

# PRODUCTIVITY IN CONSTRUCTION INDUSTRY

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Since the late 1990s, the construction industry in the Kingdom of Saudi Arabia (KSA) has lagged behind the rest of the world in actual levels of productivity and productivity growth. This is despite the KSA Government's tremendous support for the construction industry and the expectation that, in the coming decades, the KSA construction industry will continue to develop and grow to achieve the targets of Saudi Vision 2030. This paper explores in depth the concept of productivity to gain insights through answering two questions contextualized within the KSA construction industry: 1) How do managers perceive productivity? and 2) How is productivity measured? Semi-structured interviews were conducted with 13 senior managers with 10–27 years' experience in project management in the KSA construction industry. Qualitative analysis of interview results found that around 40% of interviewees had little or an incorrect understanding of the concept of productivity and its relevance to production processes. This poor understanding of productivity and its measures extends to the lack of clear specific procedures for regular measurement of productivity.

**Keywords:** Saudi Arabia, Concept of productivity, Measurement of productivity, Project delays, Project management, Productivity improvement.

## 1 INTRODUCTION

Over the past three decades, KSA has witnessed a significant increase in new building projects and construction industry activity (Sarhan *et al.* 2017). This increase in construction projects (in both number and size) has attracted construction experts and companies from around the world to work in KSA (Mahamid *et al.* 2013). The estimated value of planned and current construction projects in KSA totals over US\$800 billion (Alsedairy 2019, Worldfolio 2015), and it is anticipated that the KSA construction industry will continue to develop and grow at a significant rate in coming decades. However, the industry faces several serious issues, in particular, low productivity that has contributed to poor construction production outcomes where projects have been delayed or postponed (Al-Kharashi and Skitmore 2009, Albogamy *et al.* 2012, Assaf and Al-Hejji 2006, Hussain *et al.* 2018). Construction is a vital industry globally, but the industry has not evolved its approaches and productivity has suffered as a result. While other sectors transform their efficiency, boost their productivity, and embrace the digital age, construction remains stagnant (Renz *et al.* 2016). Therefore, the concept and measurement of productivity in construction should be investigated in depth.

## **2 LITERATURE REVIEW**

The construction industry plays an important role in a nation's economic growth, and the success or failure of construction projects can be seriously affected by productivity (Naoum 2015). The term "productivity" was introduced by Quesnay (1766), around two centuries ago, in the context of the economic distribution of annual expenditure for an agricultural nation (Bleischwitz 2001). The most commonly used general definition of productivity is that of Tookey (2011): the product of outputs divided by inputs.

Productivity is one of the prime indicators of economic growth and prosperity, with higher productivity converting to higher gains, incomes, and tax revenue, in addition to discounted products and services for consumers (Vogl and Abdel-Wahab 2014). Thus, higher productivity can benefit society as a whole (Pekuri *et al.* 2011).

Globally, the construction industry spends around US\$10 trillion on construction-related goods and services annually. Yet, the global construction sector labor-productivity growth has averaged one percent a year over the past two decades, compared to 2.8 percent for the total world economy and 3.6 percent for manufacturing. If construction productivity were to catch up to that of the total world economy, the industry's value-added could rise by US\$1.6 trillion a year (Barbosa *et al.* 2017). The construction industry's productivity is one of the key drivers of economic production activities (Pekuri *et al.* 2011, Riratanaphong 2013, Tangen 2005, Vogl and Abdel-Wahab 2014).

Productivity is one of the most difficult factors to measure as it varies considerably by design, project size, site characteristics, and location of measurement. Crawford and Vogl (2006) provide an overview of the methods used in the construction industry. Looking at recorded industry trends for measurement, supporters of independent engineering and construction companies in the United States are observed to undertake measurement using sophisticated computer-based models and sampling work using technology tools (Naoum 2015). Yet, the resulting productivity values may not be directly comparable.

## **3 RESEARCH METHODOLOGY**

### **3.1 Methods**

This research is qualitative in nature, which will increase understanding, increase knowledge, and explore a phenomenon on which little research has been conducted (Creswell and Poth 2017). Qualitative research is described as a naturally occurring and unfolding model in a setting that enables the researcher to develop a level of detail highly involved in the actual experiences (Creswell and Creswell 2017). One of the determinants of qualitative research is the social phenomenon investigated from participants' perspective. Quantitative research involves collecting data so that information can be measured and subjected to statistical processing to support or disprove "alternative knowledge claims" (Creswell 2012).

