Vendor Management Model to Achieve Just In Time (JIT) in Material Procurement

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Abstract

This research focuses on optimizing material procurement in EPC (Engineering, Procurement, and Construction) Companies by using Always Better Control (ABC) and Analytical Hierarchy Process (AHP) methods to reduce lead time to achieve Just In Time goals. The main problem faced is the long lead time of material procurement, which harms productivity, operational costs, and customer satisfaction. The ABC method was used to classify materials based on their economic value, dividing them into three categories: A, B, and C. The analysis showed that seven category A items (such as Steel Grid and Power Cable) accounted for about 62.62% of the total project cost, requiring strict inventory control. Meanwhile, the AHP method was used to determine vendor selection criteria by considering four approaches: Single Item Single Vendor (SISV), Single Item Multi Vendor (SIMV), Multi Item Single Vendor (MISV), and Multi Item Multi Vendor (MIMV). Weighting criteria through a questionnaire with 13 respondents resulted in MISV as the highest criterion (43.70%), followed by MIMV (34.30%). The validity test using consistency ratio (CR) resulted in a value of 0.06, indicating the consistency and reliability of the data. The study concluded that combining ABC and AHP methods can help EPC Companies optimize the material procurement process, reduce lead time, and improve operational efficiency. Choosing the proper vendor management model and focusing on critical items can help mitigate the risk of delays and support the smooth production process.

Keywords: *ABC; AHP; EPC; JIT; procurement*

1. Introduction

As major players in the manufacturing industry, EPC companies face significant challenges in optimizing their material procurement processes. Procurement is essential to fulfill raw material supplies, especially for companies that operate every day [1]. *Procurement* is a cost center. That 60-70% of the company's budget is used for purchasing through outsourcing. Procurement aims to achieve the proper goods (quality & quantity), price, time, and place. Procurement lead time is calculated from when the material is ordered until the material is received [2]. Lead Time is vital for the smooth operation of the company. Prolonged lead time in material procurement has broad implications for the company's overall operations; this causes delays in the production process, increases inventory storage costs, and reduces the company's flexibility in responding to changes in market demand [3]. As a result, EPC Companies experience a decrease in competitiveness and risk losing market share to more efficient competitors in their supply chain management [4]. Contract Management requires timeliness (Just in Time), primarily due to external material sourcing (outsourcing). Optimal procurement management can minimize risk and act as a profit center [5].

This company's main problem is long lead times, negatively impacting productivity, operational costs, and customer satisfaction. As a result, EPC Companies experience a decline in competitiveness and face the risk of losing market share to more efficient competitors in their supply chain management [6]. Contract Management requires timeliness, mainly due to external material sourcing (outsourcing). Optimal procurement management can minimize risk and act as a profit center [7].

With this situation, EPC Companies realize the need to implement a new approach in their material procurement system. Two methods that emerge as potential solutions are Always Better Control (ABC) and Analytical Hierarchy Process (AHP). The ABC method, which has proven effective in inventory management, offers a systematic approach to classifying materials based on their value and frequency of use [8]- [9]. This approach allows companies to allocate more resources and attention to materials that significantly impact the company's operations and finances. On the other hand, the AHP provides a robust framework for decision-making in a multi-criteria manner. In material procurement, AHP can evaluate and select suppliers, determine procurement priorities, and optimize purchasing strategies [10]. This method allows EPC Companies to consider multiple factors in the procurement decision-making process, such as price, quality, supplier reliability, and delivery time.

This study aims to explore and analyze the implementation of ABC and AHP methods in the context of material procurement in EPC Companies, primarily focusing on lead time reduction. Integrating these two methods offers excellent potential to optimize the material procurement process in EPC Companies. By combining the material classification power of ABC and the multi-criteria decision-making capabilities of AHP, companies can develop more efficient and effective procurement strategies. This integrated approach is expected to significantly reduce procurement lead time, improving the company's responsiveness to market demand, reducing inventory costs, and increasing customer satisfaction.

