INVESTIGATING PROJECTS' WORKING ENVIRONMENT EFFECTS ON LABOUR PRODUCTIVITY: PERCEPTIONS OF IRANIAN ROAD CONTRACTORS' MANAGERS

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Abstract

Delays and budget overruns in construction projects have been a lifelong problem in many developing countries including Iran. Previous studies within Iranian construction context have wholeheartedly acknowledged the contribution of low labour productivity to the foregoing challenges rampant in the Iranian construction industry. In this context, identifying the factors adversely affecting labour productivity seems to be the first step towards resolving the aforementioned issues. Taking into account the crucial role of road construction projects in Iran as a developing country, this paper presents the results of one of the first studies conducted in Iranian road projects aiming at identifying and ranking the major factors influencing the labour productivity of road contractors. The literature review findings established that one of the key aspects of a project affecting labour productivity concerns the project's nature and working environments. Hence, the impacts levels of 8 overarching factors associated with working environments in road construction projects were investigated through conducting a questionnaire survey eliciting the viewpoints of CEOs of 60 contractor companies active in road construction projects in Iran. The outcomes ascertained the main factors pertaining the projects nature and environment acting as the determinants of labour productivity in road contractor companies. The primary factors were ranked as: (1) procurement policies, (2) weather conditions, (3) technologies deployed, (4) quality auditing procedures, (5) congestion and overcrowding on the site, (6) complexity of the projects, (7) site geographical conditions, and (8) reworks. The findings of the study would contribute to the body of construction management knowledge by highlighting the factors affecting labour productivity as the prerequisite for any attempt geared towards improving labour productivity

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in road construction projects.

Keywords: Construction, labour Productivity, Road Projects, Iran

1. INTRODUCTION

Construction industry (CI) is among the pillars of the economy in all the countries be it a developed or a developing country (Horta et al., 2013). Likewise, CI plays a central role in a developing countries such as Iran as there is a dire need in the country for improvement of the infrastructure systems and investments in national civil projects (Ghoddousi and Hosseini, 2012). Therefore, even the slightest improvement in productivity level on construction sites would greatly benefit the national economy. Despite this fact, from long time ago contractors in the CI have struggled to increase their productivity levels. In addition, the CI has always been criticised for the lifelong problem of low productivity (Abdel-Razek et al., 2007). Likewise, many evidences from Iran have confirmed the unacceptable levels of productivity within the construction sector in two previous decades (Zakeri et al., 1996, Ghoddousi and Hosseini, 2012, Yisa et al., 2000, Zakeri et al., 1997). Moreover, surviving within the business environment in Iranian construction sector is becoming increasingly problematic considering the large number of construction companies licensed to work. Obviously, the mentioned situation has culminated in the governance of fierce competition within the sector. Consequently, construction managers are obliged to try all promising avenues in order to increase their productivity level in delivering construction projects (Ghoddousi et al., 2011). In view of that, practitioners within the Iranian CI are now increasingly becoming aware of the need to approach the foregoing issues more systematically by valuing the factors that affect the productivity of their human resources.

As per acknowledged by the literature, a wide range of the factors affecting the labour productivity in a construction project concern the environment in which the project is being undertaken (Yi and Chan, 2013). This refers to those factors such as environmental conditions, crew size, and type of projects' task that have a significant effect on the productivity of the labour (Jarkas and Bitar, 2011). Hence, having a deep appreciation of the factors falling within the realm of mentioned category would facilitate dealing with the relevant negative effects on the productivity of labour in road projects. Nevertheless, as will be established by the literature review, the existing body of knowledge in Iran is not able to supply the practitioners and academia with the required knowledge. This gap spotted in the literature has been the driving force behind conducting this study.

Presumably, the knowledge acquired by studies like this would contribute to resolve the issues of cost and time overruns in other developing countries with conditions similar to Iranian CI. Nonetheless, this study should be regarded as a rudimentary effort to advance the borders of the body of knowledge on labour productivity of road projects in Iran and other developing countries.

2. LITERATURE REVIEW

Productivity is of great importance for the survival and growth of any organisation in any industry including construction. On the other hand, low productivity has been regarded as one of the main challenges of the CI even in many developed countries (Durdyev and Mbachu, 2011) and investigating the factors with an effect on the productivity of construction projects has been the objective of numerous studies in the construction field (Abdel-Razek et al., 2007).

