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The Critical Success Factors for Building Materials Availability at Construction Sites: A Qualitative Approach

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Abstract. The availability of building materials is one of the most important elements for the successful implementation of a project. Any failure to maintain the status of availability of materials at the construction site results in the workers experiencing a demotivated status and delays in the construction project being handled. Therefore, the objective of this paper is to identify the critical success factors of the availability of building materials at the construction site. A qualitative study which is a structured interview was conducted with thirty-eight (38) construction contractors as well as fifteen (15) suppliers. The results of the analysis found that as many as six (6) critical success factors have been successfully revealed from all the factors that affect the availability of building materials at the construction site. These critical success factors include 1) Current financial status of the contractor; 2) Relationship (tolerance) between contractor and supplier; 3) Work Planning and Scheduling; 4) Good communication of the main contractor and sub-contractor, and suppliers; 5) Availability of building materials in the suppliers' storage; and 6) Availability of machine, machinery, and trucks. These critical success factors can be used as a useful basis in ensuring the availability of building materials.

INTRODUCTION

The 'Wawasan Kemakmuran Bersama 2030' is a commitment to continue Malaysia as a sustainably developing country along with fair, equitable, and inclusive economic distribution at all levels of income groups, ethnicity, regions, and supply chains [1]. This commitment will continue towards strengthening political stability and increasing the prosperity of the country as well as ensuring that the people are united without prejudice by celebrating the diversity of races and cultures as the basis of the unification of the nation and the country. To ensure that all these visions, aspirations, and commitments are successfully achieved, once again the construction industry is given a big responsibility because of its ability to provide fixed capital for industries involved in the national economy to thrive in the future. The dependence of the construction industry in the context of the supply of production resources from other industries such as transport, tourism, production, mining, and agriculture is necessary for the effectiveness of its supply chain management. In addition, the construction industry is also a major contributor towards creating a more perfect lands transport network system such as roads and highways, light and rapid mass transit, commuter, and monorail; including the preparation of other civil engineering-related constructions such as bridges, tunnels and dams. All of these activities are important to move in an effort to have a positive impact on the economic growth of a country as a whole. Unfortunately, construction is often labeled as a backward industry because of the 3D syndrome of 'Dirty', 'Dangerous', and 'Difficult' [2-3]. This situation will inhibit the big contribution that should be played by the construction industry in a country. The real potential of the

construction industry towards fulfilling the wishes and aspirations of the government is not able to be translated perfectly into the real environment at the construction site. One of the important factors in ensuring the successful implementation of construction projects is maintaining the status of the availability of building materials at the construction site. This situation exists because the workers are unable to carry out construction activities as long as the building materials are not on the construction site. A bigger impact will occur due to the failure of this supply is that the motivation of the employees becomes lower and difficult to recover especially if it happens in the long term. Other side effects due to this supply failure include delay, low project performance, and the possibility of fines being imposed on the involved contractor. Therefore, the objective of this paper is to identify the critical success factors of the availability of building materials at the construction site. Therefore, the identification of these critical success factors will provide useful guidance to stakeholders towards improving the performance of construction projects. Next, it will increase the competitiveness of the construction industry in a country as a whole.

