



Research paper

How do contractors select material suppliers for construction projects? Evidence from Vietnam

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Abstract: Materials play an important role in determining the quality and cost of a building, especially in the context of Vietnam's rapid urbanization today. This study aims to analyze the status quo for supplier selection for construction projects in a developing country, Vietnam. Questionnaires are designed to conduct a survey among several contractors to assess the current situation of how Vietnamese construction enterprises select their material suppliers. Senior managers, project managers, site commanders, site engineers, foreman, office staff of contractors were interviewed. Based on result analysis of 117 valid responses, the most important criteria to consider when selecting material suppliers have been identified, with the most influential ones being price, delivery time, and material quality. However, the supply of materials still reveals some constraints that must be overcome. Vietnamese construction firms should pay more attention to supplier selection to optimize material delivery efficiency. This research contributes to the understanding of the status quo for supplier selection for construction projects in a developing country. This means contractors can adopt suitable measures to select material suppliers for construction projects.

Keywords: material supplier, contractor, selection, construction project

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1. Introduction

The construction industry is both an important part of the global economy and a diverse and sometimes underperforming market [1]. High fragmentation, low productivity, cost and time overruns, and disputes characterize this situation. Project schedules are often missed, budgets are exceeded, and consistency is compromised, resulting in claims and counterclaims issues [1, 2]. The principle of supply chain management is increasingly being extended to a number of industrial sectors in order to increase business efficiency, such as quicker response to a variety of consumer demands, lower costs, and higher quality [3]. Supply chain management principles are widely used in construction to direct project managers in strategic planning to achieve relationships with suppliers and improve operational construction performance. Generally, the cost of a construction work consists of 60–70% of material costs, labor cost accounts for 10–20%, and the remaining 10–20% refers to machinery costs [4–6]. In terms of contribution of materials to the construction cost, steel accounts for the largest share of about 60–70%, which is far higher than the share of cement, the second-largest distributor with only 10–15% [7]. It has been shown that the construction material industry in Vietnam has made great progress. Thanks to the right orientation, businesses have focused on investing in modern technology, restructuring product structure towards increasing the quality of products and replacing importation with exportation. Many building material products have been well-established brands and gained a foothold in either domestic or international markets, such as Viglacera, Fico and Vicem, etc. Particularly, Vietnamese construction material products have been exported to more than 100 countries in the world [7]. In fact, the main types of construction materials have satisfied the consumption needs of society, meeting the domestic construction requirements. At the same time, several materials have joined the oversea markets (i.e., cement, tiles, construction glass, paving stone, and lime).

The selection of material suppliers is critical in the contractors' production activities, as it ensures that products are available in sufficient quantities and of sufficient quality to fulfill the requirements. Selecting and managing appropriate suppliers is essential for contractors to achieve the desired quality on time and at a fair cost. Additionally, manufacturers assist construction firms in strengthening their role in an increasingly competitive industry. Despite the fact that the construction literature focuses on the selection of suppliers and subcontractors by contractors, in the Vietnamese context, no study has looked at how construction projects impact contractors' procurement processes, including their supplier selection methods. Therefore, this study is carried out to analyse the status quo for supplier selection for construction projects in a developing country, Vietnam and to examine how contractors' potential for learning from suppliers influences supplier selection methods in construction projects. Questionnaires are designed to conduct a survey among several contractors to assess the current situation of how Vietnamese construction enterprises select their material suppliers. To achieve this, this study will address the following study questions:

Question 1: How the status quo for supplier selection for construction projects in Vietnam?

Question 2: How does the contractor's understanding of a supplier's knowledge mastery influence supplier selection?

The findings of this study are expected to be used to fill a void in the literature on contractor-supplier selection in construction projects, as well as for construction firms considering getting involved in projects. The first part of this research was to do a review of the literature on the material supply chain in construction projects. The research methods, data collection, and data analysis are then discussed, followed by a conclusion last.

2. Literature reviews

In many construction markets, because of their high debt capital structure and the essence of the material import market, construction material suppliers are typically exposed to financial risks. There is a need for a method that can predict whether a commodity supplier can use derivatives to hedge financial risks depending on its financial situation [8]. Managing the supply of products has long been regarded as critical because it aids companies in increasing revenue and lowering costs. This is the most important strategic factor and a source of concern for businesses in general and construction firms in particular. Hence, research on construction material suppliers has been attracted many researchers worldwide.