Organisational climate reflects very succinctly, "what it feels like to work here". There are of course, large number of elements, which contribute and shape the perception of an individual concerning what an organisation "feels like" (Gray, 2001). The great effect of projects' working environment on labour productivity of a construction project is somehow comprehensible since according to Project Management Body of Knowledge (PMI, 2004), all projects are planned and implemented in a social, economic, and environmental context. Hence, features of natural environment of an organisation or a project largely concern factors like economic, technological, cultural, ecological, sociological elements and regulations. In this context, environmental factors have a noticeable impact on an organisation or a project. The primacy of the effects of project nature environment and climate as one of the main contributors to the human resources productivity has been confirmed in the recent broad study by Yi and Chan (2013) citing previous studies e.g. (Sanders and Thomas, 1993, Fayek and Oduba, 2005). The poor working environment is an indirect hindrance for the productivity in construction context as well, because it prevents the industry from attracting productive and qualified human resources (Choi et al., 2012).

Construction projects are mostly supposed to be delivered in environments exposed to climate effects, thus construction activities are affected by harsh weather conditions (Oglesby et al., 1989). Specifically, adverse effects of weather on road projects labour productivity are dramatic (El-Rayes and Moselhi, 2001). Besides, many other factors reflecting the conditions of planning and organising the environment of the site are effective and are of great primacy in terms of altering the level of labour productivity (Makulsawaudom and Emsley, 2001).

High levels of change in the level of labour productivity due to deploying different techniques and construction methods were observed in previous studies in Europe (Proverbs et al., 1999, Alinaitwe et al., 2007). The effects of construction techniques and methods as one of the dimensions of projects working environment have been acknowledged by recent studies in Iran as well (Ghoddousi and Hosseini, 2012).

The inspections implemented by the managers and supervisors on a construction site bring about dramatic alternations for the level of labour productivity according to the findings of the study in Ghaza Strip (Enshassi et al., 2007). The aforementioned factors affect many aspects of the work on a construction site including the quality, the timeliness of approval of completed activities, and ensuring that the site-based personnel meet the objectives of the procedures and plans (Makulsawaudom and Emsley, 2001).

Many aspects of the working environment in a construction project rest on the stewardship of the works and activities. This category covers items such as the level of congestions on the site, the effectiveness of the layout, and the access and handover of materials (Kaming et al., 1997).

A wide range of working environment features in a construction project might yield reworks. On the other hand, reworks on a construction site will adversely affect the productivity of labour on the site and will lead to large amounts of unproductive and wasted time (Makulsawaudom and Emsley, 2001, Alinaitwe et al., 2007). This has been recognised as a rampant issue in Iranian construction context (Zakeri et al., 1996, Ghoddousi and Hosseini, 2012).

Previous studies in Iran have acknowledged the effects of working environment on productivity of workers (Zakeri et al., 1996, Ghoddousi and Hosseini, 2012). However, the results are general and this implies the lack of research in Iran as the field requires more clarification on the elements and variables contributing to the effects of working environment on labour productivity. When it comes to road construction projects, things get worse as these projects have been literally overlooked in previous studies on labour productivity in Iran. On the other hand, factors of working environment such as raining might have lesser effects on other types of construction projects whereas road construction is highly affected by the weather conditions. All the above facts stress the necessity of conducting further investigations into the effects of working environment factors on labour productivity of road projects.

3. RESEARCH METHODOLOGY

Survey through questionnaires was selected as the research method due to the ease of use and the ability to provide broad cover of the population attitudes and perceptions (Buckingham and Saunders, 2004). Besides, the questionnaire survey as a quantitative approach has the potential to examine the behavioural aspects of construction management field (Amaratunga et al., 2002).



Figure 1: The conceptual framework for selecting the factors

A broad literature review was performed and 8 factors reflecting different features of the project environment were selected as illustrated in the framework of figure 1. The survey collected data from CEOs of road construction contractors within a broad geographic area in Iran. More than 100 huge companies are engaged actively in construction of roads in Iran. Eighty companies out of the total sample (i.e. 80%) returned the questionnaires of which sixty (i.e. 60%) were duly completed and therefore formed the basis of the analyses reported in this paper. It should be noted that the results have been achieved by continuous following-up and close personal contact with the offices of the CEOs of road contractors. The respondents were invited to indicate their perception of the level of effects of variables defined in figure 1 on the productivity of road construction projects by using a five-point Likert rating scale (Very high effect = 5, High effect = 4, Moderate effect = 3, Low effect = 2, and Very low effect = 1. The Likert Scale was utilised, since this method provides direct and reliable assessment of importance and ranking.

