Inventory Stockholding Policy Model

An Exploratory Study Using Multicriteria Analysis Study Case from a Fertilizer Company, Indonesia

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Abstract. Managing spare parts inventory is one strategy that needs to be adequately planned to support a fertilizer company's production. Stockholding policy is part of integrated spare part management, where spare part classification is determined based on specific inventory criteria. This paper conducts an exploratory study on the design of the stockholding policy model in a fertilizer company in Indonesia. The stockholding policy model will be built with specific inventory criteria using multicriteria analysis: (1) Operation mode, (2) Failure mode, (3) Lead time, (4) Usage, and (5) Price. The results reveal that a fertilizer company's stockholding policy model optimizes spare part inventory management. Optimum inventory is indicated by ITO (Inventory Turn Over) and Inventory value after stockholding policy model implementation. Knowing the importance and function of the stockholding policy model can develop and strengthen the company to improve spare part inventory strategy and support optimum operations for fertilizer company's production.

Keywords: stockholding policy · multicriteria analysis · spare parts management

1 Introduction

Integrated maintenance and spare parts planning can significantly improve spare parts inventory outcomes [1]. The spare part definition is MRO—maintenance, repairs, and operations when used concerning materials and spare parts. This term refers to the items used to fulfil the functions of maintenance, repairs, and operations support. Spare parts inventory needs to be managed and planned because a company will get a competitive advantage of efficient inventory management by planning spare part inventory.

Spare parts inventory management is very important for companies, including manufacturing companies. Spare parts are managed in a warehouse to accommodate the maintenance unit's needs in dealing with a breakdown of factory equipment. Although the maintenance manager understands the function of spare parts management well, some companies often face problems in storing spare parts that are too large. These spare parts can get expired and result in large holding costs for the company. The problem becomes even more complicated because almost all maintenance managers are not interested in inventory management problems.

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Several specific problems were found in analyzing spare parts inventory, including unpredictable demand. Some spare parts have high demand and others have low demand. This condition will significantly make it challenging to predict the need to replace spare parts. In managing spare parts inventory, several things need to be prioritized:

a) In general, a spare part will be stored in the warehouse if the availability level is more favorable than holding storage. This is very important, especially for spare parts with low demand. This problem can be answered by comparing the holding cost to the stockout costs.
b) Determining the midpoint of the most efficient inventory value from holding and ordering costs is the key to effective inventory. When a decision to purchase a spare part is taken, the next question is how many parts are ordered in one purchase. We can use a well-known classical economic order quantity (EOQ) formula to determine this. High inventory will burden inventory while low inventory will cause stockout risk. The minimum stock will be determined considering the consumption during the lead time. The user or the supplier gives the lead time, and demand is calculated based on data from the previous periods and based on the known (planned) needs for spare parts.

This article tries to answer some of the things and questions that have been discussed above. Some literature provides several different approaches to solving spare parts inventory problems. Several studies that serve as a reference for developing a stockholding model include [2] describing an interactive multicriteria framework approach for inventory control decision support systems. Braglia [3] describes a model for inventory management using the multi-attribute classification method. The decision diagram is integrated with analytic hierarchy process models used to solve the various multi-attribute decision sub-problems. Ching [4] conducts research by proposing the concept of ABC-fuzzy classification to solve inventory problems. De Almeida [5] explains the concept of multicriteria decision models for two maintenance problems with repair contract selection and spare provisioning. Dekker [6] investigates the type of demand for spare parts and the consequences if a stockout occurs so that it can be used as a basis for decision making.

2 Research Method

This research is a descriptive exploratory study based on the phenomenon of managing spare parts inventory at a fertilizer company in Indonesia that still does not have a stockholding policy. The research was conducted using secondary data collection techniques and direct observation of operating conditions and elaborating several related literature studies for the data management process.

3 Results and Discussion

3.1 Multicriteria Analysis

Multicriteria analysis is a spare part and component analysis technique that classifies spare parts based on certain criteria related to inventory planning strategies. These criteria include:

- Operation Mode Analysis
- Failure Mode Analysis
- Lead Time Analysis
- Usage Analysis
- Price Analysis

It is not a good solution to implement the same inventory management policy for all items in stock. Thereby, the inventory management policy means the way to determine the necessary inventory level, ordering quantity, and the time of purchase.

3.2 Operation Mode Analysis

The definition of operation mode analysis in this paper is obtained from the operating approach and failure mode data from the production unit at the fertilizer plant. Operating model analysis criteria include:

- Vital
  If needed but not available in the warehouse, spare parts can cause a shutdown of 1 plant area (For example, single equipment compressor spare parts).
- Essential
  If needed but not available in the warehouse, spare parts can cause 1or more equipment to stop/not fully functional so that it interferes with the production process, or the rate is reduced but does not cause the plant shutdown (For example, non-single equipment pumps spare parts, running-standby).
- Desirable
  If needed but not available in the warehouse, spare parts do not directly affect the production process (For example, tools, penetrate, advanced, lamp, etc.).

3.3 Failure Mode Analysis

The definition of failure mode analysis in this paper is obtained from the operating approach and failure mode data from the maintenance unit at the fertilizer plant. Failure mode analysis criteria include:

- Sudden
  Spare parts whose damage is unpredictable and catastrophic, zero planning horizon (For example, vibration sensor).
- Predicted
  Spare parts whose damage can be predicted or planned and are not catastrophic (For example, bearings and turbine casing).