A knowledge-sharing framework for related construction material suppliers' activities is defined, with the aim of minimizing their mutual risks through the use of derivatives [9]. J.-H. Chen concluded that ten financial variables have been shown to be viable candidates for financial risk hedging [8, 9]. From the standpoint of derivatives and the proposed Support Vector Machine prediction model, construction material suppliers tend to be able to use this model. The findings of [10] offered useful insight into the crucial success factors of Western Australian material suppliers' customer relationship management (CRM) technical initiatives. This can be used by material suppliers and other companies in the building and engineering industries that are considering implementing a CRM strategy to gain a deeper understanding of CRM applications. D. Burt (2009) defined the role of material supply management as: (1) Creativity – creating new design ideas for products through research process and development; (2) Finance – management of material supply including capital management, financial planning and financial control of the enterprises; (3) Human resources – governance of labor resources and relationships with employees; (4) Materials supply – managing the procurement of necessary materials, services and equipment; (5) Production – managing the manufacture of economically valuable products and services from purchased materials; and (6) Distributing – managing marketing and sale of products and services [11]. Construction companies may benefit from supplier relationship management to gain a competitive advantage. The supplier relationship management (SRM) is specified, and an assessment criteria framework is established based on the types of supplier relationships, which are categorized according to the materials. Hence, the BP model is used to assess the building material suppliers was proposed by [12]. D. Waters (2011) found supply chain management is a challenging task because it poses a lot of risks, either small ones leading to delays or terrible risks disrupting the entire supply chain [13]. Therefore, understanding and controlling the entire process that makes up the supply chain is an indispensable requirement to minimize risks. M. Christopher and H. Peck (2004) and

M. Christopher and H. Peck (2006) emphasized that the flexibility of material supply is highly dependent on the flexibility of the supply chain [14, 15]. According to R. Rajesh and V. Ravi (2015), resilient suppliers are defined as being capable of supplying quality products at market prices and have sufficient flexibility to respond to fluctuations in market demand for a fleeting time without adversely affecting the safety and business environment [16]. The studies of [17–19] also shown that the authors agree with the view that quality, cost, and flexibility are essential evaluation factors in material supplier selection.

Material suppliers are crucial to the efficient completion of building projects. The choice of the right supplier is critical to the project's progress. There are several approaches for evaluating and selecting the best-fit suppliers. Hence, a total of 20 criteria for selecting green suppliers for construction projects in the UAE were identified and grouped into four categories: technical and commercial bid, company characteristics, environmental and socioeconomic [20]. A. Asaad (2021), F. Schramm (2012) and A. Azimifard et al. (2018) proposed a multi-criteria decision model to select material suppliers in construction [21–23]. P. Pitchipoo et al. (2013) argued that the evaluation is mainly aimed at reducing the cost of raw materials and establish a close, long-term relationship with the material suppliers [24]. Two prominent issues that need to be considered when selecting suppliers include the factors used as criteria for assessment and how to assess them. H. Kopfer et al. (2005) referred to the assessment of material suppliers as a prolonged process with multi-levels and suitability to introduce new products [25]. The first step is a preliminary evaluation to select a certain number of suitable material suppliers. According to J.I. Moliné and A.M. Coves (2014) [26], whereas the categorical and weighted-point systems evaluate the level of material supplier's satisfaction based on many criteria, the cost-based system only depends on the total cost. In addition, evaluation methods based on checklists and knock-out screening criteria are used regularly. V.R. Kannan and K.C. Tan (2002) [27] pointed out the significance of supplier selection, stating that qualitative criteria to evaluate material suppliers for the US manufacturing companies (i.e., strategic commitment, readiness and capability of suppliers in sharing information) have greater impact on supplier performance than quantitative criteria, but the former are currently considered less important. While selecting suppliers, the cost of the material is not the only benchmark. However, there should be some appropriate principles in the supplier selection process on which project managers can rely on to determine the most suitable supplier for the task [28]. W.Benton and L.F. McHenry (2010) [29] explained that the most critical criteria for selecting suppliers in the construction industry are material quality, delivery reliability and price although their roles may vary depending on the characteristics of each company. S.K. Paul et al. (2011) [30] identified seven key factors in the evaluation of supplier selection through various multi-criteria decision-making techniques, including Quality, delivery, production capacity, service, technical capacity, business structure, price. D.S. Verma and A. Pateriya (2013) [31] categorized the criteria for evaluating supplier selection into 6 groups: cost/competitive price, product quality, delivery performance, and competency of suppliers, ability to meet customer needs, strategies, and commitments. S. Patil and M.P. Adavi (2012) [32] explained that selecting suppliers in a construction supply chain serves as a prerequisite for integrating components inside that chain. Every

