

## **Critical Factors Influencing Construction Productivity in Thailand**

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### **Abstract**

Factors affecting construction in Thailand were disclosed in previous studies carried out by the authors, which confirmed that the construction industry in Thailand has experienced productivity problems like many other countries (Makulsawatudom and Emsley, 2001a and 2001b). The objective of this paper is to identify factors that should be focused upon, when productivity improvement is to be initiated. To do so, 34 project managers working in the construction industry in Thailand completed a structured questionnaire survey and the factors were ranked according to their perception of their levels of influence and their potential for improvement based on their overall experience in managing projects in the industry. To supplement the questionnaire data, in depth interviews were conducted with some project managers. This study is intended to create the foundation for further study of construction productivity measurement and improvement in Thailand, which aims to lead to overall productivity improvement.

### **Keywords**

Productivity, Productivity Improvement, Rank Index Approach

## **1. THE CONSTRUCTION INDUSTRY IN THAILAND**

Like many countries, the construction industry in Thailand has been dominated by a small number of large companies (>1,000 employees) and a large number of small companies (<20 employees), representing 0.2% and 68.1%, respectively of the 17512 organisations in the industry. Furthermore, these large companies have 21.5% of the market share, while the small companies, major players in the industry, only have 9.9% of the market share. Considering all organisations, 8% are involved in site preparation, 75.1% and 9.3% have their core business in civil engineering and building construction respectively, while 7.1% and 0.5% are involved with building completion and plant hire, respectively (National Statistical Office, 1999).

In respect of the workforce, the construction industry employs 1.28 million of the 33.00 million available workers, of which 80-90% are males, and has a turnover of 311,672.1 Million Baht (1£ = 64.54 Baht in July 2001), which is about 4% of GDP. During the last 8 years, industry contribution to GDP has ranged between 3 and 8% (National Statistical Office, 1999). Any improvement in construction productivity would, consequently, assist the industry and the country to make significant financial savings.

## **2. DATA COLLECTION**

This study was conducted in Thailand between November and December 2000, with project managers, working at management level, as the target group. A structured questionnaire survey was selected to be the study main instrument, as it provided information quickly and cheaply. Each participant was asked to rate the factors affecting productivity on a scale from 0 (no influence) to 5 (very much influence) and to rate each factor in respect of its potential for productivity improvement on a scale from 0 (no potential) to 4 (very high potential). In addition, respondents were welcome to add and rate any further factors that they believed have an effect on construction productivity. A total of 34 questionnaires was completed. Then, before a relative importance index (RII) was applied to prioritise the severity of the factors, the raw rankings were multiplied together to produce a critical factor index (CFI). Finally, in-depth interviews were conducted with project managers.

## **3. RESPONDENTS' CHARACTERISTICS**

Most respondents (97%) are male. This is not surprising as the construction industry in Thailand has traditionally been male dominated. According to project managers interviewed, it takes 12 years for an inexperienced engineer to gain adequate experience to become a project manager. Therefore, it is reasonable that 85% of project managers have at least 11 years experience. In addition, it is not surprising that 88% of respondents are over 34 years old, as engineers in Thailand usually graduate between 22-24 years old. During the last two decades, the majority of construction works have been public infrastructure projects. Consequently, civil works includes the maximum number of experienced respondents. However, the residential field has only started to grow in the last 8 years, so contains the least number of experienced project managers. 68% of the project managers have first degrees, with the remainder qualified at masters level and none at PhD level. Limited numbers of universities available for masters degrees, and demand for engineers in the last two decades, has encouraged new graduates into the work place. However, the relatively high number of masters graduates is due to the economic recession, providing project managers with more time to upgrade their qualifications. Over half of the project managers (59%) have worked for their organisation for at least 6 years, and almost one third (32%) for over 10 years, reflecting that a project manager in Thailand has a fairly high commitment to his organisation. 83% of the respondents work for main contractors, while 3% are sub-contractor labour only. Like the working experience of project managers, organisations that work in the residential field include the least number of respondents, 35%, due to the same reason as discussed previously. In respect of geographic location, Bangkok (the capital) and boundary has the most respondents (91%) and the eastern part of Thailand, which has successfully been promoted as an industrial zone during the last two decades, has the second highest number (76%). In addition, 41% of the organisations usually subcontract at least 50% of the project value to subcontractors. In order to identify any relationship between company turnover and percentage subcontracted and geographic location of organisations, Spearman correlation coefficient was employed, which indicated that there are rank correlations between the two factors and turnover. This means the higher a company's turnover, the more jobs are subcontracted in a project, and the more geographic locations they work in.

