NEED FOR JIT IMPLEMENTATION: MATERIAL SHORTAGE PROBLEMS AS A CAUSE OF DELAY IN CONSTRUCTION PROJECTS IN EGYPT

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ABSTRACT

The construction environment is full of complexity and multi-tasks which requires excessive collaboration and coordination between individuals who take part in the construction process which makes the construction process significantly different than the manufacturing process. Materials delivery is among the critical issues that need to be appropriately controlled. Material procurement is one of the major elements of managing a construction project. If it is not managed appropriately, it could lead to cost overrun and delay for the project. The objective of this study was to investigate the materials delivery problems as one of the delay causes of construction projects in Egypt, in order to explore the need to apply new management technique Just-in-Time (JIT) in the Egyptian environment to help overcome materials delivery delays. To achieve this target, a questionnaire was developed addressing the causes of delays. One hundred surveys from professionals in various construction field were collected. The survey results identified material shortage as one of the top ranked causes of delay by both consultants and contractors. Applying such technique as Just-in-Time can assure construction fluidity in terms of managing materials procurement process in construction projects.

Key words: JIT, construction environment, Egypt, material storage.
1. INTRODUCTION
Materials delivery is generally blamed for overall project delay, many studies rank it at the top of causes of project delays. In an international setting, materials delivery was ranked as the sixteenth technical delay causes in construction projects Yates (2007). Another study done on the construction of residential projects in the State of Kuwait found that late delivery of materials causes one-fourth of total project delays Koushki, & Kartam, (2004). Furthermore, the UAE construction industry study by Faridi & El-Sayegh, (2006) ranked materials delivery as the eighth significant cause of schedule delays.

The identification of factors leading to construction delays was found to differ from study to study in the literature. Shi and Arditi (2001) put together the fundamental causes of delay in order to determine their relationship with project completion Chan (1998) looked into the principal factors affecting the duration of construction projects. Assaf et al. (1995) outlines the main causes of delay in the Saudi construction projects in large building projects and their relative importance. Delay factors were categorized into nine groups: Materials, Financing, Government, Manpower, Environment, Contractual relation, Equipment, Changes, and Scheduling and controlling techniques. Ogunlana & Promkuntong (1996) studied the delays in building projects in Thailand, as an example of developing countries. Twenty six causes of construction delays were identified, grouped according to who was responsible for the delay. A more detailed study was carried out by Kumaraswamy and Chan (1995), to investigate the principal causes of construction delay in both building and civil engineering projects. They group 83 hypothesized delay factors into eight major factor categories. Al-Ghafly and Al-Khalil (1995) conducted a study to determine the most important causes of delay in public utility projects. The causes are grouped into six major categories of delay. There has been a considerable and continued interest in the effects of construction delays in different countries as Nigeria, Lebanon, Jordan, Bangkok, Hongkong, KSA, and UK. (Chan, 1998) summarized related observations on the major factors causing delays in construction projects in different countries. Although a comparison of the results of many surveys is valuable, it cannot give accurate results since these studies used different techniques, measurements and methods of survey, and had different purposes. On the other hand, it was obvious from these studies that the group of causes including material problems was ranked high.

2. AIM OF THIS STUDY
The aim of this paper is assess the material shortage problem as a delay cause and to present JIT as a potential solution for managing the material procurement in construction projects. An effective materials management system is the system that functions along each step in the process in the most productive way.