enterprise wants to choose a reliable supplier who is able to maintain excellent product quality, provide stable materials throughout the life of the project and open a long-term relationship with partners. The supplier evaluation criteria from previous studies have been reused and improved to suit the context of integration and globalization. The study of [33] surveyed 273 purchasing managers and ranked 23 criteria basing on their importance in the assessment and selection of suppliers. C.A. Weber et al. (1991) [34] reexamined these evaluation criteria and the importance of each criterion has changed compared to Dickson's research. Some case studies used only eight main criteria [35] or five criteria when selecting suppliers [36].

In the context of globalization, several new criteria have been complemented to select appropriate contractors such as: reliability, flexibility, environmental and social responsibility, JIT responsiveness. S. Thiruchelvam and J. Tookey (2011) [37] developed 36 criteria and referred 23 criteria from the study of [33]. In general, supplier evaluation criteria can be classified into two categories: qualitative and quantitative. The choice of criteria still depends on each company's specific situation but several basic criteria such as price, quality and delivery deadlines are commonly used. Contractors used a variety of approaches to determine suppliers' expertise, including reviewing reference projects, suppliers' records, meeting tender requirements, environmental and purchasing personnel reviews, negotiations, interviews, and comparing suppliers' offers [38].

3. Research methodology

In Vietnam, the contractor who is the supplier at each site is almost entirely responsible for selecting construction material suppliers. To choose suppliers, businesses depend primarily on expertise, familiar relationships, costs, or discount rates which can have an impact on the project's quality and schedule. To understand the status quo of the selection of construction material suppliers, a survey of contractors was conducted by using a designed questionnaire. The questionnaire consists of two parts. Part I includes the information of respondents and the project's characteristics. Part II includes the lists of criteria for selecting material suppliers of contractors. This part contains eight multiple-choice questions and assessment scales designed to gather data on the current state of contractor material supplier selection.

Before the distribution questionnaire, a pilot survey was carried out with four experts who have a wide range of experience in this domain. They are required to assess the content of the questionnaire, readability, linguistics. After receiving their feedback, the questionnaire was slightly changed. Then, the final questionnaire was distributed to contractors (i.e. senior managers, project managers, site commanders, site engineers, foreman, office staff). Based on their experience, they assess the criteria for selecting material suppliers. In the problems included in the questionnaire, there are eight independent variables, so the minimum number of samples needed is: $n \geq 50 + 8 \times 8 = 114$ [39]. A total of 150 questionnaires were distributed. There are 119 responses, of which, 117 valid responses, representing 78% effective rate.

Part I provides basic information about the participants, which is essential to help the authors ensure that the respondents are from the appropriate field. Fig. 1 shows the working positions of the surveyed participants. There are 44 site engineers (37.6%), 40 office workers (34.2%), 17 construction foremen (14.5%), 13 project managers or deputy managers (11.1%), and the remainder serve as senior managers among the 117 respondents. Despite the researchers' efforts to reach out to a diverse group of respondents, the majority of the responses came from site engineers and office staff.

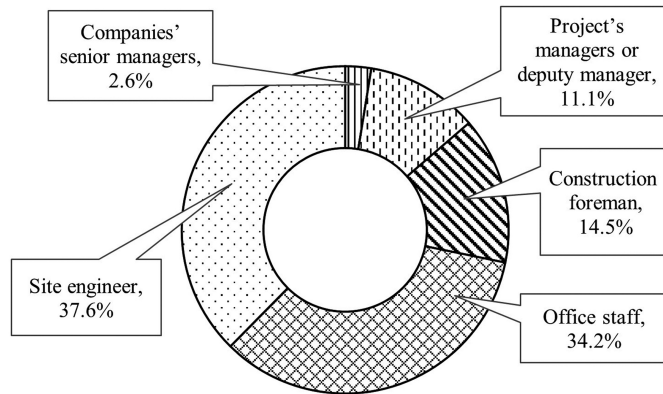


Fig. 1. Working positions of surveyed participants

In terms of work experience, 66 people have worked for 5–10 years, accounting for the highest proportion of 56.4 percent, as shown in Fig. 2, only 1.7 percent of respondents have worked at their current job for more than 20 years. Those with less than 5 years of experience made up 24.8 percent, while those of 11–20 years made up 17.1 percent. Table 1 depicts