## 4. FACTORS AFFECTING PRODUCTIVITY AND THEIR POTENTIAL FOR IMPROVEMENT

Factors that influence construction productivity were gathered from a literature review of previous studies (Borcherding and Sebastian, 1980; Hanna and Heale, 1994; Kaming *et al.*, 1998; Kaming *et al.*, 1997; Olomolaiye and Ogunlana, 1989; Olomolaiye *et al.*, 1987; Zakeri *et al.*, 1996), and project managers were asked to express their opinion on the influence of the factors (from 0 to 5) and their potential for improvement (from 0 to 4). The raw rankings were multiplied together to produce a critical factor index (CFI), which were then summated and divided by 26 (the number of possible values for the CFI) to give a relative importance index (RII). Table 1 gives the factors ranked according to their RII.

### 4.1 Lack of material

With a RII of 0.405, lack of material was highlighted as the most critical factor affecting productivity. This is not surprising, as materials are essential for the construction process. The project managers revealed that this is mainly due to *contractors' liquidity problems*, where many contractors have insufficient finance to procure the necessary materials. Other causes mentioned were *imported material* and *poor co-ordination between site and office*. In respect of its potential for improvement, although the project managers believed there is little potential, they suggested asking the client to make progress payments when materials have been delivered, implementing better sequences of work, examining materials to be used and initiating material management meetings to improve co-ordination between site and office.

### 4.2 Incomplete drawing

The interviewed respondents identified that incomplete drawing has a high impact on productivity, causing delays for revision or clarification of drawings and specifications. Therefore, it was ranked the second most crucial factor, with a RII of 0.373. The sole main cause of the factor is that *clients provide limited time and budget for designer* to complete the design in order to expedite the bidding process. As a result, drawings are often incomplete, unclear, impractical and contain conflicts. In respect of potential for improvement, the survey disclosed that incomplete drawing has high potential.

**Table 1 : Critical factors influencing the construction industry**

Rank	Factors	Influence ranked score					Potential ranked score					Total CFI score	RII	
		0	1	2	3	4	5	0	1	2	3			4
1	Lack of material	0	3	5	2	8	16	0	1	14	14	5	358	0.405
2	Incomplete drawing	0	2	3	10	12	7	0	1	13	14	6	330	0.373
3	Incompetent supervisors	0	3	7	7	10	7	0	2	11	14	7	329	0.372
4	Lack of tools and equipment	0	4	4	10	12	4	0	1	12	16	5	309	0.350
5	Absenteeism	0	3	11	10	8	2	0	2	10	19	3	307	0.347
6	Poor communication	0	2	9	12	4	7	0	3	11	13	7	301	0.340
7	Instruction time	0	1	8	11	9	5	0	1	11	16	6	299	0.338
8	Poor site layout	0	5	7	8	10	4	0	1	13	14	6	298	0.337
9	Inspection delay	0	0	6	14	10	4	0	1	13	19	1	294	0.333
10	Rework	0	6	5	12	7	4	0	1	12	15	6	291	0.329
11	Occasional working overtime	1	2	11	11	7	2	0	4	7	18	5	266	0.301
12	Change orders	0	2	7	13	11	1	0	5	13	13	3	265	0.300
13	Tools/equipment breakdown	0	5	8	13	6	2	0	1	13	15	5	261	0.295
14	Specification and	1	6	9	8	7	3	0	2	11	16	5	261	0.295

	standardisation														
15	Interference from other trades or other crew members	0	3	12	12	5	2	0	1	18	11	4	245	0.277	
16	Workers turnover and changing crewmembers	0	2	16	11	4	1	0	6	9	13	6	233	0.264	
17	Scheduled working overtime	2	6	9	12	4	1	1	2	11	15	5	226	0.256	
18	Safety (accidents)	0	10	12	6	1	5	0	3	10	16	5	220	0.249	
19	Poor site conditions	0	5	4	13	7	5	2	6	19	6	1	207	0.234	
20	Changing of foremen	2	6	12	10	2	2	0	4	11	14	5	204	0.231	
21	Overcrowding	0	8	9	7	7	3	0	9	16	6	3	190	0.215	
22	Shift work	7	5	7	11	3	1	5	5	7	14	3	182	0.206	
23	Weather	1	5	15	9	2	2	7	11	12	4	0	114	0.129	

### 4.3 Incompetent supervisors

This factor was ranked third in respect of its influence on construction productivity, with a RII of 0.372. Incompetent supervisors work slowly and may be responsible for defective works and inappropriate application of tools and equipment. One cause of this factor is *poor human resource management*, where inappropriate people are promoted to a supervisory role. The project managers believed that there was considerable potential for productivity improvement in respect of incompetent supervisors. By implementing employee in-house training and ensuring supervisors were correctly selected, the interviewed respondents were confident the effect of incompetent supervisors on productivity could be much reduced.