By combining these two methods, companies can focus on the most critical materials based on ABC analysis and make more accurate decisions in supplier selection and procurement strategies using AHP analysis for a more efficient procurement process, minimize delays, and ultimately improve the overall performance of the EPC project.

2. Method

The Always Better Control (ABC) method is used in inventory control activities to control small quantities of goods with high utility value [11]. This method divides inventory into three categories (A, B, and C) based on their value and frequency of use. Category A consists of items with high value but small quantities, and category B is for medium value and quantity items. In contrast, category C includes items with low value but large quantities. By implementing ABC, companies can focus their attention and resources on managing the most critical and high-value items [12]- [13].

The relationship between ABC and lead time lies in how they affect inventory management strategies. For high-value A-type items, companies tend to apply tighter controls and more intensive monitoring of lead times by negotiating with suppliers to shorten lead times or maintaining more extensive safety stocks to anticipate demand fluctuations [14]. Conversely, companies may tolerate longer lead times for C-type items or implement simpler ordering systems.

AHP is an abstraction of a system's structure used to study the functional relationship between components and their effects on the entire system [15]- [16]. The system is designed to rationally collect individual perceptions closely related to a particular problem topic through a procedure so that various preferences emerge among several alternatives [17]. The AHP process begins by defining the problem and determining the decision hierarchy. The next step is to compare elements within each hierarchy level pairwise. These comparisons are made using a numerical scale, usually from 1 to 9, where 1 indicates equal importance, and 9 indicates the importance of one element over another. The results of these comparisons are then organized into a pairwise comparison matrix. Once the pairwise comparison matrix is created, the next step is calculating priority weights for each element through matrix normalization and eigenvalue calculation. AHP also provides a method for checking the consistency of judgments, ensuring that the comparisons made are logical and consistent. Decision-makers may need to revise their decisions if significant inconsistencies are found. The AHP method analysis is designed to create a picture of a problem with no structure and can be measured quantitatively [18].

3. Results and Discussion

3.1. ABC Analysis

The purpose of this classification is to determine the level of importance of each component of the spare part in the production process. The ABC method uses the Pareto principle to categorize spare parts into three groups: Always, Better, and Control. This division is based on the contribution of economic value, where group A includes 20% of the types of spare parts that contribute 80% of the sales value, and group B consists of 30% of the kinds of spare parts with 15% of the sales value. In contrast, group C includes the remaining spare parts with the lowest contribution.

Products in category A include items that significantly contribute to the total project cost. From the data analysis, included in category A are Steel Grid (Grade 25 SA2.5) with a contribution of 29.98%, Power Cable Cu/XLPE/PVC/GSWA/PVC-OS 3C x 4 mm2 with a contribution of 18.12%, and Power Cable Cu/XLPE/PVC/GSWA/PVC-OS 3C x 2.5 mm2 with a contribution of 14.52%. These three products contribute about 62.62% of the total cost, indicating the importance of strict inventory and procurement management for these items.

In Category B, there are products such as Spiral Wound Gaskets, Ball Valves with various specifications, and several types of pipes and fittings. Examples include Spiral Wound Gasket 1" SS316, which contributes 10.87%, and other items that contribute about 20-30% of the total project cost. These items require medium attention in inventory management and moderately impact the overall project cost. Category C includes items with low-cost contributions, such as small fittings, supporting components, and relatively low-priced items. Examples include multiple types of pipe joints (couplings), screws, bolts, and other small components. Although individually small contributions, they collectively provide about 10-15% of the total project cost. Management for this category can be looser but still pay attention to stock availability.

The managerial implications of this ABC analysis are significant for EPC companies. For category A products, it is advisable to implement tight inventory control, aggressive price negotiation with suppliers, consideration of long-term contracts, and continuous monitoring. Category B requires a balanced management approach, while Category C can be managed with a more straightforward control system. By understanding the distribution of these costs, companies can optimize procurement strategies, reduce the risk of stockouts, and effectively allocate management resources. After analysis, the results showed that seven spare parts were in Group A, 16 were in Group B, and 115 were in Group C.