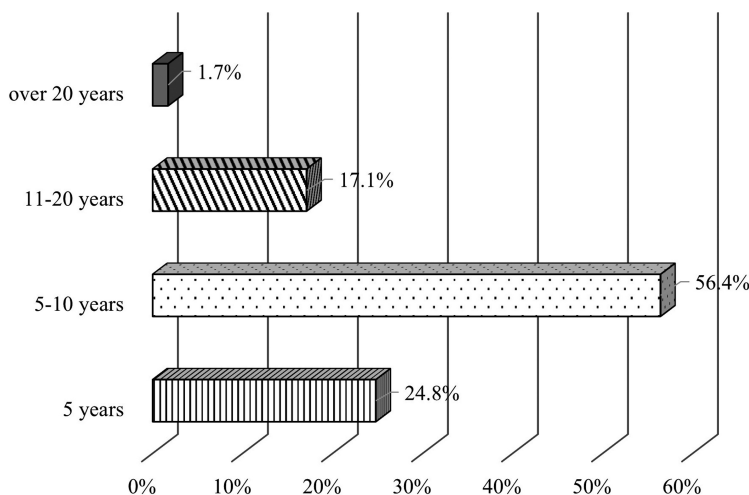


Fig. 2. Respondents' working experience

the results concerning the scale of businesses. As can be seen, the majority of respondents work for small and medium businesses, with large and super small businesses accounting for a small percentage of the total.

Table 1. Information of enterprise sizes

Enterprise size	Number of employees	Number of respondents	Percentage (%)
Big	> 300	9	7.7%
Medium	200–300	88	75.2%
Small	10–200	18	15.4%
Super small	< 10	2	1.7%
Total		117	100%

In terms of project size, as provided in Fig. 3, there are eight people involved in projects worth more than VND 200 billion (6.8 percent). The percentage of projects worth VND 100–200 billion was 17.1%. Although the majority of the participants (66.7%) worked on projects worth VND 50–100 billion, 9.4% worked on projects worth less than VND 50 billion.

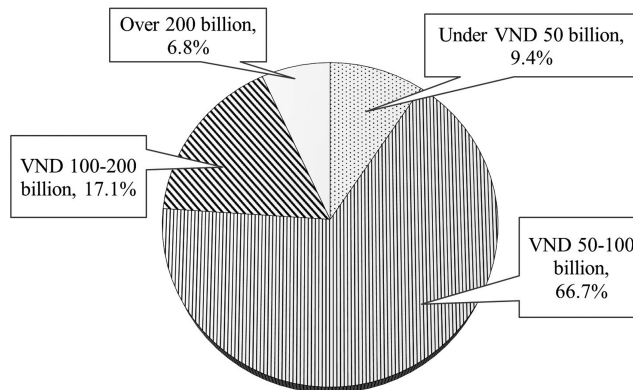


Fig. 3. Information of project scales

4. Data analysis and result

As provided in Fig. 4, the majority of contractors chose their material suppliers based on previous relationships (50.4 percent), followed by price quotations from suppliers (40.2 percent). Few respondents (9.4 percent) stated that the company used a supplier analysis method. The reasons for those two most popular methods of selecting suppliers could be personal interest, trust built from the previous supplier, saving time for searching for new suppliers, or a company profit goal. Fig. 5 shows that the majority of businesses (73%)

have material supplier selection departments, while only 27% lack a functional office. This demonstrates that companies are concerned about the selection of material suppliers, but have not invested sufficient time and effort in developing methods to select suppliers scientifically and appropriately for each type of material.

