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LABOR PRODUCTIVITY IMPROVEMENT IN A CONSTRUCTION PROJECT: PROBLEM BASED APPROACH

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Construction labor productivity is an important aspect of a construction project. However, low productivity problems have had a significant impact on construction project timeframes resulting in over budget expenditure. The objective of this study was to determine the factors affecting labor productivity in Thai construction projects. A structured questionnaire survey was employed, completed by 54 executive managers from leading companies in Thailand. The five highest importance ranking factors affecting labor productivity were found to be: lack of workers, financial shortages, incomplete drawings, labor skill and experience, and incompetent construction management team. It is hoped that the results of this research will lead to improved productivity and effectively in project work. The study is an initial investigation about labor productivity and examines the improvements necessary to make the Thai construction industry more competitive and profitable.

Keywords: Productivity, Construction, Improvement, Thailand.

1 INTRODUCTION

Construction is one of the nation's largest industries. The Thai construction industry accounted for 2.1% of the nation's GDP in 2013. Any improvement in construction labor productivity will lead to an increase in GDP and profit margins.

The decreasing of labor productivity has been a serious problem in many countries in the past decade. Thai construction project also faced a productivity problem, for example, shortage of workers, changes in construction design, delay in material procurement process and lack of competence project management team over the projects. Low labor productivity has a severe negative impact on the completion time and cost of the construction project. Therefore, to identify and minimize the factors that cause low labor productivity is essential in order to improve construction projects to be more efficient.

2 LITERATURE REVIEW

Low productivity problem has been concerned by many researchers in the past decade. Table 1 represents the summary of previous studies which lists the descending ranked of labor productivity factors as below:

Table 1. Summary of labor productivity factors from previous research.

Country	Reference	Labor Productivity Factors
Nigeria	Olomolaiye *et al*. (1987)	Lack of materials; inadequate tools; work repetition; inspection delays; instruction delays; supervisors' incompetence; absenteeism and changing crew members.
Singapore	Lim and Alum (1995)	Difficulty in recruitment supervisors; difficulty in recruiting workers; high rate of labor turnover; absenteeism at work site; communication problems with foreign workers; inclement weather that requires work stoppage for one day or more.
Iran	Zakeri *et al*. (1996)	Material shortage; weather and site conditions; equipment breakdown; drawing deficiencies/ change orders; lack of proper tools and equipment.
Indonesia	Kaming *et al*. (1998)	Interference; absenteeism; lack of material; repeat work; changing craftsmen; working overtime; equipment breakdown; overcrowding; supervision delay; lack of tools; changing foreman.
Thailand	Makulsawatudom and Emsley (2001)	Lack of material; incomplete drawing; inspection delay; incompetent supervisors; instruction time; lack of tools and equipment; poor communication; poor site conditions; change orders; poor site layout and rework.
Malaysia	Abdul Kadir *et al*. (2005)	Material shortage at site; non-payment to suppliers causing the stoppage of material delivery to site; change orders by consultants; late issuance of construction drawings by consultants; incapability of the contractors' site management to organize site activities.
USA	Mojahed and Aghazadeh (2008)	Skills and experience of workforce, management, job planning, workers motivation and material availability.
Chile	Rivas *et al.* (2011)	Materials, tools, rework, equipment, truck availability, and the workers' motivational dynamics.
Kuwait	Jarkas *et al.* (2012)	Clarity of technical specifications; extent of variation/change orders during execution; coordination level among various design disciplines; lack of labor supervision; proportion of work subcontracted; design complexity level; lack of incentive scheme; lack of construction manager's leadership; stringent inspection by the engineer and delay in responding to requests for information.
Qatar	Jarkas and Bitar (2012)	Skill of labor; shortage of materials; labor supervision; shortage of experienced labor; communication between site management and labor force; lack of construction managers' leadership; high temperature weather; delays in responding to "Requests For Information" (RFI); lack of providing labor with transportation; and proportion of work subcontracted.
Egypt	El-Gohary and Aziz (2014)	Labor experience and skills; incentive programs; availability of the material and ease of handling; leadership and competency of construction management; competency of labor supervision; construction technology (construction method and material); labor operating system (daily wage, lump sum); planning, work flow, and site congestion; constructability (integrated design and construction) and clarity of instructions and information exchange.

3 RESEARCH METHODOLOGY

The study was a pilot survey which focused on the top construction engineering and management firms in Thailand. A structured questionnaire survey was conducted and completed by 54 respondents who are the top executive managers in their organization. There are seventeen construction labor productivity factors collected from the literature review included in questionnaires (Olomolaiye *et al.* 1987, Lim and Alum 1995,

Kaming *et al*. 1998, Makulsawatudom and Emsley 2001, Abdul Kadir *et al.* 2005, Mojahed and Aghazadeh 2008, Soekiman *et al*. 2011).

The objective of this study is to evaluate the importance of labor productivity factors which affect time and cost overrun of the project in Thailand. To acknowledging the labor factors that cause low labor productivity, the improvement plan can be develop and implement to the problems which lessen unproductive time and cost in construction project.