CONSTRUCTION PROJECT PERFORMANCE AND THE BUILDING MATERIALS AVAILABILITY AT CONSTRUCTION SITES

Construction projects are temporary and involve repetitive activities but in the procurement environment, organization and locality vary from one construction site to another [4]. A project is a small unit in the construction industry. Any success in carrying out activities at the construction site will have a significant impact on the effectiveness of the construction industry's service delivery to other industries in a country. On the other hand, if any failure in the implementation of a project in providing the physical products occurs; then it will harm on the construction industry as a whole. The characteristics of failure in the implementation of a construction project include delays and incompleteness, cost overruns, low quality, and accidents and deaths occurring on the construction site. Therefore, the cause of failure in the implementation of a construction project needs to be analyzed towards the effectiveness of its implementation. According to previous researchers (such as [5-14]) factors related to the availability of construction materials greatly affect the performance and productivity of labor at construction sites. Studies carried out by [15] and [16] proved that factors related to unsuitable construction materials or prefabricated components are the second largest the most significant effect on construction labour productivity in Malaysia dan Yemen respectively. The direct effect of the problem of the non-availability of building materials at the construction site is that the workers are unable to carry out the activities the workers should be doing based on the action plan of the contractor involved. The workers will be idle while waiting for the components to arrive at the construction site. If this situation happens continuously, it will have a more severe negative effect which is the problem of the motivation of the employees becoming weaker which is normally refers to as demotivating. According to [17], the problem of demotivating is difficult to recover in a short time. It takes longer for their motivation to return to the level before this supply failure. In addition, the greater impact resulting from the failure to supply building materials at the right time, quality, and quantity is the delay in the completion of the project, the performance of the project is low and finally, the reduction of profits occurs due to the imposition of non-completion fines on the contractors involved. One of the reasons for the delay of this construction project will occur if the workers are unable to carry out construction activities [18], of which is due to the failure of the supply of building materials at the construction site. At the same time, the status of low-motivated workers in a certain period will strengthen the effect of this delay as a result of the failure of the supply of building materials at this construction site. The implementation performance of a project is often measured based on the workers' ability to carry out activities on the construction site [19]. If the motivation of the workers is high, then it will have a positive effect on the performance of the project and the construction industry as a whole [20]. Liquidated and ascertained damages are fines that will be imposed on construction contractors involved if there is no solid reason to present to the consultant the reasons for the delay. The failure of the supply of building materials will have a direct impact on workers being idle at the construction site. In addition, the indirect effect is the possibility of delays, low performance, and the imposition of fines due to unfinished work to the contractors involved.

RESEARCH METHODOLOGY

An interview approach was implemented with the parties involved. The details of the dependent variable, which is the status of availability, and independent variables, which are the factors that affect the availability of building materials at the construction site, can be obtained perfectly even though the sample size is small.

Sampling Design

A total of thirty-eight (38) respondents of various contractor registration statuses representing G1, G2, G3, G4, and G5 contractor registrations were involved in this study. The selection of this respondent is based on the majority of contractors throughout Malaysia belonging to this medium and small class. According to [21] and [22], these small and medium business status contractors are the core of the Malaysian construction industry with a registration rate of ninety percent, while large business status contractors are as much as ten percent. The definition of small and medium construction businesses is as stated: a) G1 - Is an enterprise with full-time employees of less than 5 or with annual sales turnover of less than RM200,000; G2 - G3 - Is an enterprise with full-time employees of between 5 and 19 or with an annual sales turnover between RM200,000 and less than RM 1 Million; and G4 - G5 - Is an enterprise with full-time employees of between 20 and 50 or with annual sales turnover of between RM 1 Million and RM 5 Million [21]. In addition, a total of fifteen (15) building suppliers were also involved and both of the respondent's categories reached saturation of data collection. However, the respondents involved must meet the selection criteria set including (a) being directly involved in the management of ordering construction materials at the construction site; (b) having an academic qualification in the field related to construction; (c) having extensive experience, i.e. at least 10 years of work experience in the construction industry; and (d) collaborate in giving opinions independently related to the issue under study [23] and [14].