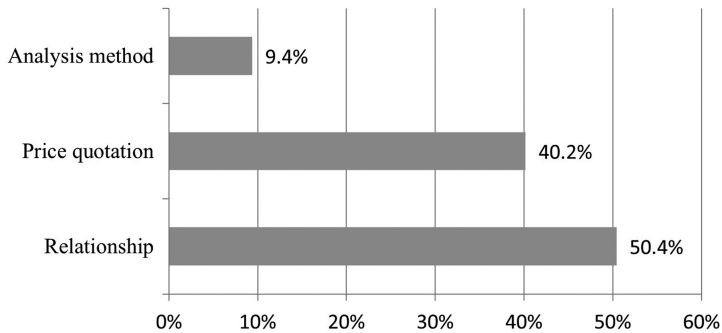


Fig. 4. Factors influencing supplier selection

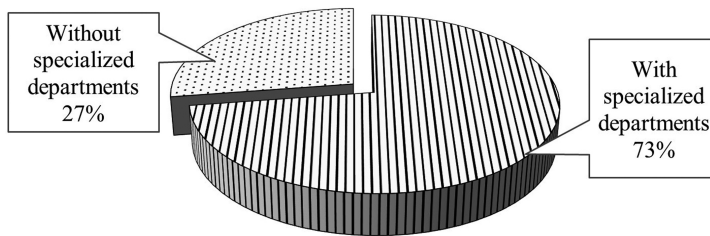


Fig. 5. Enterprises with/without specialized departments

Concerning the importance of supplier selection criteria, the researchers proposed eight criteria in the questionnaire on a Likert scale ranging from (1) absolutely unimportant to (5) very important. The data is analyzed to determine the average value (Mean) for each of the five criteria, as shown in Table 2 and Fig. 6. The results indicated that all of the survey criteria are regarded as important by respondents (Mean > 3). The three most important ones are price (4.4), delivery time (4.2), and quality (4.1). This fact aligns with the mindset of businesses that prioritize profits, delivery time (to ensure construction progress), and high-quality materials. The other five criteria are also thought to be important.

Fig. 7 shows that the majority of respondents (40.2 percent) explained that providing materials on-site is acceptable, while 38.5 percent disagree. The remainder is pleased with the construction site's material supply. With a large number of site engineers participating in the survey, assessing the limitations appears to be more practical. The most serious issues are poor material quality, a high percentage of damaged and faulty materials (42.7 percent), being late (25.6 percent), and other issues (Fig. 8).

The selection of material suppliers for businesses is evaluated using Likert scales ranging from (1) very bad to (5) very good. Table 3 summarizes the survey results, and

Table 2. Evaluating and ranking of supplier selection criteria

No.	Criteria	1	2	3	4	5	Mean
		Respondents / percentage					
1	Price	1/117 (0.9%)	3/117 (2.6%)	5/117 (4.3%)	43/117 (36.8%)	65/117 (55.6%)	4.4
2	Delivery time	0/117 (0.0%)	2/117 (1.7%)	19/117 (16.2%)	47/117 (40.2%)	49/117 (41.9%)	4.2
3	Product quality	1/117 (0.9%)	8/117 (6.8%)	21/117 (17.9%)	35/117 (29.9%)	52/117 (44.4%)	4.1
4	Services	3/117 (2.6%)	18/117 (15.4%)	25/117 (21.4%)	39/117 (33.3%)	32/117 (27.4%)	3.7
5	Product resources	3/117 (2.6%)	20/117 (17.1%)	42/117 (35.9%)	32/117 (27.4%)	20/117 (17.1%)	3.4
6	Supplier capability	7/117 (6.0%)	22/117 (18.8%)	43/117 (36.8%)	24/117 (20.5%)	21/117 (17.9%)	3.3
7	Rate of damaged products	7/117 (6.0%)	25/117 (21.4%)	32/117 (27.4%)	29/117 (24.8%)	24/117 (20.5%)	3.3
8	Payment policies	14/117 (12.0%)	17/117 (14.5%)	39/117 (33.3%)	28/117 (23.9%)	19/117 (16.2%)	3.2

