International Journal of Construction Management

ISSN: 1562-3599 (Print) 2331-2327 (Online) Journal homepage: https://www.tandfonline.com/loi/tjcm20

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To cite this article: Abdulaziz M. Jarkas (2015) Factors influencing labour productivity in Bahrain's construction industry, International Journal of Construction Management, 15:1, 94-108, DOI: 10.1080/15623599.2015.1012143

To link to this article: https://doi.org/10.1080/15623599.2015.1012143

Published online: 30 Mar 2015.

International Journal of Construction Management, 2015
Vol. 15, No. 1, 94–108, http://dx.doi.org/10.1080/15623599.2015.1012143

Factors influencing labour productivity in Bahrain's construction industry

Abdulaziz M. Jarkas*

Al Mazaya Holding Co., Safat, State of Kuwait

There are many challenges facing the construction industry in the Kingdom of Bahrain, but it can be reasonably argued that low labour productivity is among the most important. The primary objective of this investigation, therefore, is to identify, explore, and rank the relative importance of the critical factors influencing labour productivity in Bahrain's construction industry. To achieve this objective, a statistically representative sample of contractors was invited to participate in a structured questionnaire survey comprising 37 productivity factors, which were categorized under the following major groups: (i) management; (ii) technological; (iii) labour; and (iv) external. Using the relative importance index technique, the following factors are perceived as most significant in their influence on labour productivity: (1) labour skills; (2) coordination among design disciplines; (3) lack of labour supervision; (4) errors and omissions in design drawings; (5) delay in responding to requests for information; (6) rework; (7) stringent inspection by the engineer; (8) working overtime; (9) lack of incentive scheme; and (10) inclement weather. The results obtained fill a gap in knowledge of factors affecting labour productivity in the construction industry, which can be used by industry practitioners to develop a wider and deeper perspective of the factors impacting on the efficiency of operatives, and thus assist in achieving a reasonable level of competitiveness and a cost-effective operation.

Keywords: labour productivity; construction projects; efficiency; Kingdom of Bahrain

1. Introduction

In spite of significant developments in construction technologies, labour remains the key driver in the industry. In most countries, labour costs comprise 30–50% of the overall project costs (Kazaz et al. 2008; Jarkas & Bitar 2012), and hence they are regarded as a true reflection of the efficiency and success of the construction operation. Yet in today's turbulent economic conditions, and their negative influence on the construction sector across the globe, improving labour productivity has become even more pressing than ever.

The Kingdom of Bahrain, a small archipelago situated close to the east coast of Saudi Arabia, is one of the six members comprising the Gulf Cooperation Council (GCC) – the others are Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates. Although the Kingdom was the first Arabian Gulf State to discover crude oil (Held 2005), due to its limited reserves, during the past two decades Bahrain has been successfully embracing economic liberalization to diversify away from oil, and thus the economy has substantially expanded into banking, heavy industries, services, retail, and tourism. It is worth noting, moreover, that the Kingdom is regarded as the main financial hub and the centre of Islamic finance for the Arabian Gulf region (IMF 2006).

In an effort to boost the construction sector, which has been stagnant for the past few years as a result of the global economic crisis, the government of Bahrain is planning to launch the development of 187 new projects for the year 2013/14, ranging from new residential and industrial cities to major infrastructural facilities (Trade Arabia 2013). Such a plan should act as a stimulus to the local construction industry, and may, depending on the scale and complexity of the projects outlined, require the participation of international practitioners – i.e. consultants and contractors – mainly due to the shortage of highly experienced firms available locally.

There are many challenges facing the construction industry in Bahrain, but it can reasonably be argued that low labour productivity is among the most important. Notwithstanding the local availability of financial facilities, modern equipment and tools, and construction materials to contractors, the cost of construction is constantly rising, completion schedules are frequently experiencing serious slippage, and projects, most often, are significantly overrunning their budgets.

The primary aim of this investigation is to create a research-based picture because there is a knowledge gap, since such a scientific picture for the Kingdom does not exist. In addition, while previous related studies have identified various factors affecting labour productivity in the construction industry, several factors related to a local industry – socio-economic, environmental, and cultural issues – further contribute to the relative significance ranking, and hence the extent to which such factors impact on the efficiency level of operatives.

*Email: jarkas@mazayarealestate.com

The main objective of this study, therefore, is to identify, explore, and rank, based on contractors' perspectives, the relative importance of the critical factors influencing labour productivity in Bahrain's construction industry, so that the findings can be used by local and international contractors, in addition to clients, consultants, policy makers, and academics, to develop a deeper and wider perspective of the significant factors impacting on the efficiency of operatives, and provide guidance to construction project managers for effective planning and efficient utilization of the labour force; and thus assist in achieving a reasonable level of competitiveness and a cost-effective operation.

It is important to note, nonetheless, that the logic behind focusing on contractors' perspectives is threefold, although the perceptions of clients and consultants may provide further important insights to the study at hand. For the technical part, it relates to the predominant 'traditional' contract procurement method practised locally – that is, 'design–bid–build' – where the contractor is usually faced with predetermined decisions pertaining to the design and specifications criteria, on the one hand, and contractual conditions, on the other, which must be implemented during the construction stage of the project, and therefore, as an end-user, would be in a better position to provide an objective assessment of the effects of such products on labour productivity.

For the managerial part, the labour force, whether directly employed or subcontracted, is under the management and supervision of the contractor. Once again, as a direct supervisor, who is in daily interaction and communication with operatives, can afford to render a reasonably accurate judgement on the crucial and most relevant factors influencing their efficiency levels. For the research contextual paradigm part, most of the reviewed studies related to this investigation focused on contractors' perceptions in order to explore and identify the prominent factors affecting construction labour productivity in various settings around the globe. Accordingly, equal basis discussion and results comparison of this study with those previously reported, necessitates the use of a similar approach.

The paper starts with a review of literature relevant to this investigation, presents the research methodology and data analysis, provides a discussion of the results obtained, and concludes, based on the findings of the study, with recommendations geared toward improving the efficiency level of operatives, and ultimately the productivity of the construction industry in the Kingdom.

2. Literature review

Productivity, in the most general terms, is an economic measure defined as the ratio of output to input (Adrian 1987). Depending on the objectives of measurement and the availability of data, several definitions and mathematical expressions are encountered in the literature.

