Premeditated Analysis of Labour Productivity in Construction Project

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***Abstract*— This paper studies about daily labor productivity and the factors attributing to the same. In construction industry, productivity is an important aspect that can be used as an index for measuring the efficiency of production. In some cases it also helps in analyzing the economic growth of a company. This study helps in analyzing different factors affecting labor productivity. Construction sector has always been depend on manpower with most of the activity being labour intensive. Project productivity thus depends directly on productivity of labour. This study aims at determining the relationship between construction labour productivity and project performance. Hence, the study construction labour productivity time and cost over turns for certain activity for selected work site. We consulted the certain work site stakeholders like labour, supervisor and engineer. The findings show there are many factor which affecting labour productivity. So we consult the worksite to know about labour productivity factors and finally findings there result.**

Keywords*— Labor productivity, reliability test, factor analysis, regression analysis and hypothesis

1. INTRODUCTION

Construction delay means a time overrun either beyond the contract date or beyond the date that the parties have agreed upon for the delivery of the project. In both cases, a delay is usually a costly situation. Delay was also defined as an act or event which extends required time to perform or complete work of the contract manifests itself as additional days of work. Poor site management can cause project delay and affect productivity. A lot of research efforts have been made to study delay causes in different countries. For example, material-related delay is the main cause of project delays in Saudi Arabia. Bordoli and Baldwin examined the causes of delays in building projects in the United States.

Weather, labor supply, and sub-contractors were found to be the major causes of delays. Poor risk management, poor supervision, unforeseen site conditions, slow decision making involving variation, and necessary variation works are the principle delay factors in Hong Kong. Unforeseen soil condition, poor site supervision, low speed of decision making involving all project teams, client initiated variations, necessary variations of work, and inadequate contractor experience are the six significant factors contributing to delays in building and civil engineering works. Materials-, equipment-, and labor-related delays were identified as major causes of contractors' performance delays. Increases of temperature related to global climate change have continually drawn concern regarding the occupational health of the public. In 2013, the Intergovernmental Panel on Climate Change (IPCC) reported that the land and ocean surface temperature had increased by approximately 0.85° C since 1880, and the number and length of heat waves is estimated to continue increasing during this century.

Increasing temperatures increase the occurrence of high temperatures in outdoor working environments. An outdoor environment is considered high temperature when the temperature exceeds 32° C and the WBGT (Wet Bulb Globe Temperature) exceeds 25° C. High temperatures can impose heat stress on the cooling system of the human body, and when the reaction mechanisms for removing excess heat stop or slow down, heat illnesses can develop. Thus working environments and work activities that continuously expose people to high temperature increase the risk of heat related illnesses. Improving productivity is a major concern for any profit oriented organization, as it represent the effective and efficient conversion of resources into marketable products and determines business profitability. However, apart from the advantages that contractors may gain over their competitors by improving upon productivity to build projects at lower costs; most contractors do not systematically and properly address this strategic issue or evaluate its impact on the project's profit.

2. LITERATURE REVIEW

The reported low productivity in the construction industry is accompanied with its attendant problems of project time and cost overruns, disputes, project abandonment among other problems. Project abandonment is another issue that cannot be ignored on construction sites. Studies on cost and time overruns in construction projects have discovered that the construction industry in both developed and developing countries suffers from delays and cost overruns due to labour productivity problems [1]. However, despite the many suggestions and opinions in literature concerning the relationship between construction labour productivity and project performance, empirical evidence for these assertions are scarce. The problem of this study is therefore concerned with deter-mining, empirically, the influence of construction labour productivity on the time and cost performance of public building projects. Based on this under-standing, this study attempts to investigate the contribution of labour productivity to project performance [2]. The overall aim is to provide empirical evidence to show that labour productivity contributes to project performance with a view to encouraging

the adoption of labour productivity improvement techniques in construction project delivery [3].

