quality Management (TQM) and Lean initiatives in their projects especially for the above-mentioned challenges to remove or at least reduce the effects of some of the problems on their projects. Nevertheless, only using them cannot be fully effective to solve all of these challenges. In order to reduce the effects of some of them, it is necessary to use other approaches. So, further research can be undertaken to address these challenges and the way future research should identify innovative solutions in these areas and explore the factors that promote or inhibit their adoption, and in particular the potential role of them in overcoming constraints on adoption based on mentioned challenges.

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