Data Collection Procedure

In order to achieve all the questions of this study, a structured interview approach was conducted where various questions were asked to the study respondents. One of the influencing factors and elements of the success of the availability of construction materials at the construction site determined by the respondents of the study is then explained in this interview session. It has given a comprehensive overview of its importance in achieving the status of availability of building materials at the construction site. All the knowledge, experience and views of the respondents in determining the factors that influence the effectiveness of the implementation of the procedure are recorded to prevent this valuable data from being dropped. Similarly, the elements of success to achieve the goal are also recorded perfectly to be used in the next stages of the methodological procedure of the study. Interviews with respondents were conducted from February to July 2022 with each session taking 40 to 60 minutes. Earlier, an appointment with the respondents involved was made at least two weeks before the interview session was held as the platform, location and time were agreed upon before that. A reminder to hold an interview session with the respondent was done 1 to 2 days before that. This is because they have a busy work schedule to complete the projects they handle. A total of 15 interview sessions were conducted at the construction site, and 11 and 15 sessions were held at the contractors' respective company and suppliers' hardware offices respectively. While the remaining 4 and 8 interview sessions respectively used the telephone platform and virtual meetings through the Zoom and Google Meet applications. In the face-to-face interview session either at the construction site or at the respondent company's office, compliance with the Standard Operating Procedure to break the chain of Covid19 that has been outlined by the Malaysian government at that time. Compliance with this government directive is necessary because the spread of Covid19 was still happening at that time. Interviews with the respondents of this study were mostly conducted in Bahasa Malaysia. A small part is more likely to use English. The use of language, whether Bahasa Malaysia or English, is subject to the comfort and desire of the study respondents.

Data Analysis

A qualitative study using a structured interview approach requires a specific analysis towards concluding the various data collected. For that purpose, [24] who have developed a 5-level data analysis approach based on qualitative research referred to and used it in this study. This 5-stage data analysis approach based on qualitative research is as follows: -

Familiarization - All raw qualitative data was recorded in the questionnaire and then transferred and converted into data transcriptions. Systematic and thorough data transfer and conversion are highly demanded at this stage. This is because the accuracy of data analysis at the next stages is dependent on the accuracy of data handling at this stage. Transfer and conversion errors are easy to occur at this stage because it is the basic data collected directly from the study respondents. To ensure the high validity of these data transcriptions, multiple references have been made to

the recording material used during the interview session.

Identifying a thematic framework - According to [24], the theme framework developed from the qualitative raw data involved ‘‘a logical and intuitive thought process... and then making appropriate judgments about the underlying meaning, importance and relationship with the issues highlighted and the relationship between ideas and other ideas wisely’. A detailed observation of qualitative raw data is done to form themes and identify logical relationships holistically towards describing a phenomenon observed. It is a search process to ensure that all the created questions are answered perfectly by the respondents of this study. The framework that has been developed in this study is illustrated in FIGURE 1. The main interview questions are related to the implementation procedures of construction works influenced by certain factors. Therefore, this thematic framework involves the expansion of these two questions. The majority of study respondents are more inclined to delegate the factors that affect the availability of building materials at the construction site to three (3) main groups, namely: (1) Contractor Organizations; (2) Supplier Organizations; and (3) Outside and Environment The framework that includes these three (3) main groups was created based on the feedback from the study respondents regarding the factors that affect the availability of building materials at the construction site. In addition, two (2) dimensions of the availability of building materials at the construction site have been successfully identified, namely: (1) Available; and (2) Not Available.

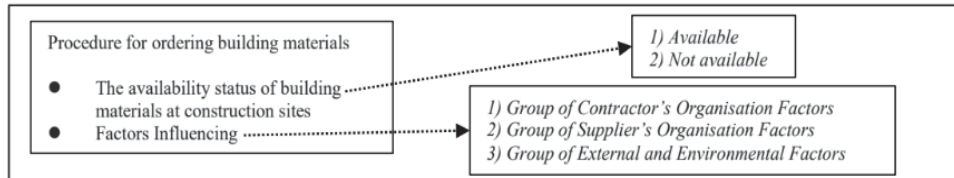


FIGURE 1. Study-themed framework

Indexing - The thematic framework that has been identified through the process of preparing interview transcripts and then through the process of interpretation using numbered codes with the help of NVivo 2.0 qualitative analysis software. Key indices from the thematic framework were elaborated and supported by brief explanatory notes as shown in FIGURE 2. Coding of the indices was done using relevant key statements. It was done by the research respondents during the interview session. Each major theme identified is associated with an explanatory statement that illuminates and justifies the formation of a thematic framework. This explanatory statement is collected from several similar statements made by the respondents based on the same basic theme.