A ratio from a difference of 1-5 (4) was used to discuss the degree of central tendency and the following results occurred:

 $1.00 \leq$ 'Very low effect' (VLE) ≤ 1.80

 $1.80 < `Low effect' (LE) \le 2.60$

 $2.60 < \text{'Moderate effect'}(\text{ME}) \le 3.40$

3.40 < 'High effect' (HE) ≤ 4.20 ; and

 $4.20 < \text{`Very high effect' (VHE)} \le 5.00.$

When using Likert-type scales it is imperative to calculate and report the internal consistency reliability for the scales or subscales one may be using. Therefore, the internal consistency test was used to examine the reliability and internal consistency of the survey instrument comprising the 8 factors as described in figure 1. The reliability analysis resulted in the Cronbach's Alpha coefficient value of 0.886, which exceeded the accepted norm of 0.7 according to Nunnaly's theory (1994), implying the reliability of the data and the

measurements.

The statistical parameters like mean, population variance and coefficient of variation, were utilised to rank the factors. The coefficients of variation (CV) were calculated for variables. Since, the scores in each variable are from individuals and all of their mean values are acceptably close enough, it is logical to take these coefficients as a measure of variation in personal/individual assessment of importance (Olomolaiye, 1988).

We extracted 3 parameters for each of 8 factors based on the answers from respondents including the mean, the standard deviation, and the coefficient of variation. The mean values of 8 factors were sorted in descending order firstly, and then the factors which their mean values were located in a distance equal to the standard deviation and two times of the standard deviation were divided into separate categories. Then the factors in each mentioned category were ranked in descending order based on their coefficients of variation. The factor in each category with a smaller coefficient of variation was evaluated as the more effective factor. Since the mentioned categories themselves were ranked in descending order earlier, we achieved the results of ranking of all the 8 factors after this stage.

4. RESULTS AND DISCUSSIONS

In this study, 8 factors pertaining the project nature and working environment affecting labour productivity in road projects of Iran were identified and ranked according to their relative importance. The survey results and the rankings with respect to each of the factors are presented in Table 1.

Rank	Project nature and working environment feature	MS	SD	RII	CV
1	Procurement Policies	3.76	1.01	0.752	26.86
2	Weather conditions	3.63	1.13	0.726	31.13
3	Techniques Deployed	3.55	1.01	0.710	28.45
4	Quality Auditing Procedures	3.53	0.94	0.706	26.63
5	Congestion and Overcrowding	3.48	1.08	0.696	31.03
6	Complexity of the Project	3.40	0.96	0.680	28.23

Table 1: Statistical results for the project nature	e and working environment factors
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7	Geography of the site	3.38	1.19	0.676	35.21
8	Reworks	3.13	1.06	0.626	33.87
	Average	3.48		0.696	

As can be seen from Table 1, the mean scores within this category of 'Project nature and working environment' ranged from 3.13 (Rework) to 3.76 (Procurement). Examination of the foregoing Table also showed that, the majority 6 (75%) of the factors had high effects (mean scores > $3.20 \le 4.20$) as will be discussed in the following sections.

4.1. Procurement

Procurement was the highly ranked factor (MS = 3.76, SD = 1.01, RII = 0.752). This factor normally concerns availability of the materials, tools, and equipment. The importance of procurement factors reflects the special conditions dominating road projects as well. it is because road projects are mostly supposed to be delivered in distant areas from the cities largely facing procurement problems. In addition, road projects delivering takes owning, leasing or renting construction equipment and machinery, which in all the cases entail costly activities and could put the contractor's resources under pressure. As far as procurement issues concern results are consistent with the findings of the studies on other types of construction works in Iran (Ghoddousi and Hosseini, 2012, Zakeri et al., 1996).