The objectives are to evaluate construction labour productivity in wall plastering activity and determine its relationship with project performance. The result of this study will assist construction managers to understand the cost and time implications of loss in productivity so as to effectively plan to improve productivity in order to achieve project objectives. Following is a comprehensive literature review on the state-of the art of vision-based construction performance monitoring, which will be structured based on the level of information perceived together with the corresponding outputs (namely project level: civil infrastructure or building elements vs. operation level: equipment and workers). The input to this type of application is often still-images or time-lapse photos. The various aspects for each of these groups of the literature are discussed in detail [4].

In particular, based on the literature review, the paper presents open challenges in this field and suggests new directions for future research. The situation is the same with the current practice of activity monitoring and analysis. Site activities involve numerous parties such as contractors, subcontractors, and trades, who may require equipment to complete their tasks [5]. Managing these activities to achieve maximum operational efficiency from the required resources is difficult and as reported. The manual implementation of direct observations is also time-consuming, labor-intensive, and can be prone to errors. The significant amount of information which is required to be manually collected from various locations on a construction site may adversely affect the quality of the analysis, and according to the U.S. National Institute of Standards and Technology, minimizes the opportunity for continuous benchmarking and monitoring which is a necessary step for performance improvement. In addition, these models can only provide post-process evaluations on construction activities [6]. Such post-evaluation models are only applicable to the enterprises in which the manufacturing process is repeated routinely.

In the case of one-time running state of construction projects, without automated and near real-time data collection, such techniques will have limited benefits. For both project-level and also operation-level monitoring, collecting data and transforming it to information takes away from the more important tasks of identifying opportunities for performance improvements, reviewing alternatives, and conducting what if analysis. Considering these challenges, the need for ‘‘automation’’ in all of these fronts becomes more clear and is in fact. As a type of easily captured and widely spread media, images and videos have become prevalent on common construction sites [7].

Civil infrastructure elements, equipment and workers, all of which play critical roles in construction performance monitoring applications, such as progress monitoring, quality control, operation analysis, safety monitoring and occupational health assessments [8].

3. LITERATURE SUMMARY

Literature has advocated for improving the productivity in the construction industry through enhancing the level of motivation of human resources. The great effects of motivation of human resources on the productivity of construction projects has been widely acknowledged. Likewise, there are seminal studies stressing the detrimental effects of low level of motivation of personnel on the success of a construction project. Based on the literature reviewed for this study, it was established that construction managers should gain a deep appreciation of the factors that affect the level of motivation of human resources . It was also indirectly signified the crucial importance of research on the determinants of motivation.

A. Parameter category Activity level parameters

Labour and crew Crew size, crew experience and competence, crew balance between journeymen and apprentices, work assignment to different crews, crowding, crew team spirit, cooperation between craftsmen, cooperation between the different crews, crew turnover, craftsmen treatment by foreman, number of consecutive days on job. Artisan’s positive attitude towards the task, artisan’s physical fitness, artisans learning speed, artisans boredom and fatigue, artisans flexibility in accommodating task changes, job site orientation program. Artisans trust in the skills and judgment of their supervisors, artisan’s participation in decision-making process, level of job security, absenteeism of artisans, craftsmen’s labour union status, craftsmen’s skill utilization, feedback on performance to craftsmen. Provision of clear goals, remunerations (salary, benefits) Materials and consumables Materials delivery to task location, material quality, shortage of consumables, correction work on prefabricated products. Temporary material storage location, unloading of materials, vertical movement materials, horizontal material movement, material order tracking system Equipment and tools Transportation equipment (cranes, forklifts), electrical power connection during operation.

Waiting time for manlifts, adequacy of hand tools, adequacy of power tools, quality of work tools, efficiency of tool crib attendant, misplacement of tools Task property Tasks repetitiveness, tasks nature (challenging and interesting), total work volume, rework sources (vendor or contractor), rework frequency. Change orders frequency, interruption and disruption frequency, most of the tasks in this project have repetitive nature, change orders frequency Location property Weather (temperature, wind, humidity, precipitation), location of work scope (distance and elevation), work area congestion.