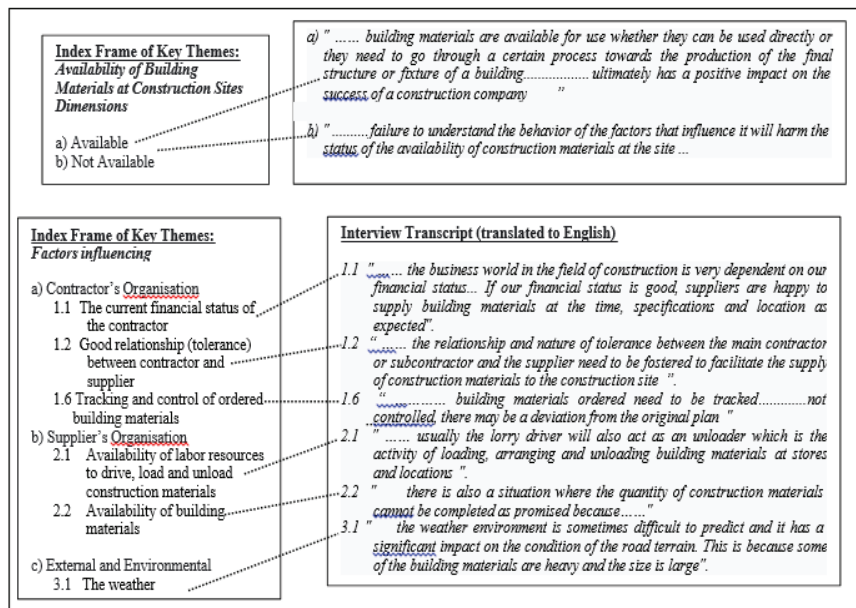


FIGURE 2: Index coding from the interview transcriptions

Charting - At this stage, a theme-based data visualization process is identified. This was done through the process of citing similar themes generated from the transcription of the interviews [24]. Data was displayed through the use of charts based on two main approaches, namely (a) thematic framework, and (b) research determination. This main element has a common theme which then crosses all the respondents of the study or a group of respondents across all related themes [24]. TABLE 1 lists an example of this datavisualization process, where two respondents are correlated with each other and both themes have been successfully identified. A macro and comprehensive view or analysis of the feedback on each theme from the relevant respondents can be done perfectly. However, there are situations where feedback on each theme developed is not communicated by the study respondents. The existence of a theme can still be accepted if the statement is supported by the majority of the study respondents.

TABLE 1: Examples of themes from the index

Respondent	Theme 1	Theme 2	Theme 3
1	<i>Contractor's Organisation</i> The availability of building materials on the construction site depends a lot on the quality of the planning action plan and good work scheduling	<i>Supplier's Organisation</i> The influence of the availability of sufficient building materials is important towards ensuring the adequacy of their availability at the construction site.	<i>External and Environmental</i> Government directives play an important role for ensuring the availability of construction materials at construction sites. This is because the work environment is now becoming increasingly uncertain.
12	The nature of tolerance or mutual trust between subcontractors/main contractors and suppliers is very important to be emphasized for availability of building materials on site.	Delivery of construction materials in crowded and narrow locations is difficult to ensure the availability of construction materials at the construction site.	The hilly terrain of the road to the location has a significant impact on the availability of heavy construction materials at the construction site.