Using semi-structured interviews allowed the researcher to ask follow-up questions of the participants to deepen the data by allowing participants to express themselves more clearly and in more detail (Fellows and Liu 2015).

### **3.2 Demographics of Participants**

All participants interviewed for the qualitative study were employed in the KSA building construction industry with companies registered with the Contractor Classification Agency in Grades 1–3. Where, under the Ministry of Municipal and Rural Affairs (MMRA) KSA, are approved contractors for defined contract values of: > USD 75 million for Grade 1; > USD20

million for 2 and > USD6 million for 3. As well, the participants had between 10–27 years' experience in project management in the industry (see Table 1).

Table 1. Interviewee details.

Interviewee	Years of experience	Nationality	Current position
I-7	27	Egyptian	General manager
I-1	25	Syrian	General manager
I-6	25	Palestinian	General manager
I-8	25	Syrian	General manager
I-3	17	Egyptian	Project manager
I-2	15	Jordanian	Project manager
I-4	15	Egyptian	Project manager
I-5	15	Egyptian	Project manager
I-10	15	Palestinian	Site manager
I-9	13	Egyptian	Site manager
I-12	11	Saudi Arabian	Site engineer
I-11	10	Lebanese	Site manager
I-13	10	Saudi Arabian	Site engineer

## 4 RESULTS AND DISCUSSION

### 4.1 Definition of Productivity

The term “productivity” can be defined in a number of ways, and comprise different elements (Dictionary 2019, Pekuri *et al.* 2011, Yi and Chan 2013). The most commonly used general definition of productivity is the product of outputs divided by inputs (Dictionary 2019, Tookey 2011). However, there are a variety of interpretations of what is meant, different foci of various productivity measurements, and availability of data (Krugman 1994).

Due to this complexity and ambiguity, the first interview question (what is the definition of “productivity”?) was designed to clarify the definition of productivity in the context of the KSA construction industry according to the interviewees to provide a consistent definition of the concept (i.e., one commonly understood by all interviewees). A few interviewees provided relatively clear definitions of productivity based on the amount of product produced per unit of time, for example, “productivity is defined as the amount of work performed by a worker in a specific period of time, whether 8 hours or 10 hours a day” (I-1); “It is the quantity produced by labor in a specific time” (I-3); and “The set of activities which are made in a specific time ... meaning kms produced by the worker per day” (I-13).

One interviewee defined productivity as the ratio of outputs to inputs, stating that “productivity is achieving a greater proportion of the result with minimal input” (I-9).

The focus of the definition of productivity can vary significantly between different industries and even between companies in the same industry (Krugman 1994). One interviewee highlighted this variance of view in his definition: “The concept of productivity is one concept agreed upon in the construction industry, but it differs in the way of calculating it according to each company or project for different types of inputs and outputs. Productivity depends on inputs (i.e., labor, time, materials) and required outputs” (I-6).

Several interviewees found it difficult to clearly define or describe productivity: “It is linking the performance of each item with the standard rates of each item and changing it according to the nationality of workers and the area of the worksite” (I-8), and “Productivity is the amount of work produced during the day by the worker according to prior measurement for matching between what is planned and what is produced on the ground” (I-7).

The latter statements demonstrate a lack of a solid understanding of the concept of productivity by a significant proportion (around 40%) of the interviewees, comprising two general managers, two project managers, and a site engineer. The findings of this study are larger than of Jergeas *et al.* (2000) who found in their study that (12%) do not have a definition of productivity.

## 4.2 Productivity Measurements

The second interview question (How does your company measure productivity?) was on how construction companies measure and monitor productivity, including any inputs and outputs. Measurements and monitoring of productivity is an essential control mechanism, allowing evaluation of the company's level of performance and its efficiency in achieving success in any construction project. A lack of regular, routine measurements and monitoring of productivity could be a cause of significant decline in a company's performance and/or lack of improvement in such performance. Therefore, reliable measurements and monitoring of productivity and associated trends in regard to construction projects and/or other company activities must be a managerial goal. It is also essential to establish the required frequency for routine productivity measurements so as to develop specific recommendations for the KSA construction industry and companies in regard to strategies for productivity growth.