The US Department of Commerce defines productivity as 'Dollars of output per person-hour of labour input' (Adrian 1987). Peles (1987), however, interpreted productivity as 'the performance accomplished by operatives', whereas Finke (1998) referred to productivity as 'the quantity of work produced per man-hour, equipment-hour, or crew-hour'.

The American Association of Cost Engineers, on the other hand, characterizes productivity as a 'relative measure of labour efficiency, either good or bad, when compared to an established base or norm' (Allmon et al. 2000). Arditi and Mochtar (2000) described productivity as 'the ratio between total outputs expressed in dollars and total inputs expressed in dollars as well', while Horner and Duff (2001) delineated productivity as 'how much is produced per unit input'.

Even though construction productivity is a multi-faceted, ubiquitously complex issue, which is difficult to measure, and therefore is often defined by reference to the basic resources used (Radosavljevic 2001), it is obvious, in view of the preceding discussion, that the general consensus among the various interpretations is to define productivity as the ratio of output to input; hence, construction productivity can be regarded as a measure of outputs which are obtained by a combination of inputs. Consequently, two measures of construction productivity emerge: (i) total factor productivity, where all outputs and inputs are considered; and (ii) partial factor productivity, often referred to as single factor productivity, where outputs and single or selected inputs are considered (Talhouni 1990; Rakhra 1991; Jarkas & Bitar 2012).

In comparison with partial factor productivity, where the definition is best exemplified by the term 'labour productivity' – i.e. units of work accomplished per labour-hour (Halligan et al. 1994) – the disadvantages of the total factor productivity measure are twofold. On the one hand, it is difficult to reasonably determine and measure all input recourses utilized to achieve the output, and, on the other hand, it is impractical, especially for researchers, to monitor, observe or assess the effects of selected individual factors on the output. The complex nature of the construction process and the interaction of its activities, furthermore, make the partial factor productivity measure the popular option, since effective control systems monitor each input separately.

Labour productivity in the construction industry has been the subject of numerous research studies. Olomolaiye et al. (1987) investigated the factors influencing labour productivity in Nigeria, and concluded that output quantities need to be established through 'time study' techniques, and that the results obtained should be disseminated to a wide range of construction firms to optimize the working methods without resorting to additional physical efforts and strenuous activities.

Horner et al. (1989), in a questionnaire survey aimed at identifying the factors bearing impacts on labour productivity in the UK construction industry, identified the following significant factors: (1) skill of labour force; (2) constructability/buildability; (3) quality of supervision; (4) method of working; (5) incentive scheme; (6) site layout; (7) complexity of construction information; (8) crew size and composition; (9) length of working day/overtime; and (10) availability of power tools.

Lim and Alum (1995) examined the factors affecting the productivity of the construction sector in Singapore, and isolated the following as most critical: (a) lack of qualified supervisors; (b) shortage of skilled labour; (c) high rate of labour turnover; (d) labour absenteeism; and (e) communications with foreign operatives.

In a survey geared toward establishing the constraints on productivity in the Iranian construction industry, Zakeri et al. (1996) differentiated the following five factors as major determinants of operatives' efficiency: (1) materials shortage; (2) weather and site conditions; (3) equipment breakdown; (4) drawing deficiencies/change orders; and (5) lack of proper tools and equipment. Kaming et al. (1997), moreover, explored the factors impacting on the productivity of craftsmen in Indonesia and identified (a) lack of materials; (b) rework; (c) absenteeism of operatives; and (d) lack of suitable tools as the most significant.

Factors influencing the productivity of the construction operation in Thailand were studied by Makulsawatudom et al. (2004), whose results discerned the following causes as most prominent: (i) lack of materials; (ii) incomplete drawings; (iii) incompetent supervisors; (iv) lack of tools and equipment; (v) labour absenteeism; (vi) poor communication; (vii) instruction time, that is, the required information is not provided in a timely manner; (viii) poor site layout; (ix) delay in inspection; and (x) rework. Abdul Kadir et al. (2005) further researched the factors affecting the efficiency of operatives in Malaysian residential projects, and reported the following factors as most important: (a) shortage of materials; (b) non-payment to suppliers causing stoppage of materials deliveries to sites; (c) change in orders issued by consultants; (d) late issuance of construction drawings by consultants; and (e) the incapability of site management.

Based on their recognized impacts on craftsmen's productivity in Uganda, Alinaitwe et al. (2007) shortlisted the following factors as most crucial: (1) incompetent supervisors; (2) lack of skills; (3) rework; (4) lack of tools and equipment; and (5) poor construction methods. Enshassi et al. (2007), on the other hand, evaluated the various causes influencing the efficiency of labour on building projects in the Gaza Strip, Palestine, and perceived the following factors as most salient: (i) materials shortages; (ii) lack of labour experience; (iii) lack of labour supervision; (iv) misunderstanding between labour and superintendents; (v) alterations of drawings and specifications during execution; (vi) delay in payment; (vii) labour disloyalty; (viii) delay in inspection; (ix) no weekend breaks; and (x) tools and equipment shortages.

Durdyev and Mbachu (2011), in addition, assessed labour productivity constraints in the New Zealand construction industry, and found the following as key determinants: (a) rework; (b) poor estimates; (c) labour skills; (d) labour motivation; (e) suitability of plant and equipment employed; (f) construction method; (g) buildability issues; (h) project complexity; (i) supervision; (j) clients' overt influence on the construction process; (k) unforeseen ground conditions; and (l) inclement weather.

Jarkas and Bitar (2012) explored the factors affecting labour productivity in Kuwait's construction industry, and identified the following as most significant: (1) clarity of technical specifications; (2) the extent of changes in instructions during execution; (3) level of coordination among design disciplines; (4) lack of labour supervision; (5) proportion of work subcontracted; (6) level of design complexity; (7) lack of incentive scheme; (8) lack of leadership by construction manager; (9) stringent inspection by the engineer; and (10) delay in responding to requests for information.

Jarkas et al. (2012), moreover, surveyed the factors influencing the productivity of construction operatives in Qatar, and determined the following causes as most critical: (a) skill of labour; (b) shortage of materials; (c) labour supervision; (d) shortage of experienced labour; (e) communication between site management and labour force; (f) lack of leadership from construction managers; (g) high temperatures; (h) delay in responding to requests for information; (i) failure to provide labour with transportation; and (j) proportion of work subcontracted.