3. IDENTIFICATION OF DELAY CAUSES
For the purposes of the present research to assess the level of importance of material shortage and its effect on delay in construction projects in Egypt, potential delay factors were categorized into 8 major groups:
• Client related factors
  o Finance and payment of completed works
  o Owner interference
  o Slow decision making
  o Unrealistic contract duration imposed by owners
• Contractor related factors
  o Site management
  o Improper planning
  o Inadequate contractor experience
  o Mistakes during construction
  o Improper construction methods
  o Subcontractors
• Consultant related factors
  o Contract management
  o Preparation or approval of drawings
  o Quality assurance / control
  o Waiting time for approval of tests and inspection
• Material factors
  o Material shortage
  o Material quality (specifications)
• Labor and Equipment factors
  o Labor shortage
  o Loss of labor productivity
  o Equipment availability
• Contract factors
  o Change orders
  o Mistakes and discrepancies in contract documents
• Contractual relationships factors
  o Major disputes and negotiations during construction
  o Lack of communication between project parties
  o Inappropriate organizational structure linking all parties
• External factors
  o Weather conditions
  o Changes in regulations
  o Problems with neighbors
  o Site conditions
4. DATA COLLECTION

After identifying the delay causes, a survey questionnaire was developed to assess the perceptions of contractors and consultants of the relative importance of construction delay causes. Questions concerned with the respondent’s experience are added as section one. This contains general questions about the profession, period of experience, sector, specialty, and the size of projects in which the respondent has participated. The second section includes the list of 28 causes of delay in construction projects. After this, the questionnaire was distributed to a random sample of contractors and consultants working on large projects in Egypt.

Sample size calculated from the equation Shash, (1993) was equal to 97. Out of 160 questionnaires distributed, some were sent out and the rest were personally handed over to respondents; and interviewer was available to answer all questions asked by respondents. This mode follow-up communication led to the return of 100 completed questionnaires from respondents.

5. DATA ANALYSIS

Respondents were asked to express their perceptions of relative importance of each of 28 causes ranging from: Extreme - Very important - Moderate - Slight – or Not important To determine the ranking of the different causes from the point of view of contractors and consultants, the relative importance index (I) was computed as:

\[ I = \frac{\sum W_i \times X_i}{\sum X_i} \]

Where:
- \( i \) = Response category index = 5,4,3,2, and 1 for Extreme - Very important - Moderate - Slight – or Not important, respectively.
- \( W_i \) = Weight assigned to the ith response 4, 3,2,1,0, respectively.
- \( X_i \) = Frequency of the ith response given as percentage of the total responses of each cause.

The data collected from delay causes questionnaire were analyzed and the indices were computed and ranked. Calculating the average indices of the causes in each group gives relative importance index of the main groups. The mean indices and the ranking of all groups are shown in the following tables.

<table>
<thead>
<tr>
<th>Category</th>
<th>Delay Cause</th>
<th>Contractors</th>
<th></th>
<th>Consultants</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Index</td>
<td>Rank</td>
<td>Index</td>
<td>Rank</td>
</tr>
<tr>
<td>Owner</td>
<td>Finance &amp; payments of completed work</td>
<td>3.74</td>
<td>1</td>
<td>3.60</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Owner interference</td>
<td>2.22</td>
<td>25</td>
<td>2.10</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>Slow decision making by owners</td>
<td>2.86</td>
<td>15</td>
<td>3.04</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Unrealistic imposed contract duration</td>
<td>3.04</td>
<td>9</td>
<td>2.88</td>
<td>12</td>
</tr>
<tr>
<td>Consultant</td>
<td>Preparation &amp; approval of drawings</td>
<td>2.96</td>
<td>11</td>
<td>2.94</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Quality control &amp; Quality assurance</td>
<td>2.80</td>
<td>16</td>
<td>2.78</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Waiting time for approval of drawings</td>
<td>2.36</td>
<td>23</td>
<td>2.38</td>
<td>22</td>
</tr>
<tr>
<td>Contractor</td>
<td>Site management</td>
<td>2.98</td>
<td>10</td>
<td>3.14</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Improper contractor planning</td>
<td>3.42</td>
<td>3</td>
<td>3.56</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Inadequate contractor experience</td>
<td>3.46</td>
<td>2</td>
<td>3.42</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Mistakes during construction</td>
<td>3.10</td>
<td>7</td>
<td>3.06</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Improper construction methods</td>
<td>3.18</td>
<td>4</td>
<td>2.86</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Subcontractors</td>
<td>2.28</td>
<td>24</td>
<td>2.33</td>
<td>24</td>
</tr>
</tbody>
</table>
Material