3.2. Determination of Criteria

Defining the right criteria is essential before conducting supplier selection analysis using the Analytical Hierarchy Process (AHP) method. In this case, the four main criteria to be considered are single-item single vendor (SISV), single-item multi-vendor (SIMV), multi-item single vendor (MISV), and multi-item multi-vendor (MIMV).

The SISV criteria emphasize the procurement of single items from a single supplier. This approach can provide benefits such as process efficiency, closer relationships with suppliers, and ease of inventory management. However, dependence on a single supplier can also be risky if a supply disruption exists. The SIMV criteria open up opportunities to procure single items from multiple suppliers to increase bargaining power, facilitate comparison, and reduce the risk of dependency. The MISV criteria allow companies to centralize the procurement of various items from a single supplier. This approach can optimize economies of scale, facilitate negotiation, and improve logistics efficiency. However, the risk of dependence on a single supplier must still be considered. The MIMV criteria provide flexibility in accessing multiple items from multiple suppliers to increase competitiveness but also require more complex coordination and have the potential for higher transaction costs. Companies must balance the benefits and challenges that may arise. Considering these four criteria, EPC companies can conduct a more comprehensive AHP analysis and produce optimal supplier selection decisions according to their business needs.

3.3. Decision Hierarchy Construction

Figure 1. Decision of Hierarchy

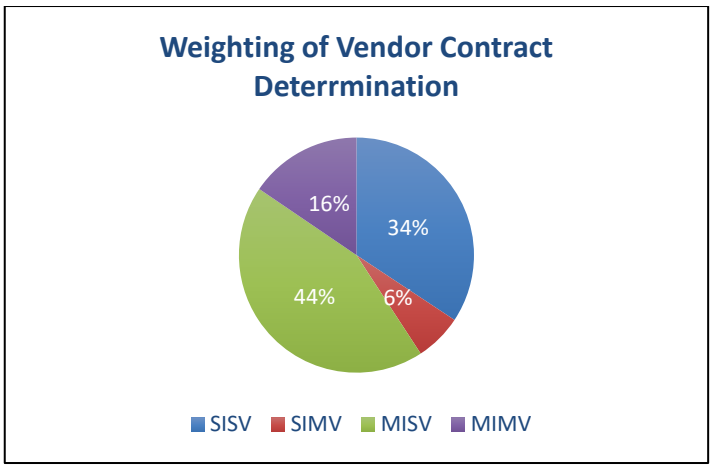

Figure 2. Results of Weighting of Vendor Contract Form Determination Criteria

Creating a decision hierarchy is an essential step in the decision-making process. The hierarchy helps organize and prioritize the factors that influence the decision. The purpose of creating a hierarchy is to facilitate understanding of the problem flow. The decision hierarchy is structured starting from level 0 regarding the goal and ending at level 1 regarding the criteria used to achieve the goal. The displayed view hierarchy has four criteria: SISV, SIMV, MSIV, and MIMV.

This decision hierarchy helps ensure alignment between the organization's strategic goals and actual actions at the operational level. Each level of decision is interrelated and influences each other, making the decision-making process more structured and focused. Organizations can make more effective decisions aligned with the overall vision and strategy by understanding this hierarchy.

3.4. Criteria Weighting

The criteria for selecting the vendor contract was weighed using a questionnaire targeting 13 respondents from EPC (Engineering, Procurement, and Construction) companies in Indonesia. After the respondents' opinion data was collected, the questionnaire results were entered one by one from the respondents' answers into the Expert Choice software so that the input to the software was more than one and adjusted to the number of respondents.

The figure shows how the four with the highest weights are MISV, with a weight of 43.70%, and the second position is MIMV, with 34.30%. On the other hand, SIMV and MIMV have lower weights, 15.50%, and 6.50%, respectively, showing that the multi-vendor approach, both for single items and multi-items, is not a top priority in determining the vendor management model. The most preferred options are the multi-item with single vendor (MISV) and multi-item with multi-vendor (MIMV) approaches. Considerations related to efficiency, consistency, and control over vendors are the main reasons for prioritizing the MISV and MIMV criteria. Understanding the weights of these criteria can help organizations make more strategic vendor contract decisions aligned with their business objectives.