Soham and Rajiv (2013) studied the factors impacting on the productivity of construction labour in the South Gujarat region of India, and highlighted the following factors: (i) labour skills; (ii) clarity of technical specifications; (iii) shortage of materials; (iv) worker motivation; (v) inclement weather; and (vi) physical fatigue of workers.

In a study aimed at identifying the important factors affecting labour productivity at a building construction project in the US, Gundecha (2013) distinguished the following causes: (1) lack of required construction materials; (2) shortage of power and/or water supply; (3) accidents during construction; (4) lack of required construction tools/equipment; (5) poor site conditions; (6) insufficient lighting; (7) weather conditions; (8) site conditions differing from plan; (9) location of materials storage; and (10) working overtime.

In a recently published research study, El-Gohary and Aziz (2014) examined the factors influencing labour productivity in Egypt, and revealed the following as most significant: (a) labour experience and skills; (b) incentive programmes;

(c) availability of materials and ease of handling; (d) leadership and competency of construction management; and (e) competency of labour supervision.

Notwithstanding that, depending on the social, cultural, economic, political, and environmental conditions, the relative influence of factors impinging upon labour productivity in the construction industry can be different in different countries and across geographical regions, an overall reasonable consensus exists on the significant factors highlighted in the literature. However, in order to effectively explore and reasonably determine the relevance and applicability of such causes to the construction industry of a specific geographical setting, not only is a simultaneous assessment of a large, yet interrelated number of factors, which can be classified under various categories, required, but it must subsequently be scrutinized by local industry experts, professionals, and practitioners.

In order to categorize the factors impacting on labour productivity in the construction industry into the main global groups, which can best relate to the various corresponding factors, several approaches have been previously used; nevertheless, a consensus among researchers on such categorization schemes is yet to be achieved.

Herbsman and Ellis (1990) reported two main divisions of influencing factors: (i) technological and (ii) administrative; whereas Talhouni (1990) suggested the following four categories affecting productivity on construction sites: (1) management; (2) site; (3) design; and (4) weather. Administrative or management-related factors comprise inadequate supervision; improper selection of construction methods; sequencing problems; crew size and composition; working overtime; shortage of materials; and the unavailability of suitable equipment and tools. Site-related factors are restricted access to site; stringent control procedures; confined working space; site layout; and congestion. Technological-related factors are, mainly, the direct result of buildability/constructability or the lack of it. They include uncoordinated, incomplete and illegible drawings; complex designs of unusual shapes and heights; unclear or outdated technical specifications; excessive delay in responding to contractors' requests for information; and stringent inspection procedures. Weather-related factors are ascribed to high or low temperatures; high humidity; high wind; rain; and snow.

Heizer and Render (1996) partitioned productivity factors into three major groups: (i) labour characteristics; (ii) project conditions; and (iii) non-productive activities. Labour characteristics involve skills, experience, satisfaction, and motivation of the labour force. Project conditions are attributed to the type, design, materials, and location. Non-productive activities are those which are either counterproductive or do not contribute directly to the progress of tasks at hand: e.g. late start and early finish; frequent breaks; unscheduled breaks; waiting time; simultaneous involvement of workers in several tasks; and the engagement of operatives in extended personal discussions.

Sugiharto (2003) assigned the key factors impacting on the construction industry's productivity in Indonesia to the following categories: (a) characteristics of contractors; (b) inadequate management strategy; and (c) organizational focus. The characteristics of contractors include ownership type; qualifications; accumulated experience; classifications; and the calibre of staff employed. Management strategy refers to the tools and managerial approaches adopted to minimize waste and unproductive activities, and thus promote lean, efficient, and cost-effective operations; whereas organizational focus pertains to the client objectives and motivations, project goals, and the active involvement of all construction personnel in the operation.

While Enshassi et al. (2007) were excessively elaborate in their categorization criteria and went on to allocate such factors under the following 10 major groups: (1) materials/tools; (2) supervision; (3) leadership; (4) quality; (5) time; (6) manpower; (7) project; (8) external; (9) motivation; and (10) safety, Durdyev and Mbachu (2011) were even more detailed in their classification approach, which identified the multiple factors influencing labour productivity under the following eight broad groups: (a) statutory compliance; (b) unforeseen events; (d) external forces; (e) project finance; (f) workforce; (g) technology/process; (h) project characteristics; and (i) project management.

Jarkas and Bitar (2012) and Jarkas et al. (2012), on the other hand, applied the following classification schemes to arrange the numerous productivity factors under: (i) management group; (ii) technological group; (iii) labour group; and (iv) external group, whereas El-Gohary and Aziz (2014) employed the following categorization system to apportion the different factors impinging upon the productivity of operatives: (a) labour; (b) industrial; and (c) management.

Even though several group designations have been proposed by different researchers, a careful consideration of the different terminologies presented reveals a considerable level of redundancy and subgroupings among some of the different classifications reviewed. For instance, the 'non-productive activities' group suggested by Heizer and Render (1996) can be reasonably included under 'labour characteristics', whereas 'organizational focus' proposed by Sugiharto (2003) may be assigned to the 'management strategy' group. The expanded groups advocated by Enshassi et al. (2007) and Durdyev and Mbachu (2011) can, moreover, be rationally depicted by the classification scheme considered by Jarkas and Bitar (2012) and Jarkas et al. (2010).

Despite the fact that factors affecting labour productivity are different in different countries, across sites, and possibly within the same construction site, depending on circumstances (Olomolaiye et al. 1998), a universal agreement on a classification scheme under which such factors can be allocated is possible, since the terms of such categorizations can hold rigorously, regardless of the geographical regions, environments or construction sites on which the specific factors vary in their impacts, either among or within.

The classification scheme considered by Jarkas and Bitar (2012) and Jarkas et al. (2012), therefore, is acknowledged and will further form the basis for categorizing the various corresponding factors explored in this study under the following four major groups: (1) management; (2) technological; (3) labour; and (4) external.

3. Research methodology and data analysis

This research study is inherently quantitative and, although it may be criticized on the grounds of causal explanation (Ackroyd & Hughes 1981), the findings are primarily used to underpin the qualitative interpretations, and thus it is not in conflict with the phenomenological paradigm.