3.1 Data Analysis

For analyzing data, the importance index was used. The productivity factors were gathered from literature and evaluated the ranked for importance and frequency index. The importance index was deriving for each factor using the following equation (Lim and Alum 1995, Abdul Kadir *et al.* 2005):

$$\text{Importance Index} = \frac{5n_1+4n_2+3n_3+2n_4+n_5}{5(n_1+n_2+n_3+n_4+n_5)} \quad (1)$$

where n_1 is the number of respondents who answered "strongly important", n_2 is the number of respondents who answered "important", n_3 is the number of respondents who answered "neutral", n_4 is the number of respondents who answered "not important", and n_5 is the number of respondents who answered "strongly not important".

4 RESULTS AND DISCUSSION

4.1 Factors Affecting Labor Productivity

Factors that influence labor productivity in construction project were ranked using an importance index which shown in Table 2.

Table 2. Ranking of Importance Index of labor productivity factors.

Productivity Problems	Importance Index	Rank
Financial shortage	0.800	2
Lack of workers	0.836	1
Motivation and Incentive	0.655	9
Labor skill and experience	0.727	4
Lack of Material	0.691	6
Incomplete drawings	0.782	3
Inspection and instruction delay	0.690	6
Rework	0.673	8
Change order	0.618	12
Incompetent construction management team	0.720	5
Lack of tools and equipment	0.600	14
Poor communication	0.582	15
Poor site condition	0.618	12
Interference	0.655	9
Technology	0.582	15
Safety and health	0.655	9
Politics aspects, laws and regulations	0.582	15

4.1.1 *Lack of worker (Importance Index = 0.836)*

Worker absence was ranked as the most severe problem causing low labor productivity with an importance index of 0.836. The construction industrial is relied on labor-base operatives that the worker is the main workforce in construction production. Inadequate amount of workforce affect to schedule pressure of the project and remaining of construction work to completion.

In Thailand few people wish to work in the construction industry. Foreign construction workers are an option for Thai contractors to address this labour shortage. However, with many new construction projects launching, there is still a labor shortage.

4.1.2 *Financial shortage (Importance Index = 0.800)*

Financial problem was the ranked the second most common factor, with an importance index of 0.800. This could cause the contractor to lose reliability in the eyes of the project owner. Financial shortages lead to several problems, including: the availability of materials, tools and equipment, payment delays to sub-contractors, and the worker credibility of involved suppliers.

4.1.3 *Incomplete drawings (Importance Index = 0.782)*

The third most important factor resulting in low labor productivity was incomplete drawings, with an important index of 0.782. The delay in construction drawings is one of the factors that have caused unproductive working time. Contractors cannot start work without completed construction drawings.

There are many causes of incomplete drawing, for example, change order by project owner, time and cost constrain to the construction designer, insufficient detail provided by designer and coordination problem among contractor and consultant.

4.1.4 *Labor skill and experience (Importance Index = 0.727)*

Labor skill and experience was ranked as the fourth factor causing labor productivity issues (with an importance index = 0.727). A skilled and experienced workforce is essential, in order to improve the productivity of construction projects. Lack of construction knowledge, skills and experience, all result in productivity losses, and are another cause of delayed projects; for example, misunderstood instructions, drawings and specifications, and their associated rework required when failures occur. Due to lack of skills, therefore, such workmanship requires the acquisition of programs such as skills-based education and training sessions.

4.2 Productivity Improvement by Problem-based Approach

Productivity in all planning operations of construction work requires improvement to maximize efficiency. This recommendation was derived from interviews with executive managers. This section proposes a problem-based approach for the resolution of productivity problems. The productivity improvement provided into four categories as below:

4.2.1 *Construction worker problems*

The main problem encountered in the Thai construction industry is the shortage of workers and their lack of skills and experience; most are new recruits with only a farming background. They have low construction skill and knowledge. Companies are highly recommended to provide training sessions to impart relevant information to reduce loss in productivity. Moreover, to encourage the engagement of qualified workers, motivation and incentive schemes should be introduced to reduce labor turnover.

4.2.2 *Management problems*

Check lists must be drawn-up in the pre-construction phases which detail the work issues that have to be organized, step-by step. For example, the improvement of construction site access, early material procurement, identification of material requirements, short-term planning and procedures, sequencing of the work detailed design and drawings clearly presented, adequate provision of tools and equipment, license and permit construction documentation complete, and adequate manpower for the job. Good preparation from the beginning of the project will increase production and productivity.

4.2.3 *Rework problems*

Rework is one of the most significant problems in any construction project. Minimizing rework will increase productivity. Rework occurs for many reasons, including wrong construction due to incomplete drawings and/or complex design, inadequate and incompetent supervision, lack of skilled labor and knowledge in construction and design change. A good management plan in the pre-construction phase will minimize project rework.

4.2.4 *Unforeseen problems*

These cannot be predicted and can occur at any time. Good implementation planning will lessen their impact. Political aspects, law and regulation changes, climate and environment changes and alterations of work schedules can all be classified under this heading. Good project management will ensure minimal impact.

5 CONCLUSION

Construction productivity is one of the most critical parts for many construction projects; this affects project time and cost. Seventeen factors are listed as the main problems responsible for decreased labour productivity. The results found that the five most important factors are: lack of workers, financial shortages, incomplete drawings, labor skill and experience, and incompetent construction management team. This paper attempts to provide a guideline for practitioners to understand and apply productivity improvements in organizations. Further research regarding

productivity improvement and related factors is required to consider and provide a systematic solution.

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