Different propositions were obtained from the interviewees in relation to the clarification of productivity measurements and the required or adopted frequency of such measurements. Typically, the indications were that productivity measurements or evaluations were obtained daily, weekly, and/or monthly. However, many of the interviewees highlighted that the requirements for productivity measurements and monitoring could differ between projects and different parts of the same project. Therefore, a significant level of flexibility should be exercised to ensure reasonable and useful productivity evaluations for each construction project or project item. Typical comments of the interviewees in regard to productivity measurements and frequency of any such measurements were as follows:

- “Overall, productivity is measured according to the timetable set for the project monthly based on financial flows, while productivity is measured and monitored daily by specifying the number of meters produced daily by the worker. This varies from one item to another ... Productivity of workers is measured on a daily basis for the produced quantity, and it is calculated during the month” (I-1).
- “The project consists of several items and each item has its circumstances, productivity, rates and measurements. For example, in construction projects, the foundations are calculated separately as a key stage of the project” (I-4).
- “This is done first by dividing the project into a number of items and tasks and then specifying a timetable based on the rate of workers' productivity. For example, how many cubic meters of concrete can be done per hour? Then, workers' productivity are compared in reality on-site with the timetable and planned productivity” (I-6).
- “Internal labor is evaluated every 15 days (every two weeks), then every three months and then yearly to compare it with plans” (I-7).
- “Measurement is also done by item, materials and the number of workers in a specific period of time” (I-3).
- “Monthly, at the end of each month” (I-11).

The majority of the interviewees focused their responses about productivity measurements on timely completions and existing timetables. While these may be relevant to the determination of productivity, it is also important to understand that productivity measures should often involve

measurements of material inputs against the measure determined by the selected definition of productivity (see above). There were only a few indications about the specific approaches and adopted procedures used for measuring productivity. Instead, interviewees tended to make general statements about such evaluations, their uncertain, and confusing regularity (between daily and yearly). This demonstrated that regular productivity measures and monitoring were not likely to be part of the established routine activities and management at KSA construction companies. This was further corroborated by the observation that, “Unfortunately, what happens here in Saudi Arabia in general is that productivity of the project is not measured from start to finish. You rarely find a company which does this from start to finish in a professional manner” (I-4).

This conclusion is consistent with the finding from the first question that many senior managers in the KSA construction industry have little or an incorrect understanding of productivity concept and its relevance to the production processes. This relatively poor understanding of productivity and its measures extends into the lack of clear specific procedures for the regular measurement of productivity. As a result, some interviewees presented confusing and highly non-specific (and largely irrelevant) explanations of their productivity evaluations. For example:

- “Productivity is measured here according to the timetable prepared in advance. Measuring and monitoring are done according to that timetable and continuously. According to that timetable and prepared plan, I know the number of workers the project needs, whether by increasing or decreasing the number accordingly to save cost and salaries and vice versa ... Monitoring is done daily, and there is a report of the budget monthly, and quarterly, and annually” (I-5).
- “Any project has timetable, which is connected with payments and a financial value, so whenever the work is done accordingly to that and faster, productivity increases, and the length of time is shortened. It also means saving in the number of working days and salaries workers” (I-3).
- “Concerning our company, it is new in the construction industry, so concerning the setting of timetables, we did not have experience or structures here” (I-2).
- “This is monitoring the costs of the project and, thus, productivity is measured and then obtained during that period, and whether this is in line with the plan and timetable previously-prepared” (I-13).

## 5 CONCLUSION

The presented extracts of interviewees’ responses clearly demonstrate the significant level of confusion among senior management staff in the KSA construction industry about basic productivity issues and concepts, including the absence of an established routine for regular evaluation and management.

The only way to overcome this significant issue with productivity in the KSA construction industry is through targeted educative interventions and measures developed at the company and/or government level to ensure significantly better knowledge of productivity-related issues among engineering and management staff. This is essential for the successful development and increased productivity and efficiency of the KSA construction industry.

## References

Al-Kharashi, A., and Skitmore, M., *Causes of Delays in Saudi Arabian Public Sector Construction Projects*, Construction Management and Economics, 27(1), 3-23, 2009.