The data for this investigation were collected by a structured – closed-ended – questionnaire survey, i.e. a 'quantitative' data collection instrument, which comprises a series of questions that limit the respondents' answers to a fixed set of responses in order to obtain statistically useful information about a topic under investigation (Foddy 1993). The logic underlying the selection of such a data collection technique is fourfold: (a) it is less intrusive and cost-effective when compared to unstructured – open-ended – questionnaires that allow the participants to respond in any way they choose, telephone, or face-to-face interviews, and thus is especially advantageous for collecting large sample sizes; (b) the familiarity of the questionnaire survey concept to most potential respondents; (c) the practicality and relative simplicity with which the sets returned can be analysed; and (d) in comparison with telephone and face-to-face interviews, it assists in reducing the bias that may be introduced by researchers' verbal and visual clues.

Based upon previous reviewed studies on labour productivity in the construction industry, but most importantly their applicability and relevance, as recognized by a group of local industry experts, professionals, and practitioners, to the geographical setting upon which this study focused, 37 factors, classified under the previously indicated four major groups, were identified and shortlisted as being potentially critical, or among the relatively most influential factors on the productivity of the construction labour force in Bahrain. Table 1 presents the factors surveyed, and related groups to which they were allocated.

The target population included both local and international construction firms, which are prequalified and classified by the Ministry of Works (MOW). The prequalification criteria for construction firms in Bahrain are based on: (i) the credentials of the technical and administrative staff employed; (ii) previous experience; (iii) equipment and tools available; and (iv) financial position and strength. As a result, the numbers of firms classified under the AA, A, and B grades, are 45, 23, and 22, respectively, for a total of 90 (MOW 2013).

Although the vast majority of the classified construction firms are Bahraini, the regulations of the Kingdom allow – with restrictions – international contractors to practise locally as a 'branch' of the 'parent' firm. However, as with other GCC countries, the priority in awarding contracts, expect for special cases, is always for local contractors. Consequently, the majority of international contractors operating in the Kingdom, to preserve competitive viability, are currently under partnership agreements with Bahraini construction firms; thus, for all statutory purposes, these can be categorized as 'local' firms.

It is important to highlight, moreover, that the grading criteria control the magnitude of projects that can be undertaken by contractors, where firms classified under the AA grade are bound by no 'upper' limit on the contract value of any construction project, whereas those classified under the A and B grades are formally restricted by the following monetary limits on any contract value that they can undertake, respectively: Bahraini dinar (BD) 6 million (US$16 million) and BD 2 million (US$5.3 million); however, there is no upper boundary on the combined value of contracts imposed on any classification grade.

In order to obtain a statistically representative sample of the population, the formula shown in Equation (1) was used (Hogg & Tannis 2009).

$$n = \frac{m}{1 + \left(\frac{m-1}{N}\right)} \tag{1}$$

Where n, m, and N represent the sample size of the limited, unlimited, and available population, respectively. On the other hand, m is estimated by Equation (2).

$$m = \frac{z^2 * p * (1-p)}{\varepsilon^2} \tag{2}$$

Table 1. Productivity factors surveyed and groups under which they were classified.

No.	Factor	Related Group
1	Lack of labour supervision	Management
2	Working overtime	Management
3	Lack of incentive scheme	Management
4	Payment delay	Management
5	Unavailability or shortage of materials	Management
6	Unrealistic scheduling and expectations of labour performance	Management
7	Construction method	Management
8	Not providing labour with transportation	Management
9	Proportion of work subcontracted	Management
10	Congestion and labour interference	Management
11	Incompetent supervisors	Management
12	Sequencing problems	Management
13	Accidents as a result of poor safety programme	Management
14	Communication problems between site management and labour	Management
15	Client's intervention with site management and operatives	Management
16	Late arrival, early departure, and frequent unscheduled breaks	Management
17	Crew size and composition	Management
18	Site layout	Management
19	Unavailability of equipment and suitable tools	Management
20	Coordination among design disciplines	Technological
21	Errors and omissions in design drawings	Technological
22	Delay in responding to requests for information	Technological
23	Rework	Technological
24	Stringent inspection by the engineer	Technological
25	Inspection delay by the engineer	Technological
26	Quality of drawings	Technological
27	Frequent change to orders during execution	Technological
28	Clarity of technical specifications	Technological
29	Design complexity	Technological
30	Confinement of working space	Technological
31	Labour skills	Labour
32	Physical fatigue	Labour
33	Labour motivation	Labour
34	Inclement weather	External
35	Unforeseen ground conditions	External
36	Delay in statutory approvals	External
37	Frequent changes in statutory regulations	External

Where z is the statistical value for the confidence level used, i.e. 2.575, 1.96, and 1.645, for 99%, 95%, and 90% confidence levels, respectively; p is the value of the population proportion which is being estimated; and ε is the sampling error of the point estimate.

Since the value of p is unknown, Sincich et al. (2002) suggest a conservative value of 0.50 be used so that a sample size that is at least as large as required be obtained. Using a 95% confidence level, that is 5% significance level, the unlimited sample size of the population, m, is determined by Equation (2) as follows:

$$m = \frac{(1.96)^2 * 0.50 * (1 - 0.50)}{(0.05)^2} = 385$$

Therefore, for the total number of 90 classified contractors, i.e. N, the representative sample size of the population required is quantified by Equation (1) as shown below:

$$n = \frac{385}{1 + \left(\frac{385-1}{90}\right)} = 73$$

The questionnaire survey comprised an ordinal measurement scale ranking the influence level perceived of each factor surveyed in an ascending order from 1 to 5. It is worth noting, however, that the numbers assigned to the scale indicate neither equal intervals nor absolute quantities, but the influence degree of each factor, from the respondents' perception, on the productivity of operatives.

In an effort to establish a reasonable validity of the findings – that is, to ensure that the questions do measure what they are supposed to measure – and assess the reliability of the questionnaire, a pilot test – that is, 'a small scale trial run in preparation for a major study, where a sample size of 10–20% of the sample size required for the research study is a reasonable number of respondents to consider enrolling in the test' (Baker 1994; Polit et al. 2001) – was conducted on samples of the prospective respondents, where the questionnaire was distributed to senior construction project managers representing 15 local contractors from the 90 classified firms (20% of the sample size required), who expressed genuine interest in providing objective assessment and feedback on the research data collection instrument.