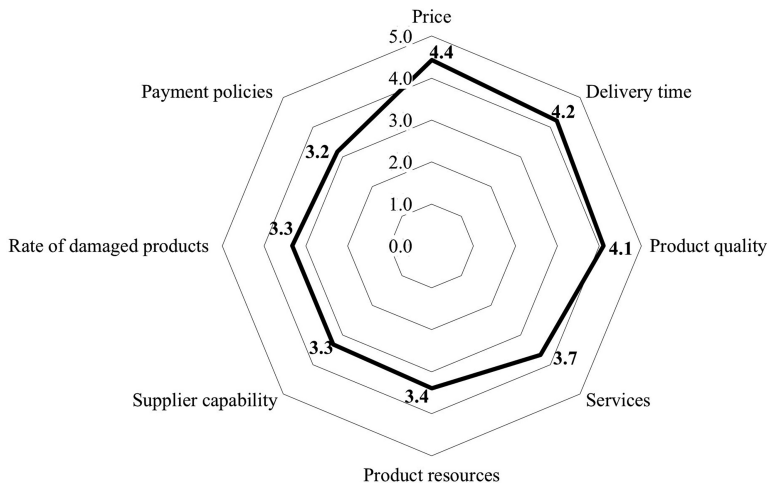


Fig. 6. Assessing the importance of material supplier selection criteria

Fig. 9 depicts the average value (Mean) of each assessment criterion. Accordingly, the majority of respondents questioned objectivity during the supplier selection process, while the other two characteristics were rated as medium.

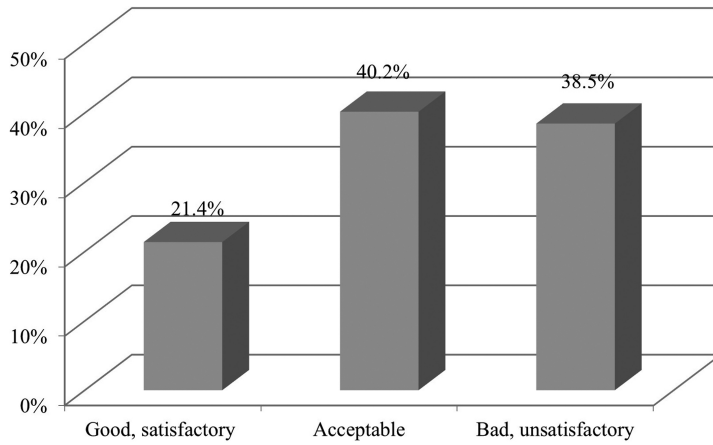


Fig. 7. Assessment of material supply on construction site

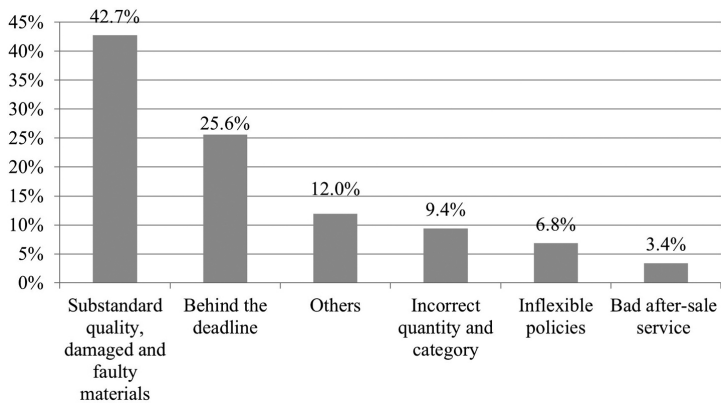


Fig. 8. Materials issues on construction site

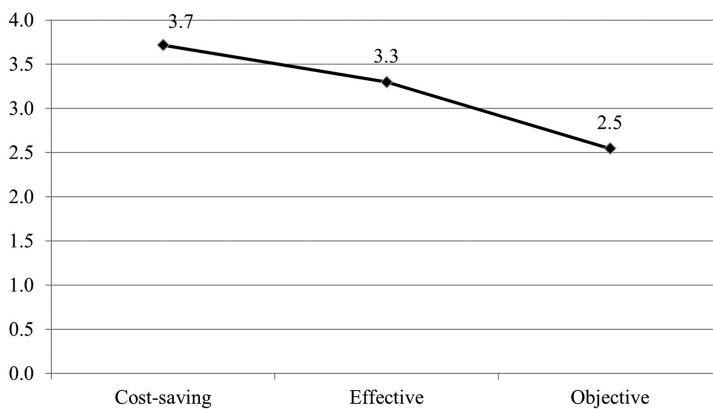


Fig. 9. Evaluation on characteristics of supplier selection

Table 3. Evaluation on characteristics of supplier selection

No.	Characteristics	1	2	3	4	5	Mean
		Respondents/ percentage					
1	Cost saving	3/117 (2.6%)	13/117 (11.1%)	29/117 (24.8%)	41/117 (35.0%)	31/117 (26.5%)	3.7
2	Effective	19/117 (16.2%)	12/117 (10.3%)	24/117 (20.5%)	39/117 (33.3%)	23/117 (19.7%)	3.3
3	Objective	41/117 (35.0%)	19/117 (16.2%)	21/117 (17.9%)	24/117 (20.5%)	12/117 (10.3%)	2.5