Quality of material 2.96  11  3.06  7
Material shortage 3.16  6  3.26  4

Labor supply 3.06  8  2.70  17
Labor productivity 3.18  4  3.04  9
Equipment availability & failure 2.80  16  2.74  16

Labor & Equipment

Labor supply 3.06  8  2.70  17
Labor productivity 3.18  4  3.04  9
Equipment availability & failure 2.80  16  2.74  16

Contract

Change orders 2.50  21  2.66  18
Contract mistakes 2.66  18  2.38  22
Major disputes & negotiations 2.63  19  2.46  20

Contractual relationships

Inappropriate overall organization structure linking all parties of the project 2.88  14  2.66  18
Lack of communications between parties 2.61  20  2.78  14

External causes

Weather condition 1.48  28  1.64  27
Regulatory changing & building code 1.74  27  1.58  28
Problems with neighbors 2.02  26  2.18  25
Unforeseen ground condition 2.94  13  3.16  5

Table 2 Importance index and ranking of major delay categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Contractors</th>
<th>Consultants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner</td>
<td>2.965</td>
<td>2.906</td>
</tr>
<tr>
<td>Consultant</td>
<td>2.642</td>
<td>2.625</td>
</tr>
<tr>
<td>Contractor</td>
<td>3.07</td>
<td>3.061</td>
</tr>
<tr>
<td>Material</td>
<td>3.06</td>
<td>3.161</td>
</tr>
<tr>
<td>Labor &amp; Equipment</td>
<td>3.013</td>
<td>2.827</td>
</tr>
<tr>
<td>Contract</td>
<td>2.5976</td>
<td>2.50</td>
</tr>
<tr>
<td>Contractual relationships</td>
<td>2.746</td>
<td>2.72</td>
</tr>
<tr>
<td>External causes</td>
<td>2.645</td>
<td>2.14</td>
</tr>
</tbody>
</table>

The spearman's correlation coefficients of the ranking of contractors and consultants for all the causes and for the main categories computed from equation are 0.884 and 0.952 respectively. Which indicates strong agreement between contractors and consultants on the ranking of all causes and of the main categories. The following figure shows the top ten ranked delay causes by both contractors and consultants.

Figure 1 Top ranked delay causes
6. JIT APPLICATIONS AND IMPLEMENTATION IN CONSTRUCTION PROJECTS

The main goal of JIT materials management system in construction project is to optimize materials delivery timing and to minimize inventory quantities. Inventory or storage on site are exposed into certain deficiencies such as protecting it against theft, damage, and weather, and failing to provide space for materials. The implementation of JIT in construction requires commitment from staff and crew involved in the construction in terms that all parties from the planning and site should collaborate together and participate in the decision making process. The successful implementation of JIT is dependent on the suppliers’ flexibility, users’ stability, total management and employee commitment as well as teamwork.

7. CONCLUSIONS

Materials delivery delays have negative impacts on the success of the construction project. The study has been done to identify the main causes of material delivery delays in Egyptian construction projects. In addition, it has also been made to propose techniques and solution to prevent such in problems in materials for construction projects. Based on the conducted survey among construction professionals in Egypt, one of the core causes of delays in projects is material shortage. The material category was ranked high, second by contractors and first by consultants. This was true for material shortage which was ranked sixth by contractors and fourth by consultants. Delays are costly and often result in disputes and claims. So, the need to apply new techniques as JIT in order to improve the current situation. The main aim of JIT materials management system in construction project is to optimize materials delivery timing and to minimize inventory quantities. This gives a positive sign that Just-in-Time (JIT) can assure construction fluidity in terms of managing materials procurement process in construction projects. We suggest two areas for further research. Studying applicability of JIT implementation in construction industry in Egypt. A case study in project showing the delivery scheduling procedure for material procurement systems, and develop the practical applicability of the proposed solution.

REFERENCES