Cleanness of work area, temporary electrical service provision, work conditions (noise, dust, and fumes), work area protection from weather effect, washrooms location, adequacy and location of lunchrooms, adequacy of camp facilities (residences, recreation, and shops), site access. Foreman Fore man experience foreman training for leadership, foreman’s management style, frequency of change of foremen, span of control, fairness in performance reviews of craft workers, foreman skill in proper resource allocation, clear goals provision by project managers. Feedback on performance, uniformity of work rules Engineering and instructions

Availability of drawings and specifications, readability of drawings and specifications, drawings and specification's frequency of updates, response time for drawing questions, adequacy of job instructions Parameter category.

B. Project level parameters

Project delivery and contract Delivery system (design bid build, design build, BOOT), contract type (lump sum, unit rate, cost plus) Health, safety, and environment Health and safety training. Daily project briefing and debriefing practice, daily job hazard assessment system practice, tailgate safety meetings, stringency of project site safety rules, accidents and injury frequency, efficiency of safety incident investigations, planning of safety inspections and audits, sorting of waste materials practice, frequency of corrective actions to meet environmental requirements.

Planning of environmental inspections and audits Project management practices Integration, scope, cost (identification and documentation of the estimation stages), cost (monitoring status of project to update project budget and manage changes), cost (reporting system for the identification of cost overruns), quality (identifying quality requirements and (or) standards), quality (process for monitoring and recording results of quality activities, QC). Human resource (trainings, workshops, seminars), human resource (overall participation of HR in the formulation and realization of competitive strategies), procurement (project procurement plan), procurement (evaluation criterion to select bidders). Procurement (documentation of procurement process and follow up), risk (use of risk assessment tool), risk (process for tracking, monitoring, and mitigation of risks), change (documentation process), change (monitoring and controlling changes), communication (availability of procedures).

Communication (documentation and tracking systems), business development (development of a time scaled business plan) Project best practices. Detailed front end planning, alignment in front end planning stage, constructability reviews, formal team building process, material management practices (planning and controlling of materials), zero accident techniques implementation. Use of automation and integration technologies, planning for startup, productivity measurement and improvement practices, efficiency of work permit process Project owner nature Owner's primary driver (schedule, cost, quality, safety).

The project site is transferred timely to the contractor, owner team competence and knowledge, owner team decision provision, owner's project team adoption of project risk management practices, frequency of change requests, suspension of projects (frequency).

C. Parameter category Provincial level parameters

Provincial Provincial economy, competing projects within the province, provincial codes and regulations, quality of labour, adequacy of available labour, labour strikes, quality of supervisors, adequacy of available supervisors, taxes (income tax, provincial GST), construction material price fluctuations, unemployment rate for construction workers, balance of expenditure towards energy-related and non-energy related projects, increase of prices for outputs (project completion costs)

D. Parameter category National level parameters

National Stability of political system, competition from international firms, adequacy of available labour, recruitment of foreign workers, quality of labour, interest rates, unemployment rate for construction workers, population, aging of population, competing projects among provinces, inflation rate.

E. Parameter category Global level parameters

Global economy forecast, recession effect of global economy, global energy supply and demand balance, oil price, oil price volatility, natural gas price, natural gas price volatility.

F. Review of Related Literature

The term productivity has been in the front burner of the construction industry and other industries for a long time now. In the construction industry, it has received much attention and discussion within the past few decades and is still being discussed and researched. It has been widely used as a performance indicator to evaluate construction operations through the entire construction phase. Construction companies have to track productivity continuously in order to gauge their performance capacity to maintain profitability and to prepare future bids.