As provided in Fig. 10, the majority of respondents stated that their companies maintain long-term relationships with their suppliers (48.7%), whereas, 23.9 percent of them reported partner changes. Some respondents (27.4%) stated that contractors maintained long-term relationships with certain suppliers but switched to other suppliers based on specific conditions. Those who have long-term relationships, are afraid to change, or are satisfied with an existing supplier will maintain that relationship. In contrast, some contractors are constantly on the lookout for new suppliers for new projects. There are businesses that keep a number of strategic suppliers while developing a network of suppliers to find potential ones.

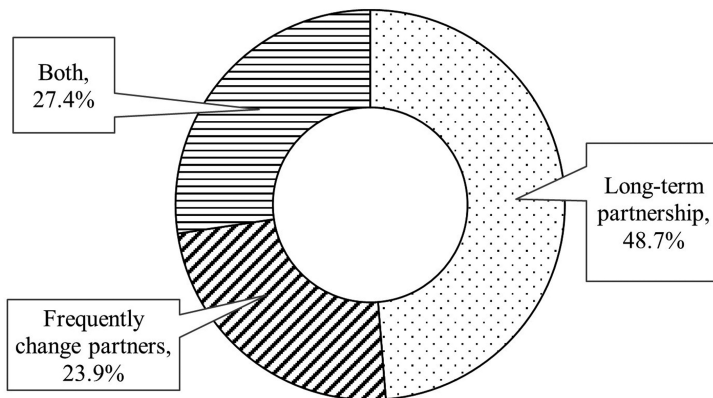


Fig. 10. Relationship between enterprises and their material suppliers

Fig. 11 depicts the role of selecting material suppliers. The majority of survey respondents rated selecting material suppliers as either important (44.4 percent) or very important (44.4 percent) (53 percent). As a result, it can be deduced that construction firms in Vietnam place a high value on the process of selecting material suppliers. However, the implementation has been unsatisfactory, owing to the fact that they still do not have the most effective and appropriate method for selecting suppliers.

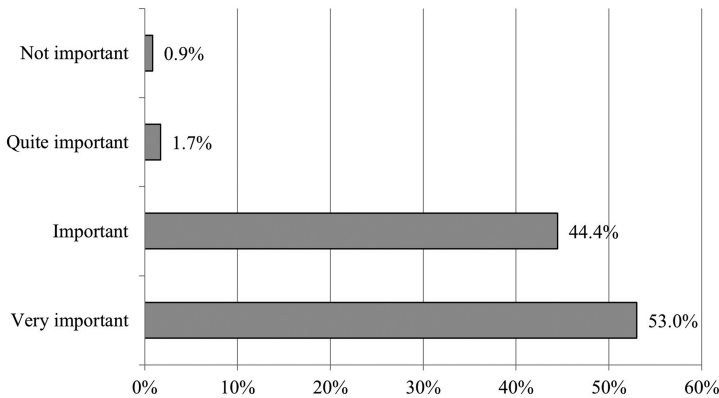


Fig. 11. Importance of supplier selection

According to the analysis results, the general supply of materials of Vietnamese construction enterprises is fairly good, but it has not achieved the best results. The majority of them place a premium on material supply, as evidenced by the fact that they have their own functional departments tasked with purchasing materials. Many construction enterprises are also aware of the role and importance of selecting suppliers and building cooperative relationships with suppliers. Correct perception is the basis to help businesses improve the supply of materials to bring about efficiency. However, there are some issues existing among the selection of materials supplier process such as:

– Regarding supplier selection:

Many contractors do not develop a set of criteria for selecting suppliers for a particular material. They made their decision implicitly and subjectively at the discretion of the material supply function staff. In other cases, there may be some shared criteria, but no scale has been developed. As a result, the specialized staff makes a decision by "judging" the appropriateness of the suppliers based on existing criteria.

The choice of a supplier is based on familiar relationships. Personal interests or price quotes from specific suppliers with specific materials may influence decisions. They choose a supplier based solely on price, ignoring the importance of other factors. As a result of the importance of profits for businesses, price criteria outweigh the others.