3.4 Lead Time Analysis

The amount of time between the start of a process and its completion is known as lead time. During the pre-processing, processing, and post-processing stages, companies evaluate lead time in manufacturing, supply chain management, and project management. They can determine where inefficiencies exist by comparing results to established benchmarks. Reducing lead time can improve productivity, output, and revenue by streamlining operations. A longer lead time, on the other hand, has a negative impact on sales and manufacturing processes.

Lead times can be influenced by production processes and inventory management. Building all aspects of a finished product on-site may take longer than completing some items off-site in terms of production. Transportation problems can cause delays in receiving critical parts, halting or slowing manufacturing, and lowering productivity and ROI (ROI). Shortening lead times and speeding up production by using locally sourced materials and labor, as well as offsite sub-assemblies, can save time. Companies can enhance output during moments of high demand by reducing production time. Sales, customer happiness, and the company's bottom line can all benefit from faster production.

Effective inventory management is required to maintain production schedules and meet consumer demand. When inventory, or stock, is unavailable, it prevents the fulfillment of a customer's order or the assembly of a product. If an organization underestimates the amount of stock required or fails to place a replenishment order, and suppliers are unable to replenish materials immediately, production will come to a halt. This can have a negative impact on the company's bottom line. A Vendor-Managed Inventory (VMI) program, which automates stock replenishment, is one solution. These programs are frequently provided by a third-party vendor who uses just-in-time (JIT) inventory management to order and deliver components based on usage.

- Acceptable
  Spare parts whose total procurement process time is less than 3 months.
- Unacceptable
  Spare parts whose total procurement process time is more than 3 months.

3.5 Usage Analysis

The definition of usage analysis in this paper is obtained from the operating approach and failure mode data from the maintenance unit at the fertilizer plant. Usage analysis criteria include:

- Most frequently used
  Spare parts that are used 5 times in the last five (5) years and 3 times in the last three (3) years.
- Frequently used
  Spare parts that are used 4 times in the last five (5) years and 2 times in the last three (3) years.
- Less frequently used
  Spare parts that are used 3 times in the last five (5) years and 1 time in the last three (3) years.

- Rarely used
  Spare parts that are used 2 times in the last five (5) years and 1 time in the last three (3) years.
- No Used
  Spare parts that have never been used in the last five (5) years.

3.6 Price Analysis

The definition of price analysis in this paper is obtained from the operating approach and purchasing data from the procurement unit at the fertilizer plant. Price analysis criteria include:

- High
  Spare parts whose acquisition price exceeds the capitalization threshold of the investment assets value in a fertilizer company.
- Low
  Spare parts whose acquisition price is below the capitalization threshold of the investment assets value in a fertilizer company.

3.7 Criticality and Stock Policy Matrix

Based on the parameters of the multicriteria analysis, a criticality matrix and a stock policy matrix can be compiled. The two matrices (see Fig. 1 and Fig. 2) can be used as the basis for determining the stockholding policy model that can be implemented in fertilizer producers in Indonesia.

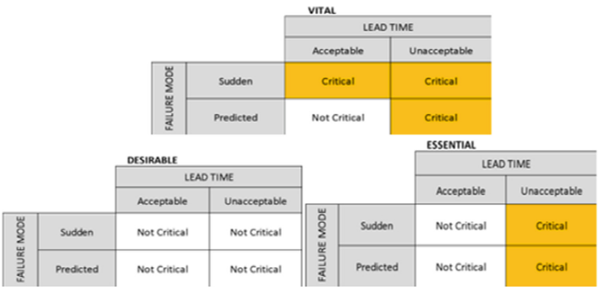

Fig. 1. Criticality Matrix

CRITICAL

		USAGE				
		More Frequently Used	Frequently Used	Less Frequently Used	Rarely Used	No Used
PRICE	High	Stock	Stock	Stock	Schedule Stock	Schedule Stock
	Low	Stock	Stock	Stock	Stock	Schedule Stock

NOT CRITICAL

		USAGE				
		More Frequently Used	Frequently Used	Less Frequently Used	Rarely Used	No Used
PRICE	High	Stock	Stock	Order to Stock	Non Stock	Non Stock
	Low	Stock	Stock	Order to Stock	Non Stock	Non Stock

Fig. 2. Stock Policy Matrix

4 Conclusion and Recommendation

Inventory management for spare parts is critical for any manufacturing organization. The use of a multicriteria inventory model to optimize spare component costs is proposed in this research. Operation Mode Analysis, Failure Mode Analysis, Lead Time Analysis, Usage Analysis, and Price Analysis are among the multicriteria in issue. The mathematical model for connecting management policy to each inventory item would be far too complex to be useful. Therefore, the stockholding policy model proposed in this paper is simpler and clearer to be implemented in the operational activities of a fertilizer company and is good enough to increase efficiency and cost reduction.

Future research should focus on quantitative research related to the relationship between the parameters of multicriteria analysis and their effect on the management of spare parts inventory. This research is expected to advise management to focus on the inventory parameters that significantly affect inventory.

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