- Albogamy, A., Scott, D., and Dawood, N., *Addressing Construction Delays in The Kingdom of Saudi Arabia*, International Proceedings of Economics Development and Research, 45, 148-153, 2012.
- Alsedairy, F. S., *Dynamics of Mega Infrastructure Decision-Making in Saudi Arabia*, 2019.
- Assaf, S. A., and Al-Hejji, S., *Causes of Delay in Large Construction Projects*, International Journal of Project Management, 24(4), 349-357, May, 2006.
- Barbosa, F., Woetzel, J., Mischke, J., Ribeiroirinho, M. J., Sridhar, M., Parsons, M., and Brown, S., *Reinventing Construction: A Route to Higher Productivity*, Mckinsey Global Institute, 2017.
- Bleischwitz, R., *Rethinking Productivity: Why Has Productivity Focussed on Labour Instead of Natural Resources?* Environmental and Resource Economics, 19(1), 23-36, 2001.
- Crawford, P., and Vogl, B., *Measuring Productivity in The Construction Industry*, Building Research and Information, 34(3), 208-219, 2006.
- Creswell, J., *Research Design*, 2012.
- Creswell, J. W., and Creswell, J. D., *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, Sage Publications, 2017.
- Creswell, J. W., and Poth, C. N., *Qualitative Inquiry and Research Design: Choosing Among Five Approaches*, Sage Publications, 2017.
- Dictionary, B., *Business Dictionary*, 2019.
- Quesnay F., *Analyse De La Formule Arithmetique Du Tableau Economique De La Distribution Des De Pensées Annuelles D'une Nation Agricole*, Journal De l'Agriculture, Du Commerce and Des Finances (in French), 11-41, 1766.
- Fellows, R. F., and Liu, A. M., *Research Methods for Construction*, John Wiley and Sons, 2015.
- Hussain, S., Zhu, F., Ali, Z., Aslam, H., And Hussain, A., *Critical Delaying Factors: Public Sector Building Projects in Gilgit-Baltistan, Pakistan*, Buildings, 8(1), 6, 2018.
- Jergeas, G. F., Chishty, M. S., And Leitner, M. J., *Construction Productivity: A Survey of Industry Practices*, AACE International Transactions, P6A, 2000.
- Krugman, P., *The Age of Diminishing Expectations, US Economic Policy in The 90s*, 1994.
- Mahamid, I., Al-Ghonamy, A., and Aichouni, M., *Major Factors Influencing Employee Productivity in The KSA Public Construction Projects*, International Journal of Civil and Environmental Engineering, 14(01), 16-20, 2013.
- Naoum, S., *Productivity in Construction Projects Design Economics for The Built Environment*, Wiley Online Library, 93-106, 2015.
- Pekuri, A., Haapasalo, H., and Herrala, M., *Productivity and Performance Management-Managerial Practices in The Construction Industry*, International Journal of Performance Measurement, 1(1), 39-58, 2011.
- Renz, A., Solas, M., Almeida, P., Buhler, M., Gerbert, P., Castagnino, S., and Rothballer, C., *Shaping The Future of Construction. A Breakthrough in Mindset and Technology*, The World Economic Forum, June, 2016
- Riratanaphong, C., *Performance Measurement of Workplace Change: In Two Different Cultural Contexts*, TU Delft, 2013.
- Sarhan, J. G., Xia, B., Fawzia, S., and Karim, A., *Lean Construction Implementation in The Saudi Arabian Construction Industry*, Construction Economics and Building, 17(1), 46, Mar, 2017.
- Tangen, S., *Demystifying Productivity and Performance*. International Journal of Productivity and Performance Management, 54(1), 34-46, January, 2005.
- Tookey, J. E., *Labour Productivity in The New Zealand Construction Industry: A Thorough Investigation*, Construction Economics and Building, 11(1), 41-60, March, 2011.
- Vogl, B., and Abdel-Wahab, M., *Measuring The Construction Industry's Productivity Performance: Critique of International Productivity Comparisons at Industry Level*, Journal of Construction Engineering and Management, 141(4), 04014085, April, 2014.
- Worldfolio, *Saudi Infrastructure \$800 Billion of Mega-Projects to Boost Infrastructure and Spur Development*, The Worldfolio, United Kingdom, 2015.
- Yi, W., and Chan, A. P., *Critical Review of Labor Productivity Research in Construction Journals*. Journal of Management in Engineering, 30(2), 214-225, 2013.