The aim of this test was threefold: (a) to assess the clarity, comprehensibility, interpretation, and appropriateness of the questions provided in capturing the factors impinging upon the productivity of construction operatives in Bahrain; (b) to test the range adequacy of response choices; and (c) to determine the efficiency with which the respondents complete the questionnaires.

Except for minor comments, which were mainly related to some contextual interpretations of few questions, almost all of the respondents' feedback was positive. Consequently, the author rearticulated such questions using simpler expressions and incontrovertible background to avoid any future confounding of the framework within which the response of the participants is sought.

The internal consistency of the questionnaire was tested by computing the Cronbach's alpha of the sets returned. The alpha coefficient ranges in value from 0 to 1, and is used to describe the reliability of factors extracted from dichotomous, multi-point formatted, or ordinal rating scale questionnaires. Cronbach's alpha (α) is calculated by Equation (3) (Howitt & Cramer 2008).

$$\alpha = \frac{n}{n-1}\left(1 - \frac{\sum V_i}{V_{test}}\right) \tag{3}$$

Where: n is the number of questions; V_i is the variance of scores on each question; and V_{test} is the total variance of the overall scores. The higher the alpha coefficient score, the more reliable is the generated scale. Nunnaly (1978) has indicated that a value of 0.700 is an acceptable reliability coefficient; nonetheless, lower thresholds are commonly encountered in the literature.

Cronbach's alpha for the sample group of respondents was computed by the Statistical Package for the Social Sciences (SPSS) V18 software, where the coefficient value of 0.837 was obtained, hence indicating an acceptable measure of questionnaire reliability by all respondents. Therefore, a total of 80 (approximately 90%) randomly chosen firms from the MOW list of classified contractors were invited to participate in the survey, and were followed up by frequent reminders. It is worth noting, nonetheless, that the logic behind the random selection technique was to eliminate, or at the very least minimize, any bias in the selection process by allowing equal probability of selection of the contractors surveyed.

The data collection phase spanned almost five months, after which a total of 59 completed questionnaires were received, representing approximately 81% of the required sample size. However, such a relatively high response rate, in comparison with most previous related investigations, suggests reasonable reliability, validity, and robustness of the findings. The respondents are considered senior ranking officials within their organizations, largely comprising technical directors and construction project managers, with a minimum practical experience of 15 years in the local construction industry.

The data collected were analysed using the Relative Importance Index (RII) technique (Fugar & Agyakwah-Baah 2010; Jarkas et al. 2012). The RII for each factor explored, whose values range from 0 (not inclusive) to 1, was quantified by the formula shown in Equation (4).

$$RII = \frac{5(n5) + 4(n4) + 3(n3) + 2(n2) + n1}{5(n1 + n2 + n3 + n4 + n5)} \tag{4}$$

Where *n1*, *n2*, *n3*, *n4*, and *n5* are the number of respondents who selected: 1, for no effect; 2, for little effect; 3, for moderate effect; 4, for strong effect; and 5, for very strong effect, respectively.

On the other hand, the rank of each group was established by quantifying the average value of the relative importance indices for all factors classified under them; the higher the average value, the stronger the influence of the group factors on the efficiency of labour (Enshassi et al. 2007; Jarkas & Bitar 2012).

4 Results and discussion

The perceived effects of the 37 factors surveyed on labour productivity in Bahrain's construction industry are determined. The relative importance indices and ranks of the factors explored are presented, discussed, and, where possible, compared to previous related findings. In addition, the main groups' average relative importance indices are quantified, and therefore a comparison of their influence levels is carried out.

Table 2 depicts the relative importance indices and ranks achieved for each factor investigated. According to the overall perceived importance of the factors surveyed, the results obtained show that the critical – i.e. top 10 – factors influencing labour productivity in Bahrain's construction industry are the following: (1) labour skills; (2) level of coordination among design disciplines; (3) lack of labour supervision; (4) errors and omissions in design drawings; (5) delay in responding to requests for information; (6) rework; (7) stringent inspection by the engineer; (8) working overtime; (9) lack of incentive scheme; and (10) inclement weather.

It should be highlighted that since some of the critical factors identified share common characteristics, to avoid redundancy, the outcomes discussion of such factors will be carried out collectively, irrespective of the ranks achieved.

With an RII of 0.893, the 'labour skills' ranks first in its influence on labour productivity in Bahrain's construction industry. This finding corroborates the results obtained by Horner et al. (1989), Lim and Alum (1995), Alinaitwe et al. (2007), Enshassi et al. (2007), Durdyev and Mbachu (2011), Jarkas et al. (2012), Soham and Rajiv (2013), and El-Gohary and Aziz (2014), whose research studies reported this factor among the most significant determinants of labour productivity in the UK, Singapore, Uganda, Palestine, New Zealand, Qatar, the South Gujarat region of India, and Egypt, respectively.

This outcome is conceivable as 'labour skills', which can be considered as a measure of the level of workers' expertise, specialization, and supervisory capability, and is essential to the productivity of the construction process. Unskilled and poorly trained operatives are commonly characterized as having low and faulty outputs coupled with unjustifiably high inputs. Their outputs, additionally, are almost always rejected, either in whole or in part, by inspectors, resulting in extensive and expensive rework, rectifications, or repairs. In contrast, experienced workers possess sound intellectual abilities, practical solutions to problems encountered, and high-level technical skills, all of which lead to higher productivity, lower labour costs, and better-quality finished products.

Perceiving 'labour skills' as the salient factor affecting the efficiency of construction operatives in Bahrain, however, indicates a shortage of experienced labour, which further suggests a problem with the quality of the labour force employed in the Kingdom's construction industry.

As is the case with other GCC members, the vast majority of construction labour in Bahrain comprises foreign operatives, largely from Nepal, India, Bangladesh, and Pakistan, where Bahraini nationals primarily make up the technical and managerial workforce of both the public and private sectors. Therefore, in an effort to organize, balance, and regulate the influx of foreign workers, the Ministry of Labour imposes predetermined quotas (i.e. numbers and nationalities) on each contractor – with tougher regulations and restrictions, as previously highlighted, being applied to foreign or international firms – in accordance with the current workload and projects undertaken. Hence, the shortage of skilled labour can be mainly attributed to the limited flexibility in foreign recruitment available to contractors due to the restrictions imposed on granting work visa permits, on the one hand, and to the shortfall of labour recruiting agencies in providing sufficiently skilled operatives, on the other.