Mapping and interpretation - Qualitative data analysis is driven by 6 main steps including a) concept identification; b) mapping range and nature of phenomena; c) topological production; d) unity search; e) production of information; and f) related strategy development [24]. The analysis of this study is done on the questions that have been formed in the early stages of this study. Mapping analysis is based on data themes that have been collected before the evidence structure is produced. The data analysis of this study has revealed the main dimensions of the availability of building materials at the construction site as shown in FIGURE 3. The data that has been collected has revealed the factors that affect the availability of building materials at the construction site. These factors need to be considered in such a project environment to ensure the successful supply of construction materials at the construction site.

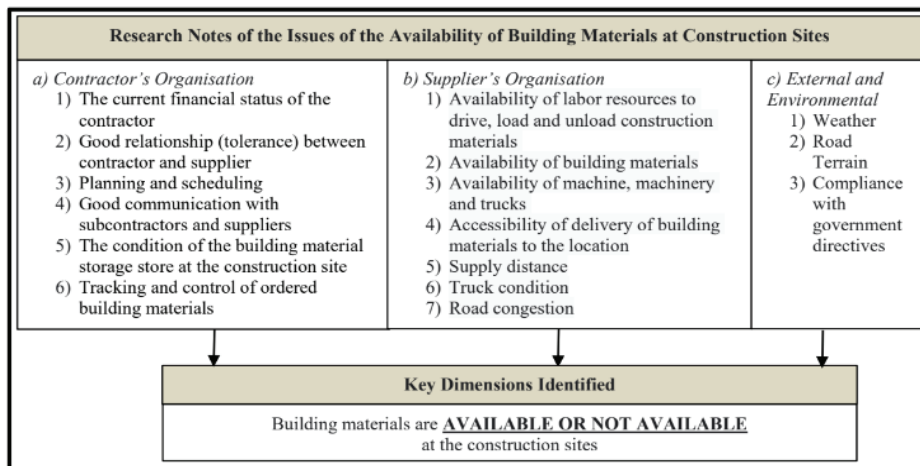


FIGURE 3: A framework for the availability of materials at construction sites

FINDINGS AND DISCUSSIONS

Six (6) critical success factors have been successfully revealed in the analysis based on the high responses of the respondents of this study. The high response from the respondents gives the sense that a certain variable is often emphasized by the respondents of the study. It is a critical success factor in the implementation of procedures at the construction site. The critical success factors of the availability of materials at the construction site are as stated below:-

Good relationship (tolerance) between contractor and supplier

A good relationship until there is tolerance between the two parties, namely the contractor and the supplier, is also listed as the critical success factor of the availability of building materials at the construction site. This good relationship can be achieved if both parties, the contractor and the supplier, trust and believe each other in carrying out their business affairs. A relationship of mutual trust and confidence can be fostered between these two parties. When there is a good relationship between them, the implementation of the supply of building materials at the construction site becomes easier and more effective. As an implication of the good relationship between these two parties, an attitude of tolerance was born in the hearts of contractors and suppliers involved. The attitude born between these two parties will make the supply of building materials easier to implement. This attitude of tolerance is important to embody between these two parties to face the increasingly complex and uncontrollable project implementation environment. The closer the relationship is to the point of tolerance between these two parties, the clearer the availability of building materials at the construction site can be realized in the real environment.

Planning and scheduling work

The work planning and scheduling to be prepared by the contractor is also listed as a critical success factor in the availability of building materials at the construction site. At the initial stage, the management should determine the requirements for effective and perfect building materials to be used on the construction site. Any failure in providing good and effective work planning and scheduling will cause the building materials to be used at a certain time, quality and quantity to be unable to be supplied by the suppliers involved. The contractor needs to list and order building materials according to the priority and sequence of implementation of a construction project. With the order list based on this work planning and scheduling action plan, the supplier can provide all the building materials at the construction site perfectly. The building materials order form becomes effective when reference is made to the planning action plan and work schedule. A holistic work planning and scheduling action plan will guide all movement of building materials more perfectly on the construction site.

