CHAPTER I
INTRODUCTION

1.1. Background of the Study

In an era of intense business competition, efficiency in the supply chain has become one of the key factors for business success. The process of distributing goods from distributors to retail outlets plays a vital role in ensuring product availability to end consumers. Delays or errors in distribution not only result in financial losses but also reduce customer loyalty. Therefore, companies are required to establish a distribution system that is optimal, fast, and accurate.

CV. Citra Nalar Teknologi, the parent company of Delivery Director, operates in the field of distribution and delivery services for various retail businesses and partners. In its operational activities, the company is responsible for managing the distribution of goods with varying types, volumes, and delivery destinations. This condition requires an appropriate distribution management process to ensure that goods are delivered effectively and in accordance with the needs of each retail outlet.

The main challenge lies in the large number of factors that must be considered simultaneously. Optimal distribution decisions should not be based solely on the "highest demand." Other factors must also be taken into account. This situation is commonly referred to in industrial contexts as a Multi-Criteria Decision-Making (MCDM) problem [1].

To address this multi-criteria problem, a Decision Support System (DSS) is required. A DSS is a system designed to assist administrators or managers in making more objective and effective decisions [2]. One of the DSS methods that can be applied to prioritization and ranking problems is the Simple Additive Weighting (SAW) method. This method has been proven effective in solving various prioritization and allocation problems [3].

In the context of forecasting, several methods are commonly used to predict product demand. The Moving Average (MA) method is a simple approach that calculates the average of historical data with equal weighting for each period [4]. Single and Multiple Exponential Smoothing methods are only effective for stationary data without trend or seasonal patterns [5]. The ARIMA method requires stationarity assumptions and complex parameter identification processes, making it less practical for real-time implementation in distribution systems [6]. Holt-Winters Exponential Smoothing (HWES) is capable of handling data with three main components: level (baseline), trend (direction of movement), and seasonality (periodic patterns). This method is available in two variants: additive (for constant seasonal variation) and multiplicative (for seasonal variation proportional to the level). The selection of Holt-Winters Exponential Smoothing in this study is based on several considerations. First, its ability to capture complex patterns, as the distribution data at CV. Citra Nalar Teknologi exhibit both seasonal fluctuations and long-term trends. Holt-Winters has been shown to be superior in handling such characteristics compared to other methods [7]. Second, its parameter flexibility, as it allows adjustment of smoothing parameters (α, β, γ), enabling optimization according to specific data characteristics and improving adaptability to market demand dynamics [8]. Third, its effectiveness in the logistics sector, as demonstrated in a study by Drop (2025), which confirms the suitability of Holt-Winters for seasonal time series demand forecasting in logistics and distribution [9].

In DSS-based distribution optimization, several MCDM methods have been developed. The Analytical Hierarchy Process (AHP) is prone to subjective inconsistency and has high computational complexity [10]. The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) requires complex normalization and may be less intuitive for non-technical decision-makers [11]. The Multi-Objective Optimization on the Basis of Ratio Analysis (MOORA) involves more complex mathematical computations compared to other methods [12]. In contrast, the SAW method calculates preference scores by summing the weighted normalized criteria values [13]. The selection of SAW in this study is based on several considerations. First, its ability to handle mixed criteria (benefit and cost), which is essential in distribution problems where some criteria, such as distance, are cost-based (the smaller, the better), while others, such as demand, are benefit-based (the larger, the better) [14]. Second, its lower computational complexity, making it suitable for web-based systems requiring fast response times [10]. Third, its result consistency, as a comparative study by Ciardiello (2023) shows that SAW rankings have a high correlation (>0.85) with other MCDM methods, indicating reliability [11]. Finally, its flexibility in weighting, allowing dynamic adjustment of criteria weights according to company policies [15].

Based on observations at CV. Citra Nalar Teknologi, the current distribution process is still conducted manually without considering future demand projections. There is no system that integrates demand forecasting and structured prioritization of deliveries. In fact, forecasting methods such as Holt-Winters Exponential Smoothing can effectively estimate demand, while the SAW method can objectively determine distribution priorities based on specific criteria.

Previous studies, such as "Determining Goods Delivery Priority for Transportation Service Companies Using SAW Method" by Sumaizar Simaizar et al. (2021) and "Time Series Forecasting Using Holt-Winters Exponential Smoothing: Application to Abaca Fiber Data" by Mary Cris F. Plenos et al. (2022), generally discuss SAW and HWES separately, with limited research integrating both methods in the context of goods distribution.

Therefore, this study proposes an integration of two approaches. First, the Holt-Winters Exponential Smoothing method is used to process historical demand data as a forecasting technique [16]. Second, the prediction results are incorporated as one of the benefit criteria in the DSS calculation using the SAW method. This integrated approach aligns with recent research trends aiming to produce more robust decision-making outcomes [17], [18]. The system is designed as a web-based application, consistent with prior implementations of SAW in web-based DSS platforms [19].

1.2. Problem Formulation

Based on the background described above, the research problems are formulated as follows:

1. How can a web-based system for optimizing product distribution priorities be designed for CV. Citra Nalar Teknologi (the parent company of Delivery Director)?
2. How can the Holt-Winters Exponential Smoothing method be applied to forecast product demand?
3. How can the SAW (Simple Additive Weighting) method be applied to determine the priority ranking of product distribution?
4. How effective is the system in providing distribution priority recommendations?

1.3. Scope and Limitations

To ensure that this study remains focused, the following limitations are defined:

1. The system is developed as a web-based application using the Laravel (PHP) framework.
2. The user interface (frontend) is developed using Tailwind CSS.
3. The database used is MySQL.
4. The forecasting method applied is Holt-Winters Exponential Smoothing.
5. The DSS method used is SAW (Simple Additive Weighting) with the following criteria:
    a) C1: Forecasting results (Benefit) from Holt-Winters Exponential Smoothing
    b) C2: Distance (Cost)
    c) C3: Priority Customer (Benefit)
    d) C4: Stock (Benefit)
6. This study does not address route optimization. The system focuses solely on prioritizing distribution (ranking), not on determining the shortest path.
7. The dataset is limited to distribution and demand data from CV. Citra Nalar Teknologi (parent company of Delivery Director).

1.4. Research Objectives

The objectives of this study are as follows:

1. To develop a web-based system for optimizing product distribution priorities for CV. Citra Nalar Teknologi using the Laravel framework.
2. To apply the Holt-Winters Exponential Smoothing method to generate demand forecasting values.
3. To implement the SAW (Simple Additive Weighting) method to produce a priority ranking for product distribution.

1.5. Significance of the Study

This study is expected to provide the following benefits:

1.5.1. For CV. Citra Nalar Teknologi :

1. Providing an objective and systematic decision-support tool for determining distribution priorities.
2. Improving the efficiency of resource allocation in distribution and reducing operational costs.
3. Preventing stock-outs at retail locations, thereby increasing customer satisfaction and sales.

1.5.2. For the Author:

1. Enhancing knowledge and skills in applying Decision Support Systems and forecasting methods.
2. Fulfilling one of the requirements for completing the Informatics Study Program at the Faculty of Computer Science, Universitas Pembangunan Nasional "Veteran" Jawa Timur.