On a broader scale, however, this outcome may be further ascribed to the fact that contractors, whether local or international, usually take a short-term view of labour training, which is mainly due to the workload and its fluctuation, depending on the economic conditions and demand for construction, on the one hand, and the provisional objectives of foreign operatives of such an interim and transient employment, on the other (Jarkas et al. 2012).

Table 2. Overall relative importance indices, related groups, and ranks of productivity factors surveyed.

Factor	RII[a]	Related Group	Rank
Labour skills	0.893	Labour	1
Coordination level among design disciplines	0.876	Technological	2
Lack of labour supervision	0.861	Management	3
Errors and omissions in design drawings	0.843	Technological	4
Delay in responding to requests for information	0.830	Technological	5
Rework	0.822	Technological	6
Stringent inspection by the engineer	0.814	Technological	7
Working overtime	0.809	Management	8
Lack of incentive scheme	0.803	Management	9
Inclement weather	0.786	External	10
Payment delay	0.778	Management	11
Unavailability or shortage of materials	0.761	Management	12
Unrealistic scheduling and expectations of labour performance	0.757	Management	13
Construction method	0.748	Management	14
Physical fatigue	0.733	Labour	15
Lack of providing labour with transportation	0.725	Management	16
Labour motivation	0.719	Labour	17
Proportion of work subcontracted	0.711	Management	18
Inspection delay by the engineer	0.703	Technological	19
Congestion and labour interference	0.685	Management	20
Quality of drawings	0.672	Technological	21
Incompetent supervisors	0.664	Management	22
Unforeseen ground conditions	0.647	External	23
Sequencing problems	0.633	Management	24
Frequent of change of orders during execution	0.625	Technological	25
Clarity of technical specifications	0.619	Technological	26
Accidents as a result of poor safety programme	0.602	Management	27
Delay in statutory approvals	0.574	External	28
Design complexity	0.567	Technological	29
Communication problems between site management and labour	0.555	Management	30
Client's intervention with site management and operatives	0.548	Management	31
Late arrival, early departure, and frequent unscheduled breaks	0.536	Management	32
Cramped working space	0.529	Technological	33
Crew size and composition	0.521	Management	34
Site layout	0.513	Management	35
Unavailability of equipment and suitable tools	0.494	Management	36
Frequent changes in statutory regulations	0.472	External	37

[a] Relative Importance Index.

With relative importance indices of 0.876, 0.843, 0.830, and 0.814, 'level of coordination among design disciplines', 'errors and omissions in design drawings', 'delay in responding to requests for information', and 'stringent inspection by the engineer' rank second, fourth, fifth, and seventh in their effects on labour productivity, respectively.

The recognized significant influence of these factors on labour productivity can be attributed to the following reasons: (i) coinciding with the practice in other GCC countries (Jarkas & Bitar 2012; Jarkas et al. 2012), where most clients, mainly for investment purposes or time constraints, expedite and 'rush' the design phase of projects by placing more emphasis upon the 'kick-off' of the construction stage, thus imposing insufficient, at times even unrealistic, times upon designers to develop and review design alternatives, related details, specifications, and tender documents; therefore, design documents are usually uncoordinated and involve serious conflicts among the various design disciplines, unclear, or contain several errors and omissions of relevant details; (ii) the lack of 'buildability' or 'constructability' practices by the design firms operating in the Kingdom; and (iii) the possible failure of designers to provide quality work and efficient professional services.

As a result, the progress of work on-site experiences constant interruptions and/or disruptions, where operatives may have to stop or slow down until the requests for information or clarifications are addressed by designers, and face possible rework – at times even demolition – due to substantial revisions to design documents that may be required. In addition, changes are usually performed on a 'crash – out of sequence basis', leading, therefore, to 'dilution of supervision', where the attention and effort must be diverted to analyse and re-plan the alterations proposed. Such circumstances, coupled with on-site over-inspection procedures applied by the engineer, lead to labour frustration, dissatisfaction, and demotivation, which would negatively affect their performance and efficiency.

The previously discussed findings further substantiate the results obtained by Horner et al. (1989), Zakeri et al. (1996), Makulsawatudom et al. (2004), Saghatforoush (2009), Durdyev and Mbachu (2011), Jarkas and Bitar (2012), and Jarkas et al. (2012), whose investigations recognized the significant impact of constructability on labour productivity in the UK, Iran, Thailand, Malaysia, New Zealand, Kuwait, and Qatar, respectively; constructability, commonly designated as 'buildability' in Europe, is defined by the Construction Industry Institute (CII), as 'the optimum use of construction knowledge and experience in planning, design, procurement, and field operations to achieve overall project objectives' (CII 1986).

On the other hand, the Construction Industry Research and Information Association (CIRIA), refers to buildability as 'the extent to which the design of a building facilitates ease of construction, subject to the overall requirements for the completed building' (CIRIA 1983). Although both expressions target similar issues, the term constructability covers wider range of disciplines, including conceptual planning, design, procurement, and construction. Nevertheless, it is important to note that an early attempt to address the buildability concept can be credited to Sir Harold Emmerson (1962), when he suggested a new form of relationship between designers and contractors. The point of concern was the lack of cohesion between the two parties and their inability to see the whole construction process through each other's eyes.

Supporting the outcomes of Horner et al. (1989), Alinaitwe et al. (2007), Enshassi et al. (2007), Durdyev and Mbachu (2011), Jarkas and Bitar (2012), Jarkas et al. (2012), and El-Gohary and Aziz (2014), whose research asserted the importance of supervision on labour productivity in the UK, Uganda, Palestine, New Zealand, Kuwait, Qatar, and Egypt, respectively, with an RII of 0.861, 'lack of labour supervision' ranks third among the 37 factors explored.

The perceived effect of this factor indicates that quality and continuous on-site supervision of labour by management is necessary to optimize the productive input. Lack of supervision may encourage operatives, especially those who are under the direct employment method, to take frequent unscheduled breaks, remain idle, engage in unproductive activities, or may even leave the work sites during working hours to attend to personal matters. Moreover, direct supervision of labour is required to avoid faulty and work not conforming to plans and contractual specifications, and therefore minimizes expensive incidents of rework, and the possible associated delays to subsequent activities.