Good communication among main contractors, subcontractors and suppliers

The relationship that exists between one party and another party in carrying out activities related to construction is communication. Communication is a form of signal or information sent from the sender to the receiver through a certain medium. Good and effective communication occurs if the recipient receives complete information from the informant; the time factor is also involved for this communication. Therefore, this factor of good and effective communication needs to exist between the main contractor and the subcontractors and suppliers involved. It is to ensure the availability of building materials at the construction site is realized in the real environment. Any failure of a party to convey that information to another party will have a significant impact on the availability of building materials at the construction site. Therefore, all parties should join hands to ensure that this effectiveness is fully achieved in the construction project. Next, have a significant impact on the entire implementation of a construction project.

Availability of building materials in the suppliers' storage

This critical success factor of availability is very sensitive to the current status of building materials in the supplier's storage or control. These building materials must be ensured to be sufficient in terms of quantity and quality towards the effectiveness of their delivery at the construction site. If there is a current situation where it is not in storage and control but the party is willing to provide it; therefore, it will invite the risk of the availability of building

materials at the construction site to the contractor. The contractor needs to make sure that the supplier can supply the building materials. This capability refers to whether it exists in the current storage or there is clear evidence of the existence of control of the building materials by the supplier involved.

Availability of machine, machinery and trucks

Building materials are related to a large quantity, heavy and large size. It requires the help of machines, machinery and trucks to move it from the storage location to the construction site. The machines, machinery and trucks used by the supplier are obtained through rental activities or own ownership. This situation may cause damage or failure to the machines, machinery and trucks; preventing to operate perfectly in the activities of ordering, transporting and unloading building materials in a construction project. The high dependence on the status of the presence and perfection of these machines, machinery and trucks causes this factor to be considered critically towards success in fulfilling the status of availability of building materials at this construction site. This situation exists because although the building materials are in the storage or control of the supplier, the status of the machines, machinery and trucks is also important to emphasize. Any damage or failure of the assisted operation of these machines, machinery and trucks will harm the level of availability of building materials at the construction site.

In conclusion, the tendency of critical success factors to meet the status of availability of building materials at the construction site is happening in the main contractor organization including subcontractors and suppliers. The contractor needs to be stable in the context of financial status if they have just made order and supply arrangements with certain suppliers. At the same time, the contractor needs to increase the intimacy of the relationship with the suppliers involved so that an attitude of tolerance is fostered between them. The closeness between them is important for creating a feeling of mutual need, respect, and help until perfection in the supply of building materials at the construction site is triggered. At the same time, the contractor needs to focus on producing a good and realistic planning and scheduling action plan. It is important to translate this action plan into a more organized and systematic order list of building materials needed on the construction site. Good and effective communication between the main contractor and subcontractors and suppliers should always be implemented. This is because the sufficiency of information conveyed from one party to the other within the time frame involved will have a significant impact on the successful supply of building materials at the construction site. The supplier also plays an important role in ensuring that the availability of building materials can be realized at the construction site. These building materials must always exist in the storage or control of the supplier. This is because any failure to ensure this environment exists will harm the availability status of building materials at the construction site. In addition, the supplier also needs to ensure that all machines, machinery or lorries that are rented or owned are always in perfect condition. It is important to be given serious attention by the supplier to ensure the effectiveness of the activities of transporting and unloading the building materials involved. Next, it will indirectly affect the status of the availability of building materials at the construction site. The main contractors, sub-contractors and suppliers need to work hand in hand to ensure the availability status of building materials can be realized at the construction site. Relationships and communion are good until the feeling of need-need, help-help and respect need to be nurtured from time to time towards the effectiveness of unloading and placing building materials on the construction site. Contractors and suppliers must ensure that all information and production resources involved are handled and maintained perfectly. This situation is necessary because all the information and production resources involved are always available to be used for that purpose. Therefore, these six factors are critical to be considered to ensure the completeness of the supply of building materials can be realized at the construction site.

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