4.2. Weather conditions

The factor or variable of 'Weather conditions' was ranked the second (MS = 3.63, SD = 1.13, RII = 0.726). Owing the size of the country, the weather patterns in Iran vary enormously across the regions and depend largely on the location of the projects, thus the impact could have varying effects. This finding is consistent with the study by Zakeri et al. (1996) among construction operatives in Iran. The susceptibility of road projects to weather conditions is the reason behind ranking weather conditions as the second primary factor in this category. Road construction projects are mostly executed in open areas and entail activities such as asphalt concrete performance as a commonplace method in Iran, which are prone to delays due to raining, snowing or humidity. In addition, warm weathers will decrease the productivity of workers. This factor is particularly applicable to road projects and presumably is not as important in building construction projects.

4.3. Techniques deployed

The third ranked variable or factor was that of 'Techniques deployed' (MS = 3.55, SD =

1.01, RII = 0.71). Project techniques and machinery commonplace in Iran are still traditional and with low productivity. This might be the reason behind ranking this factor as the third primary variable. The findings of the work by Ghoddousi and Hosseini (2012) ranked this issues as the main contributor to wasted time on construction projects that is consistent with our results.

4.4. Quality auditing procedures

Quality auditing ranked the fourth (MS = 3.53, SD = 0.94, RII = 0.706). The positive side of the quality inspection mostly regards the reduction of the rework cases. Ng et al. (2004) studied the factors influencing the productivity of civil engineering projects in Hong Kong and their findings support our results in this regard.

4.5. Congestion and Overcrowding

Previous studies in Iran (Ghoddousi and Hosseini, 2012) have regarded poor organising as one of the contributors to congestions on sites that accordingly ends up in low productivity levels. However, it seems respondents did not consider it as a challenge in road projects. This could be explained by the nature of the road construction works being executed in vast areas and normally without congestion. Moreover, road construction activities are completed in a sequential manner, thus different teams do not work on site simultaneously.

4.6. Complexity of the project

Project complexity was ranked as the sixth by the respondents (MS = 3.40, SD = 0.96, RII = 0.68). Obviously, job simplification increases the speed of production according to Gray (2001). Nevertheless, road projects are not like industrial civil projects with complicated drawings and designs and mostly follow the same pattern for designing and execution. This matter would justify the low effect of project complexity in road construction projects.

4.7. Geography of the sites

The variable of 'Geography of site' was among the low ranked ones (MS = 3.38, SD = 1.08, RII = 0.696). This finding is hardly surprising as delivering projects in remote areas all over the country is regarded as an inherent attribute of road projects that is common between all the projects. As a result, this variable is not important in terms of affecting the productivity of construction companies in delivering road projects.

4.8. Rework

The lowest ranked variable was 'Rework' (MS = 3.13, SD = 1.06, RII = 0.626). This finding is rather surprising and contradicts results of some studies e.g. (Ng et al., 2004, Ghoddosi et al., 2008). For example, Ng et al. (2004) found 'rework' as a major source of

dissatisfaction leading to negative impacts on the productivity among the civil engineering workers in Hong Kong. Similarly, within the context of Iran, Ghoddousi et al (2008) found that defects in rules and regulations contributed to increase in reworks for contractors and was among the influential factors affecting the dam construction projects. One probable explanation for the low ranking comes from the fact that in Iranian construction projects, priority of higher speed of project delivery outweighs the quality of work for clients. Clients by far value timely completion of the projects in comparison to delivering high quality projects due to the pressure from government authorities.

5. CONCLUSIONS

The fact that some of the factors associated with the project nature and working environment have been regarded as low effective seems quite expectable given the recent improvements of the working conditions in the Iranian construction industry. In addition, the obvious discrepancies between the factors prevailing the productivity in road projects as opposed to other types of construction activities became obvious. Generally, there is still the need for harnessing the benefits of innovative procurement strategies, application of new project techniques, and enhancing the effectiveness of quality management in order to improve the productivity of Iranian road contractors. Policy makers and researchers in the country would benefit from focusing on the identified factors in order to improve the labour productivity. In addition, the study directs future researchers in developing countries towards fertile grounds of investigation including studies aiming at validating the identified factors through the lenses of other parties involved in road projects namely clients, consultants, and government authorities. On top of that, incorporating the perceptions of the personnel and site-based workers might show other horizons. Furthermore, more emphasise on the dissimilarities between various types of construction activities should be incorporated in conducting future studies on labour productivity.

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