Productivity is defined as a measure of the ability to create goods and services from a given amount of labour, capital, materials, land, knowledge, time, or any combination of these. Conversely, productivity has also been defined as the ratio of the quantity of input to the quantity of output. Measures of productivity can be examined in terms of the full range of production factors – capital, labour, intermediate goods, and services (including natural resources) or a single factor such as labour. In as much as productivity describes the output potential of a production process in relation to its inputs, it can be measured based on two broad categories of Single Factor Productivity such as Average Labour Productivity (ALP) and Multi- Factor Productivity or Total Factor Productivity (TFP).

While Single Factor Productivity measures the impact of one input (labour), Multi-Factor or Total Factor Productivity measures the impact of all inputs on output. Tasks refer to specific construction activities such as block/brick work, wall plastering, concrete placement or structural steel erection and so on. Opine that task-level metrics are widely used in the construction industry. Most task-level metrics are single factor measures and focus on labour productivity. Attar maintain that at project sites contractors are often interested in labour productivity; they define it in one of the following two ways:

Labour Productivity = Output /Cost Labour

Labour Productivity = Output/hour - Work

The study also observes that there is neither a consensus as to the meaning nor a universally accepted measure of productivity and that the inverse of labour productivity, man-hours per unit (unit rate) is also commonly used.

Various performance indicators have been used to measure project performance. Many of them are based on the frameworks developed by both public and private

organisations. Key Performance Indica-tors (KPIs) are developed by KPI working group in UK while Project Performance Evaluation (PPE) is launched by Australian New South Wales Public Works Department [19]. It is, however, important to distinguish between performance indicators, performance measures, and performance measurement. Performance indicators specify the measurable evidence necessary to prove that a planned effort has achieved the desired result. They further observe that when indicators can be measured with some degree of precision and without ambiguity, they are called measures. However, when it is not possible to obtain a precise measurement, it is usual to refer to them as performance indicators. The subjective parameters refer to the performance indicators while the objective parameters relate to the performance measures.

It could, therefore, be concluded that quantitative/objective and qualitative/subjective indicators of project performance, no matter the terminology used are prominent in research studies with time and cost as the major parameters of objective measure of project performance. However, these two parameters have their limitation because their values rely on the initial and final contract period or cost of a project. Nevertheless, the common assessment of the success of construction projects is that they are delivered on time, to budget, to technical specification, and meet client satisfaction. In view of the agreement among researchers on the use of time and cost overruns as objective measures of project performance, these measures have been adopted in this study to assess the influence of productivity on project performance vis-à-vis wall plastering activity. There is a general agreement among researchers that delays in project delivery which are most times used interchangeably with time overruns results into cost overruns . Construction delays and cost overruns although reported to be frequent occur-rences in developing countries have also been acknowledged to be a global phenomenon.

Studies on time and cost overruns of construction projects have identified various reasons for its occurrence which vary along with types of project, locations, sizes, and scopes. Ramanathan et al. [9] discover that the causes of time and cost overruns identified from previous studies are classified into 18 categories namely; Finance-related, Project-related, Project Attributes, Owner/Client, Contractor, Consultant, Design-related, Coordina-tion, Materials, Plant/Equipment, Labour/Man-power, Environment, Contract-related, Contractual Relationships, External, Changes, Scheduling & Controlling and Governmental Relationship. While some of these studies clearly pinpoint labour productivity as one of the causes of time and cost overruns, others have associated labour productivity indirectly with cost and time overruns through factors affecting productivity under different headings. Nevertheless, remark that for the client, construction delay refers to the loss of revenue, lack of productivity, dependency on existing facilities, and lack of rentable facilities among other things.

4. METHODOLOGY

5. SITE IDENTIFICATION

1) Shortage of experienced labour - Contractors in T&T employ most workers temporarily (employment typically lasts the duration of the project), thus they are unable to retain experienced labourers. There are no opportunities for vertical mobility within local construction companies. Workers rather offer their services to competing firms then decide which jobs to pursue, thus the experienced workforce becomes divided.