'Rework', in further corroboration of the results reported by Kaming et al. (1997), Makulsawatudom et al. (2004), Ng et al. (2004), Alintaitwe et al. (2007), and Durdyev and Mbachu (2011), whose investigations discerned the importance of this factor on the efficiency of construction operatives in Indonesia, Thailand, Hong Kong, Uganda, and New Zealand, respectively, with an RII of 0.822, ranks sixth in its impact on labour productivity.

In construction projects, rework, which principally involves correcting and/or replacing defective or nonconforming items and activities during or after site inspection, can result from various reasons, such as poor supervision, buildability issues, labour errors, over-inspection, change in orders, poor coordination, physical fatigue of workers due to overtime, or ineffective communication. Nevertheless, operatives take considerable pride in the output they achieve (Jarkas & Radosavljevic 2013), and having to redo the work can be frustrating and discouraging, thus translating into unsatisfactory performance and lower than expected productivity.

Among the 37 factors explored, with an RII of 0.809 'working overtime' comes eighth in rank in its influence on labour productivity. This finding is in agreement with the outcomes of Horner et al. (1989), Enshassi et al. (2007), Gundecha (2013), and Soham and Rajiv (2013), whose investigations classified this factor among the crucial determinants of labour productivity in the UK, Palestine, the US, and the South Gujarat region of India, respectively.

Commonly, overtime refers to the hours that operatives work beyond a regular 40-hour workweek. The construction industry typically employs the overtime method to complete critical activities on-time, overcome delays through schedule accelerations, attract additional labourers due to higher pay, or take advantage of favourable weather conditions. However, there is evidence to show that labour productivity, on average, decreases by 10–15% for 50- and 60-hour workweeks, which would worsen as more days per week are worked (Thomas & Raynar 1997).

The adverse effects of overtime work on the efficiency of operatives can be mainly related to the following causes: (1) physical fatigue and, hence, decreased labour agility, stamina, and motor skills; (2) low morale, poor mental attitude, and demotivation; and (3) in the case of schedule accelerations, the disruptions caused by the inability of site management to provide materials, tools, equipment, and information at an accelerated rate. All of which not only lead to low labour productivity, but also to a high probability of poor workmanship, rework, higher costs, disputes, and excessive hazards.

Coinciding with the findings of Horner et al. (1989), Jarkas and Bitar (2012), and El-Gohary and Aziz (2014), whose studies distinguished 'lack of incentive scheme' as among the primary factors affecting labour productivity in the UK, Kuwait, and Egypt, respectively, with an RII of 0.803, this factor ranks ninth in its effect on the efficiency of construction operatives in Bahrain.

This outcome is attributed to the structure of the construction labour force in the Kingdom, which, as previously indicated, comprises mainly foreign operatives, whose primary employment goal, as is the case with other GCC countries, is purely financial (Jarkas & Bitar 2012; Jarkas et al. 2012). Therefore, in addition to basic earnings, the introduction of a monetary incentive scheme seems to be a crucial factor to satisfy the first hierarchy need of Maslow (1954), and thus can further promote the common objective of labour employment, whose motivation level is primarily driven by the desire to fulfil their needs. Accordingly, the results indicate that the failure to apply such a stimulus measure has a significant adverse influence on labour performance and productivity.

'Inclement weather', with an RII of 0.786, ranks tenth among the factors surveyed in its impact on labour productivity. This finding is in accordance with the results obtained by Zakeri et al. (1996), Thomas et al. (1999), Durdyev and Mbachu (2011), Jarkas et al. (2012), and Soham and Rajiv (2013), whose investigations discerned the importance influence of weather conditions on construction labour productivity in Iran, US, New Zealand, Qatar, and the South Gujarat region of India, respectively.

The recognized effect of weather on construction labour productivity in Bahrain is not unexpected. However, to develop a wider and deeper understanding of this finding, the prevailing climate conditions in the Kingdom merit further elaboration.

As a natural desert terrain, the weather in Bahrain experiences mainly two seasons, which can generally be described as severely hot in summer and relatively cool in winter. Starting in April and spanning through October, Bahrain's long summer season experiences an average temperature of 40°C (104°F). Nonetheless, between the months of June and September, conditions become much worse, when the temperature soars to sizzling 50°C (122°F), and humidity is at its highest, reaching above 90%, making working conditions, especially outside, rather unbearable.

Consequently, the government imposes a midday work ban on open construction sites, between the hours of noon and 4:00 pm, during the period from 1 July to 31 August. The summer in the Kingdom is further typified by the periodical appearances of the hot, dry south-west wind, known locally as the 'Qaws', which covers the barren southern end toward the capital (Manama) with thick clouds of sand. During the winter season, i.e. from November to March, temperature levels drop considerably, fluctuating between 10°C (50°F) and 20°C (68°F). Nonetheless, humidity levels take the exact opposite direction during winter, often rising above 90%. Winter is further the season when the country receives the bulk of its rainfall, most of it in the form of sudden, brief but heavy torrential bursts and thunderstorms. Yet the Kingdom receives a meagre 3 inches (72 mm) precipitation annually (Bahrain Weather 2013).

In view of this, it is apparent that high temperatures and severe humidity are the predominant weather conditions in Bahrain. It is conceivable, therefore, that working under such conditions reduces labour performance and efficiency.

On the other hand, Table 3 shows the overall ranking of the four major groups under which the factors surveyed are classified. To further substantiate of the results obtained by Jarkas et al. (2012), whose research distinguished the significant effects of the labour-group factors on the productivity of the construction process in Qatar, with an average RII of 0.782, the labour-group factors rank first in their collective influence on the efficiency of operatives in Bahrain.

The 'technological' group factors, with an average RII of 0.718, rank second, over the 'management' and 'external' group factors, which come in third and fourth, with average relative importance indices of 0.669 and 0.620, respectively. Nevertheless, the quantified relative importance indices of the technological and management group factors demonstrate, on average, the same effects as factors belonging to both groups on labour productivity, further affirming Whitehead's (1995) theory that 'construction productivity is strongly related to the degree of management control'.

Table 3. Group factors average relative importance indices and overall ranks achieved

Related Group	Group Factors Average RII	Group Rank
Labour	0.782	1
Technological	0.718	2
Management	0.669	3
External	0.620	4

5. Recommendations

It is a common objective among contractors, designers, clients, and policy makers in Bahrain to enhance the efficiency level of the construction industry. The findings of this study, collectively or selectively, as may be practically applicable to the relevant phase of the project and the party involved, can assist in achieving this goal by focusing and acting upon the critical factors perceived to influence labour productivity.

