

CHAPTER 1- INTRODUCTION

1.1. Background

The petrochemical industry in Indonesia plays a crucial role in the country's economy. Its history begins with the discovery of oil and natural gas reserves in various regions of Indonesia such as Sumatra and Kalimantan. The availability of natural resources has driven the development of the petrochemical industry as part of the oil and gas sector. The presence of natural resources, especially crude oil and natural gas, forms a strong foundation for the petrochemical industry in Indonesia. Petrochemical plants are scattered across regions with oil and gas reserves, creating strategic production centres.

PT. XYZ, is a company that has been operating for over 30 years in the petrochemical or process manufacturing industries that provides chemical powder as raw material for polyester fibres, films, and resins which have a wide range of applications in industries such as textiles, packaging, automotive, and construction. Manufacturing facilities operates large-scale petrochemical plants equipped with technologically advanced machinery and sophisticated processing units. The production process involves several chemical reactions that transform raw materials derived from petroleum into petrochemical products. The equipment used generally includes processing units and supporting facilities. Here are some examples of the equipment that may be present in a petrochemical plant: Reactor, Distillation Columns, Pumps, Heat Exchangers, Storage Tanks, Process Control Systems, Air Compressor, Analytical Instruments etc.

The company aims for optimal equipment performance to achieve production. However, equipment performance declines with age, necessitating maintenance activities to restore optimal conditions. According to Quatrini (2020), maintenance refers to all actions taken to preserve or restore items or equipment to a specific condition. It is an essential factor for profit and productivity in industrial systems. The company's capability in maintenance management is seen from aspects of availability and reliability. The company's efforts to achieve target availability and reliability are closely related to its ability to manage spare parts. There are several aspects that make spare parts demand and spare parts management

complex, including the large number of spare parts being managed and the intermittent or lumpy demand patterns. Intermittent demand refers to demand that occurs irregularly over time with varying quantities. On the other hand, lumpy demand refers to demand that is uneven over time and in requested quantities, requiring higher investment in inventory and longer response time compared to what was predicted previously (Constantino, 2017).

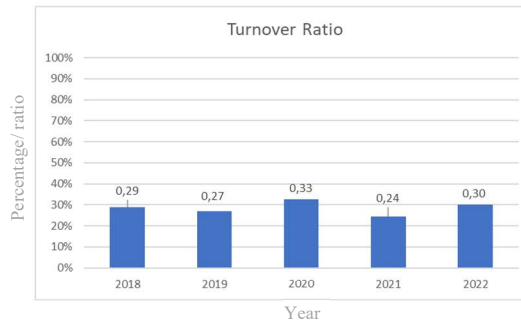


Figure 1. Spare Parts Inventory Turnover Ratio

PT XYZ manages spare parts intuitively based on previous demand, in addition, the company's maintenance spare parts inventory turnover ratio is still low, at only 0.29 in average from 5 years previous historical data as shown in Figure 1, resulting in yearly warehouse write-offs due some unused parts, expired components and obsolescence issue. Based on the twenty largest maintenance spare parts inventories in this company, Figure 2 shows that the Air Compressor has the highest accumulated value of spare parts, which is 2.5 million USD end balance in the year of 2022, with an average turnover ratio of 0.12.

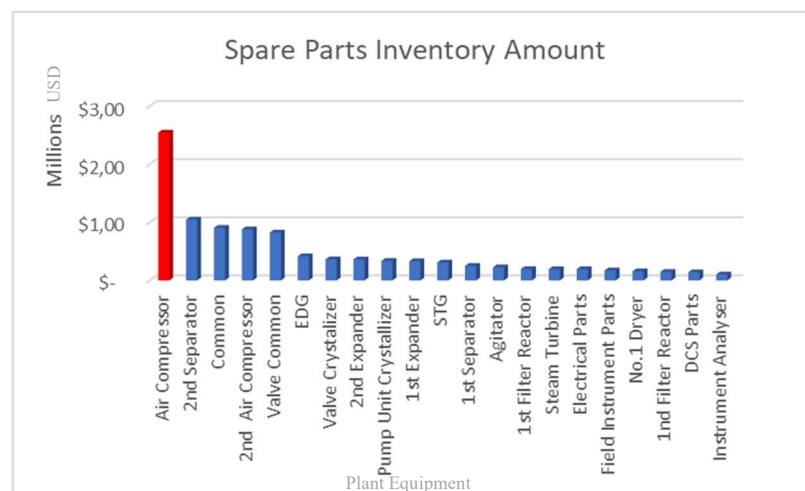


Figure 2. Spare Parts Inventory Amount

In a petrochemical plant, the function of an air compressor is crucial in the production process. The primary function is to supply high-pressure compressed air to various parts of the process, mainly for the oxidation process, also used for various instrumentation and control purposes throughout the plant. It helps operate pneumatic actuators, control valves, and other equipment that require compressed air for their functioning.

Based on observation, due to the crucial function of the Air Compressor, the decisions made to determine which critical spare parts need to be stocked and their quantities, tend to be highly subjective, depending on the experiences and knowledge of the person in charge at that time and previous spare parts consumption experiences without clear policies or method in place.

Moreover, having formal procedure for conducting criticality analyses and subsequent prioritization is crucial to reduce the need for unplanned and informal assessments. Implementing such procedure helps avoid ad hoc decisions made solely by experts, which can result in suboptimal conclusions based on individual knowledge, experience, intuition, or personal intentions, and instead ensures that decisions are based on reliable data and information. (Antosz, 2019).

The low inventory turnover ratio value, which leads to inventory accumulation in the warehouse and necessitates annual warehouse writes off, indicates that the inventory planning policy implemented on determining critical components and its stock by the company needs to be evaluated. It is necessary to conduct research on how to determine critical components and how to determine minimum and maximum stock levels for each of these critical components to give optimum critical spare part inventory management system in Air Compressor Unit system.

1.2. Research Problems

The problems in this research are the lack of systematic procedure on how to determine the critical and how to determine the minimum and maximum spare parts stock levels for critical component on essential equipment such as Air Compressor Unit System.

1.3. Research Objectives

The Objective of this research is to improve system to determine critical component, demand of quantity of minimum and maximum stock of spare parts in Air Compressor Unit system, furthermore the method can be implemented to other units.

1.4. Significance of Study

Based on review on other researcher result, that systemic perspective for the assessment of criticality and subsequent prioritization of spare parts required to enhance the availability and reliability of a manufacturing system. (Antosz, 2019).

The significance of this thesis lies in addressing the challenges, specifically in evaluating of proposed method in determining critical components and establish the minimum and maximum stock for maintenance spare parts, to optimize the critical spare parts management system.

1.5. Research Questions

Question#1: What criteria are defined to determining critical spare parts/ component that led to optimum conclusion?

Question#2: What method are defined to determining minimum and maximum spare parts/ component stock that led to optimum level?

1.6. Hypothesis

Hypothesis #1: Systematic method for determining critical spare parts/components will lead to optimal conclusions, resulting in increased availability and reliability of the manufacturing system.

Hypothesis #2: Implementing a formal approach to determine the minimum and maximum stock levels for critical spare parts in the essential unit equipment will lead to an optimized inventory management system, reducing inventory write-offs and improving maintenance efficiency.