2) Skill of labour - Temporary employment with different contractors develops different methodologies and work habits in labour. Besides, contractors do not anticipate an extended association with workers thus they are unwilling to develop labour as they do not want to train workers for competing businesses.

3) Motivation of labour - There are many facets to encouraging labour: management relations, adequate and prompt salary payment, job security in addition to job satisfaction. Most labourers lament the lack of employee benefits available to them and their insecure future in the construction industry. Labourers perceive their jobs to be stagnant rather than a rewarding career and this has a negative effect on their output.

4) Physical fatigue - Survey participants noted that labourers do not complain of physical fatigue but would target

less strenuous occupations once they were accessible, this trend however, can be attributed to negative local customs. Extended work hours have great effect on fatigue during which workmanship and safety practice begin to wane.

6. QUESTIONNAIRE SURVEY

The prepared Questionnaire on human resource management in Construction Site is distributed to 75 labors and their response have been extracted Responses from all three levels (large scale, medium scale and small scale) of companies are equally distributed. The answered questionnaires were collected and the answers were ranked in order to obtain statistical data from the theoretical options. Ranking should be based on scale type. As five point scale was adopted, rank 1 represents the strongly disagree factor and rank 5 represents the strongly agree. In our case neutral point is suggested as rank 3. The neutral point represents neither positive nor negative condition, the frequency of respondents, that is, for every factor respondent's view may vary. The variation in views can be obtained through the answers from questionnaire survey. These issues (not listed in any order) are reoccurring factors gathered wherever relevant research has been undertaken, have consistently been found to be at the forefront of poor productivity.

7. FACTORS AFFECTING LABOR PRODUCTIVITY

Labor productivity is affected by external and internal factors, representing those outside the control of the firm's management and those originating within the firm respectively. In a study of 45 factors negatively affecting labor productivity. The 10 most important factors negatively affecting labor productivity are: material shortages; lack of labor experience; lack of labor surveillance; misunderstanding between labor and superintendents; drawings and specification alterations during project execution; payment delay; labor disloyalty; inspection delay; working seven days per week without holiday; and tool/equipment shortages.

The identified six key factors impinging on labor productivity as follows: lack of material; supervision delays (instruction time); lack of tools and equipment; rework; absenteeism; and interference. The results show the factors with significant impact on labor productivity in descending order of importance are as follows: unavailability of material, late payment of salaries and wages, suitability of plant and equipment, supervisory incompetence, lack of manpower skills, lack of labour experience, plant breakdown, late delivery of material, shortage of tools and equipment, and low remuneration.

Those factors with the greatest influence on construction labor productivity are drawn from five group categories, i.e. materials related factors (unavailability of materials, late delivery of materials); manpower related factors (lack of manpower skills, labour inexperience); motivation related factors (late payment of salaries and wages, low remuneration).

Plant and equipment related factors (suitability/ adequacy of plant and equipment, plant breakdown, shortage of tools and equipment); and management related factors (supervisory incompetence). The analysis was extended to look at the impact of group factors on labor productivity and their effect was ranked in descending order as follows: plant and equipment related factors, materials related factors , management related factors, manpower related factors, motivation related factors, technical related factors and other factors.

7. PROBLEM IDENTIFICATION

Factors related to poor project management are seen to be common to most of these studies, although they vary in their importance from one study to another. The most common controllable factors identified are ineffective planning and control, poor site management, material procurement problems, low labour productivity and weak communication and coordination.

For the purpose of generalization, most of the available literature concerning previous studies of construction delay in developing countries has been examined. An analysis of this body of work shows that the findings on delay causes cluster around two issues: management and project environment. Management-related factors include ineffective planning and control, poor site management, poor communication between the parties involved and unreliable availability of materials. It should be understood that such factors are controllable and efforts should be directed towards minimizing their impact.