### 4.4 Lack of tools and equipment

This factor was ranked fourth, with a RII of 0.350 and is caused by *inadequate management*, for example, insufficient provision of tools, ignorance of maintenance programmes leading to inefficient use and the use of old and obsolete equipment and shortage of spare parts. In addition, an *incompetent project manager*, who, for example, overestimates the capacity of a machine, resulting in insufficient numbers of the machine being employed, was also mentioned. With regard to productivity improvement, the occurrence of lack of tools and equipment can be reduced by implementing preventive maintenance, as the maintenance cost is small when compared with the costs incurred when tools/equipment breakdown.

### 4.5 Absenteeism

Respondents ranked this factor fifth, as a crucial factor affecting the construction industry, with a RII of 0.347. The factor's peak impact occurs seasonally, which is usually around May to June and November to December of each year, since craftsmen, who mostly are agriculturists, have to go home to do paddy farming. Apart from these periods, International, Thai (Songkarn) and Chinese New Years are occasions when the work on many sites is almost virtually stopped for one week, because of absenteeism. Causes of the factor are due to *part time workforces*, who come to work in the industry only when they are free from cultivation, and *irresponsible craftsmen*, who, for example, drink alcohol and gamble overnight and, accordingly, they cannot come to work the next day, or who are just absent to spend their money, after pay day.

### 4.6 Poor communication

Poor communication was ranked sixth, with a RII of 0.340. This factor allows defective works to occur due to *incompetent communication skill*. In order to overcome poor communication, the interviewed respondents advised that, instead of informal verbal communication, documentation such as work procedures, manuals, charts and guidelines should be used.

#### **4.7 Instruction time**

With a RII of 0.338, instruction time was ranked seventh. This factor causes delays and, although jobs are not stopped, they can move forward only slowly and may be crucial if jobs are on the critical path. According to interviews with the project managers, the main cause is *inadequate management*, for example, insufficient numbers of foreman employed in order to decrease expense. In addition, the interviewed respondents suggested ideas such as increasing the number of engineering officers, providing substitute field supervisors and proceeding with other jobs, when a job is stopped, which may dramatically decrease the effect of instruction time on productivity.

#### **4.8 Poor site layout**

This factor was ranked eighth, with a RII of 0.337, in respect of its significance on construction productivity. Poor site layout interrupts work flow, for example, material search difficulties, equipment transportation difficulties, or access problems. In addition, the factor may cause avoidable delays such as time lost due to, for example, too long a distance from the working area to the toilets, when 20 manhours a day could be lost if it takes 2 minutes each way per trip for 100 craftsmen for 3 trips per day. An *incompetent project manager*, who has insufficient working experience in order to sequence work properly, is the only cause of poor site layout specified by the project managers.

#### **4.9 Inspection delay**

Respondents ranked this factor ninth in respect of its impact on productivity, with a RII of 0.333. Inspection delay may delay job progress, which, similar to instruction time, may be acute for jobs on the critical path. The project managers further specified that causes of inspection delay are an *incompetent project manager*, such as one who does not realise which jobs are ready to be inspected, does not prioritise jobs for inspection or does not facilitate co-operation between the contractor and inspector, and an *irresponsible inspector*, such as one who is not punctual, abuses authority and ignores jobs. Similar to lack of material, while this factor has considerable effects on productivity, it has low potential for productivity improvement.

#### **4.10 Rework**

Rework was ranked tenth, as the critical factor affecting the construction productivity, with a RII of 0.329. The more rework, the more time and cost needed for construction. Causes of rework can be attributed mainly to *incompetent craftsmen*, and *incompetent supervisors*. Insufficient working skill and knowledge of drawings are examples of an incompetent craftsman, while lack of experience, leading to deficient supervision, is an example of an incompetent supervisor. Others causes of rework advised were *change order* and *incomplete drawing*. In respect of potential for productivity improvement, the interviewed project managers suggested the provision of experienced supervisors which would overcome the two major causes of rework, incompetent craftsman and supervisor, specified above.

## 5. CONCLUSION

This study has found that there have been construction productivity problems in Thailand, and disclosed the ten most significant factors affecting construction productivity in Thailand as lack of material, incomplete drawings, incompetent supervisors, lack of tools and equipment, absenteeism, poor communication, instruction time, poor site layout, inspection delay and rework. However, various suggestions were raised in order to improve productivity by alleviating the effect of adverse factors. Improvement of an organisation's productivity in Thailand should now be focused on these ten factors, since this will not only make an organisation more profitable, but also increase its chance of survival in the industry, especially as there is very high competition due to the economic crisis. If improvement in many organisations' productivity can be facilitated, overall construction productivity in Thailand will also be improved. Therefore, using this research as the foundation, future studies will concentrate on productivity improvement.

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