3.5. Determining the Form of Vendor Contract

Philosophically, Just in Time includes four main principles: eliminating activities that do not provide added value, continuous quality improvement, continuous improvement, and activity simplification. The main principles contained in Just in Time can be implemented in the tender process, which is interpreted as a selection method carried out by the company to obtain vendors as providers of goods [2]. In the context of achieving just in time, vendor contract selection strategy is a key element that determines the effectiveness and efficiency of a company's supply chain.

Table 1. AHP Processing Results

	Weight	Order
SISV	0.343	II
SIMV	0.065	IV
MISC	0.437	I
MIMV	0.155	III

With a SISV (Single Item, Single Vendor) weight value of 0.343, the company can consider using SISV contracts for critical items with significant consequences if there is a delay. SISV contracts can focus and entrust a single vendor with ensuring timely delivery of goods, which is a fundamental principle in the just-in-time philosophy. Companies can consider SIMV (single-item multi-vendor) contracts with a weight value 0.065 for less critical items. By using multiple vendors for one item, companies can have alternative sources of supply and increase procurement flexibility.

Meanwhile, in procuring goods with a more significant number of items, the MISV (Multi-Item Single Vendor) contract with a weight of 0.437 can be a suitable choice to support the just-in-time strategy. The company can improve coordination, communication, and monitoring with a single vendor handling all items. In cases where many items need to be procured, a MIMV (Multi-Item Multi-Vendor) contract with a weight of 0.155 can be considered. Despite its higher complexity, the MIMV contract can provide flexibility in selecting the best vendor for each item.

In addition to considering the weight value, companies also need to pay attention to critical factors that can significantly impact operations, such as potential penalties or fines due to delays, additional costs, and management reprimands.

4. Conclusion

Based on the analysis of the ABC (Always Better Control) method in EPC companies, it can be concluded that the classification of materials is carried out based on the contribution of economic value, which divides spare parts into three main categories: A, B, and C. Category A, which includes 20% of spare part types, contributes 80% of sales value and consists of critical items such as Steel Grid, Power Cable Cu/XLPE/PVC/GSWA/PVC-OS 3C x 4 mm2, and Power Cable Cu/XLPE/PVC/GSWA/PVC-OS 3C x 2.5 mm2, which cumulatively contribute 62.62% of the total project cost. Category B includes 30% spare part types with 15% of sales value, including Spiral Wound Gaskets and Ball Valves, which require middle management attention. Category C comprises 115 items with low-cost contributions, providing 10-15% of the total project cost. The managerial implication is the application of different inventory controls for each category, with a primary focus on tight management for category A items, a balanced approach for category B, and a simple control system for category C to optimize procurement strategies and resource allocation.

Based on the analysis of the weighting criteria for determining the form of vendor contracts through a questionnaire involving 13 respondents from EPC companies in Indonesia, it was found that the Multi-Item Single Vendor (MISV) approach with a weight of 43.70% and Multi-Item Multi Vendor (MIMV) with a weight of 34.30% were the most preferred choices, indicates that organizations prioritize efficiency, consistency, and control over vendors compared to the Single Item Multi Vendor (SIMV) or Single Item Multi Vendor (MIMV) approaches, which have lower weights. This conclusion provides essential insights into vendor contract decision-making, indicating that the right vendor selection strategy can support the achievement of organizational business goals more effectively.

Based on a comprehensive analysis of vendor contract selection strategies in just in time, supply chain management requires a strategic approach that considers various contract models by considering specific weights and characteristics. The Multi-Item Single Vendor (MISV) contract, with a weight of 0.437, was identified as the most optimal solution, capable of providing the coordination, responsibility, and efficiency needed to minimize the risk of delays. With the complexity of delays that can reach 146 days, the just-in-time concept is not just a technical methodology but a management philosophy that demands perfect synchronization between needs, supply, and time, where the selection of vendor contract strategies is the primary key to achieving efficient, transparent, accountable procurement, and can prevent production disruptions and financial losses for the company.

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