Controlling such causes of delay in construction projects can be achieved by improving management practice. In contrast, project environment factors (labour shortage, problems in material supply and financial difficulties), all of which are related to the immaturity of the economy, financial institutions and labour market in a developing country, are external factors that have to be taken as given in any project.

8. PROJECT IDENTIFICATION

A. Factors affecting labour productivity

Labour productivity is a function of various controllable and uncontrollable factors. Listed these factors under six groups comprising:

(1) Schedule acceleration;
(2) Change in work;
(3) Management characteristics;
(4) Project characteristics;
(5) Labour and morale; and
(6) Project location/external conditions.

B. Impacts on Project

Changes in any planned activity will cause a disturbance and will require the rearrangement or review of the existing plan under the recent developments. Given the complex, multi-party and multi-resource nature of the construction industry, it is not difficult to perceive the impacts of changes on projects. Impacts of a change are defined as the **net** effects of the change on the project performance. Numerous studies have been done to identify the impacts of changes, relationships between change and its impacts, and true consequences of changes in terms of cost and time.

C. Direct Impacts

Direct impacts are impacts of changes that appear in immediate activities of the changed work. These impacts can be easily linked to the change in most cases. Nevertheless, closer analysis and supervision of the impacted activities are required to identify these impacts. Moreover, the true consequences such as quantification of the impacts solely due to changes are not easy and require additional data keeping and analysis.

Productivity degradation: Production will be lowered due to interruptions. The magnitude of the impact is a function of the required degree of concentration for the changed work, type of the required resources, total number of interruptions, elapsed time since the last interruption, expectation of interruption, source of the interruption and, finally, whether workers agree with the change.

Delays: Additional and different types of material may be required. This may take some time.

Equipment and labor in tearing out completed work: Removal of the completed work may be require additional equipment and labor.

Materials wasted in rework: Changes may necessitate removing some contractor furnished material. This may result in waste of materials.

Non productive periods during redirection of work: Reorganization of the crew may take some periods of nonproductive times.

Recovery scheduling: Overtime and multiple shifts may be required to meet deadlines in the project. Each of these items will be a burden to the project in terms of additional cost and time. Further, these impacts will also cause secondary impacts on the other activities.

D. Indirect Impacts

Indirect impacts known as consequential or ripple effects, are those resulting from the direct impacts and are experienced by the other activities either concurrently or later in the project. The identification and proof of these type of impacts are more difficult since this time a logical link to the impact of the change should be established. However, they are equally important and should be included in an analysis.

Productivity degradation in succeeding sequential activities: There is a tendency that the lowered productivity will adversely affect the succeeding activity.

Productivity degradation of adjacent concurrent activity: Interruption in one activity will have impacts on the adjacent activities. The affected crews will reflect their idleness to the surrounding work area.

Increased overhead costs: First, additional supervision will be needed. Also, a delay in completion time will increase overhead costs.

Extended project time: A critical activity may be affected and the project duration may be extended. In case the owner fails to recognize the extension, constructive acceleration will occur. The contractor should claim the incurred costs.

Crash scheduling cost: In order to meet project completion time, schedule compression may be required. This necessitates overtime and multiple shifts, which are not so efficient.

Changes to Subcontracts: Any change will be reflected in the work performed by subcontractors. When this happens, they will request price and schedule adjustment.

Time-value of capital employed: Changes may require purchasing some additional material. This money would be used somewhere else or earn interest.

Change of work to a different working period: Sometimes, delays caused by changes may push the working time to another working period. This working period may not be convenient in terms of weather conditions and cause disturbance e.g., a concrete pour that moves into the winter.