Improving labour skills is certainly the first step in the right direction. This can be reasonably accomplished through periodic training programmes offered by construction firms to operatives. On the other hand, policy makers can contribute, in coordination with labour agencies, in obviating the recruitment of unskilled and inexperienced labour force by developing an effective screening process for labour visa applications, and imposing minimum prerequisite conditions for the qualifications of applicants, such as authenticated proof of prior construction experience, field and trade expertise, and adequate communication skills in either the English or Arabic language, which must be submitted along with, and be a required part of the application process. Such a regulation could prove effective in enhancing the quality of the labour force employed in the construction sector, and could result in a substantial saving in time, effort, and costs associated with the training required to improve the skills and abilities of operatives.

Increasing designers' awareness of the positive effect of applying the buildability or constructability concept on the productivity of the construction process is another issue that could help markedly improve the efficiency of operatives. Such an approach may be augmented by encouraging contract procurement or project delivery methods which allow the involvement of contractors during the design phase of projects, such as design–build (DB), design–build–operate–transfer (DBOT), or engineering, procurement, and construction (EPC), and therefore facilitate incorporating the construction experience at an early stage of the project development process, so that the associated benefits can be realized during execution. Perhaps, in view of the results obtained, policy makers may, additionally, consider instigating a formal constructability assessment application as a proviso for granting construction permits, where minimum requirements of constructability principles must be satisfied before a permit can be issued.

The improvement of construction productivity can be further attained by employing experienced construction project managers, who can (i) apply effective labour supervision criteria to enhance productive hours spent by operatives on site, on the one hand, and curtail faulty output incidents, on the other; (ii) organize and carry out practical working hours, especially during peak temperatures and inclement weather; and (iii) scrutinize the contract documents and detect potential pitfalls, obscurities, and missing important details, and prepare, early enough in the process, a comprehensive 'request for information' list to obviate excessive delays in responding to sporadic or intermittent requests, avoid possible rework due to nonconformities and deviations from contractual requirements, and avoid employing overtime to overcome delays, disruptions, or interruptions, which may, consequently, be encountered in the course of the construction operation.

Since this procedure can help reduce possible arguments and disagreements in interpreting missing, ambiguous, or conflicting information in contract documents at the site level, such a control measure can, moreover, prove effective in alleviating adversarial relationships between construction managers and inspectors, and thus may assist in assuaging the stringency of the engineer's inspection.

In view of the previously discussed socioeconomic background of the labour force, it is further recommended that construction managers, in coordination with the executive management of the contracting firms, establish incentive monetary schemes geared toward rewarding labourers who pass certain predetermined benchmarks, especially those associated with activities located on the critical paths of construction schedules. Such an approach may motivate and encourage the rest of the operatives to improve their performance to match, and perhaps surpass such achievements, all of which can create a level of competition, enthusiasm, satisfaction, and a sense of pride among the labour force, and therefore may translate into a vibrant and productive operation.

6. Conclusions

This study has identified, explored, and, based on the quantified relative importance indices, established a ranking of 37 factors perceived to influence labour productivity in Bahrain. The factors surveyed were, moreover, classified under the following four major groups: (a) management; (b) technological; (c) labour; and (d) external.

Based on the relative importance recognized by the contractors surveyed, the findings reveal that the critical factors influencing labour productivity in the Kingdom's construction industry are the following: (1) labour skills; (2) level of coordination among design disciplines; (3) lack of labour supervision; (4) errors and omissions in design drawings; (5) delay in responding to requests for information; (6) rework; (7) stringent inspection by the engineer; (8) working overtime; (9) lack of incentive scheme; and (10) inclement weather. In addition, the quantified average relative importance indices of the four major groups, under which the productivity factors explored are categorized, distinguish the 'labour' group factors as most important, followed by the 'technological', 'management', and 'external' group factors, respectively.

Even though 'labour skills' is perceived as the salient factor impacting on the efficiency of operatives, the results obtained further indicate a lack of buildability/constructability practices among the various design and contract management consultants operating in the Kingdom, which may suggest a lack of awareness on their part of the importance of this concept to the productivity of the construction operation.

The findings, moreover, demonstrate that the notion of exerting pressure on designers to cut down design fees and durations is a 'false economy', since more opportunities exist to substantially lower the total project cost by directing more attention to the design than to the construction phase. Decisions made during the design phase of a project not only have a maximum impact on its construction costs, but also dictate its viability, future expenditures, and duration. It may further justify, from the designers' perspective, the 'cutting corners' approach commonly used in such circumstances, to both quality and design time, in order to rationalize the cost/benefit ratio of contracts.

Such a practice leads to poor concepts and details, which are, most often, associated with low buildability levels, such as uncoordinated disciplines and drawings, design errors and omission of important details, and incompatible contract documents, translating into frequent requests for information, disruptions and interruptions to ongoing activities, variations or changes to orders, and possible rework, resulting in low productivity rates, increased cost of projects, and prolonged durations for construction.

The outcomes reported in this investigation not only contribute to the overall body of literature related to factors affecting the efficiency of construction operatives, which could be valuable for researchers and academics whose interests involve the field of construction productivity, but also fill a gap in knowledge of the factors influencing labour productivity in Bahrain, and hence can be used, furthermore, to provide local and international contractors, consultants, clients, and policy makers with guidance for focusing and acting upon the significant factors perceived to affect the efficiency of the labour force employed in the construction industry of the Kingdom.

However, based on the slight differences among the relative importance indices of most factors explored, which render further validity to the factors shortlisted, and subsequently surveyed, it is obvious that distinguishing one factor from another is rather impractical. Accordingly, what is suggested is to consider most of the factors explored, but with special emphasis being placed on the critical factors identified.

Notwithstanding that several findings have been drawn from this study, other researchers are encouraged to replicate the investigation, taking into consideration, in addition to contractors, the perceptions of consultants and clients in order to assess the level of agreement among the three groups with respect to the importance of the factors surveyed, on the one hand, and to corroborate the results obtained by this study, on the other. This would further assist in improving the productivity of the construction industry in a fiercely competitive environment of ever-increasing demand for lower cost and faster delivery of construction projects.

Disclosure statement

No potential conflict of interest was reported by the author.

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