The selection process is either unavailable or not strictly followed. Due to time and financial constraints, gathering information about suppliers has not been completed thoroughly. There has been no research to develop a set of criteria and methods for selecting suppliers who are appropriate for each material.

The task of identifying suppliers has received insufficient attention. It is done with little information verification based on the trend of raw material situation and information from traditional suppliers.

Despite the fact that suppliers have been compared in terms of their advantages and disadvantages, these comparative judgments are primarily personal. There is no network of evaluation criteria for determining the significance of each indicator. The strengths and

weaknesses of each supplier have not been evaluated. As a result, selecting suppliers can be subjective, personal, and inaccurate at times.

Companies have almost no solutions to improve suppliers' ability to ensure a consistent supply of materials.

Contractors no longer focus on gathering information about other potential material suppliers in the market after selecting suppliers. They only use their internal information storage system to update information on the implementation of contracts with existing suppliers. This may lead to a situation where existing suppliers need to be replaced.

– On the issue of building cooperative relationships with suppliers:

Many businesses have maintained relationships with their suppliers because they are hesitant to change and do not want to spend time and effort searching for new suppliers; or because they understand the value of long-term cooperation of mutually beneficial parties. There are activities that promote cooperation, such as information sharing, assisting suppliers in overcoming difficulties, collaborating with suppliers to improve material quality, and increasing the efficiency of production and business operation. However, because many contractors have not paid enough attention to maintaining long-term relationships, they frequently switch suppliers, depriving themselves of opportunities to reduce costs from suppliers.

There are several reasons for the above mentioned limitations were identified such as: Because sales departments are under cost pressure, they continue to select partners based on price; Vietnamese construction firms have not been able to Fig. out how to effectively order from suppliers in order to reduce costs; Construction firms lack an optimal mechanism and process for monitoring their relationships with their suppliers; Contractors have not rigorously evaluated the role of a set of criteria and have not invested significantly in developing it for selecting suppliers for each material; There are interest groups that do not prioritize the company's interests and prestige during the selection of material suppliers. Some questions in the questionnaire elicited a wide range of responses, owing to respondents coming from various units or working environments with disparate goals and business strategies. In other cases, they work in the same company but in different positions with different responsibilities and powers, so they approach the problem from a different perspective (i.e. an engineer does not have the same perspective as that of the senior manager).

5. Conclusions

The study provided a relatively comprehensive overview of the current situation in Vietnam in terms of selecting materials suppliers, which has been ineffective. Choosing suppliers based on price and relationship is a risky decision that can result in lower product quality, delays in the construction schedule, or labor safety issues. The findings indicated that Vietnamese construction enterprises should pay close attention to supplier selection by developing an effective selection process, using assessment methods to select suppliers

suitable for each type of material, developing cooperative relationships with strategic suppliers and potential suppliers, and managing supplier networks.

This paper had answered for study questions as:

Question 1: How the status quo for supplier selection for construction projects in Vietnam?

Answer: The survey results show that the current situation of selecting material suppliers for Vietnam's construction sites has not yet achieved optimal efficiency due to many factors such as: there is no set of selection criteria. choosing the right supplier for each specific material, deciding to choose a supplier based on its own relationship and emphasizing the "price" factor, there is no process for selecting an appropriate supplier or implementing the process. The process is not strict leading to reduced product quality, affecting construction progress, problems of labor safety, and so on.

Question 2: How does the contractor's understanding of a supplier's knowledge mastery influence supplier selection?

Answer: The research results also show that the knowledge proficiency of the supplier also affects the supplier selection. With a knowledgeable supplier, the cooperation relationship will take place more smoothly, more effectively and easily achieve the purpose for the mutual benefit of the parties. Research also shows that contractors have paid attention to building relationships with their suppliers. However, it is necessary to pay more attention to specific activities to maintain and develop relationships with suppliers such as sharing information, sharing risks and benefits, and jointly finding solutions to improve efficiency on production and business at the same time, re-evaluate existing suppliers and look for potential alternative suppliers.

This study is limited to assessing the situation of Vietnamese contractors' material supplier selection. Companies should improve the planning, implementation, and control of the supply process in order to improve material supply. As a result, future studies on material supply should be conducted in order to recommendations for improving construction material supply from a logistics standpoint.

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