9. RESULT

This study examined the factors that affect labour productivity in T&T, and ranked 42 predefined factors divided into four (4) categories, namely 1) Management; 2) Technological; 3) Human/Labour, and 4) External. Labour productivity is an important dynamic measure of both organizational performance and competitiveness, and innovation is widely regarded as a fundamental source of competitive advantage in today's increasingly changing environment. In fact, it has been stated that innovation capability is the most important determinant of company performance. Logically, it is of the utmost importance for companies to find effective and obtainable ways to enhance their labour productivity and innovation. Moreover, in the current dynamic environment organizations need to find creative ways to flexibly arrange their labour needs in order to adjust to these circumstances. Internal flexibility practices may help to address both needs. They not only help organizations to better cope with changing market demands, but, as we showed, may enhance companies' labour productivity and product innovation performance. Companies should therefore consider internal labour flexibility practices, such as job rotation, multi-tasking, flexible working schedules and allowing for individual tailor-made arrangements, when designing their labour flexibility and innovation policies.

10. CONCLUSIONS

Reliability analysis test results showed five factors that had to be discarded. This was due to the following reasons 1) Unclear questions 2) Lack of experience of the respondents.3) Factors which were irrelevant to their projects. Factor analysis for the client's factors, divided the factors into five components and factor untimely approvals or responses was deleted. Political influence on the industry, economic slowdown /Recession, government regulations, accidents during construction, health and safety factors and poor co-ordination between different departments was classified in the first component.

In factor analysis similar components were classified based on some commonality. Correlation test showed that design changes is dependent on drawing errors and also equipment selection specific to job is related to professionalism of the technical team. Nonlinear regression analysis, indicates the degree of dependency of two factors. It is found that Design changes has a dependency on drawing errors. From the suggestions by the respondents, it can be observed that most of them think that planning and scheduling

has to be improved at site followed by proper logistic plan and availability of materials at site before the start of the work. It is also observed that regular safety trainings, issuing drawings on time and efficient cash flow also has to be improved as per the respondents.

REFERENCE

[1] Henry, M.A., Mwakali, J.A. and Hansson, B. (2007), "Factors affecting the productivity of building craftsmen: Studies of Uganda", *Journal of Civil Engineering and Management*, Vol.13, No.3, pp.169-176

[2] Horner, R.M.W. and Talhouni, B.T. (1995), *Effects of Accelerated Working, Delays and Disruptions on Labour Productivity*, Chartered Institute of Building, Ascot, Berkshire, UK.

[3] Jarkas, A. and Bitar, C. (2012), "Factors affecting construction labour productivity in Kuwait", *Journal of Construction Engineering and Management*, ASCE, Vol.138, No.7, pp.811-820.

[4] Jiukun, D., Goodruml, P. and Maloney, W. (2009), "Construction craft workers' perceptions of the factors affecting their productivity", *Journal of Construction Engineering and Management*, ASCE, Vol.135, No.3, pp.217-225.

[5] Olomolaiye, P., Wahab, K. and Price, A. (1987), "Problems influencing craftsmen productivity in Nigeria", *Building and Environment*, Vol.22, No.4, pp.317–323.

[6] Makulsawatudom, A. and Margaret, E. (2003), *Critical Factors Influencing Construction Productivity in Thailand*, University of Manchester Institute of Science and Technology (UMIST), Manchester, UK.

[7] PIOJ (2009), *Vision 2030 Jamaica Labour Market and Productivity*, Planning Institute of Jamaica, Kingston, Jamaica

[8] Proverbs, D.G., Holt, G.D. and Olomolaiye, P.O. (1999), "The management of labour on high rise construction projects: An international investigation", *International Journal of Project Management*, Vol.17, pp.195-204

[9] Rifat, S. (2007), "Impact of occasional overtime on construction labour productivity: Quantitative analysis", *Canadian Journal of Civil Engineering*, Vol.34, pp.803-808.

[10] Soekiman, A., Pribadi, K.S., Soemardi, B.W. and Wirahadikusumah, R.D. (2011), "Factors relating to labour productivity affecting the project schedule performance in Indonesia", *Procedia Engineering*, Vol.14, pp.865-873.