CHAPTER 1

INTRODUCTION

1.1 Problem Background

In modern supply chain management, accurate sales and demand forecasting is crucial for optimizing inventory levels, ensuring product availability, and minimizing stockouts or overstocking. Small and medium-sized enterprises (SMEs) are often impacted heavily by the current market volatility and have limited resources to work with. The traditional methods are used most of the time, which relies on historical data and assumptions, leading to inefficiencies and increased costs. Hence, this project aims to apply predictive analytics to empower small and medium-sized enterprises by supplying accurate forecast sales and demand trends, optimizing supply chain processes, and facilitating data-driven decision-making.

1.2 Problem Background

Market volatility, incomplete data, and seasonal variations are often the cause of vulnerability of small and medium-sized enterprises when faced with daunting challenges in predicting demand and supply chain management such as resource constraints and limited access to advanced forecasting tools. These uncertainties may lead to serious problems such as excess inventory, stock-outs, or increased warehousing costs, which may significantly increase customer dissatisfaction and subsequently, cause missed sales opportunities. Since the current forecasting methods may be insufficient to meet all of the challenges in this competitive market landscape, it is critical to align the supply chain processes with the actual market demand. Hence, accurate forecasting analysis and supply demand are lifesavers for companies.

1.3 Problem Statement

Small and medium-sized enterprises often require a lot of budget and resources to calculate data effectively and accurately, especially when real-time changes and seasonal variability must be considered. The challenges imply further that when faced with a massive amount of data, the continued reliance on traditional manual forecasting methods and the lack of real-time insights could not support further in achieving the accuracy of forecast demand calculations. This will lead to inefficient supply chain operations such as unstable inventory adequacy and declining customer satisfaction, which is unconducive to the company's development. This project hopes to address this gap by exploring more advanced and cost-saving forecasting methods to help small and medium-sized enterprises better understand and respond to their sales and demand trends.

1.4 Research Goal

1.4.1 Research Objectives

The objectives of the research are :

(a) To collect historical sales and inventory data from small and medium-sized enterprises, and preprocess it to handle missing values, outliers, and seasonality

(b) To analyze the complex forecasting results into actionable insights for small and medium-sized enterprises by using Tableau and Power BI

(c) To assess the performance of various forecasting models using SARIMA, LSTM, and XGBoost based on the aspect of prediction accuracy, reliability, and suitability for small and medium-sized enterprises

(d) To provide actionable recommendations to improve inventory levels and reduce supply chain inefficiencies

1.5 Captions

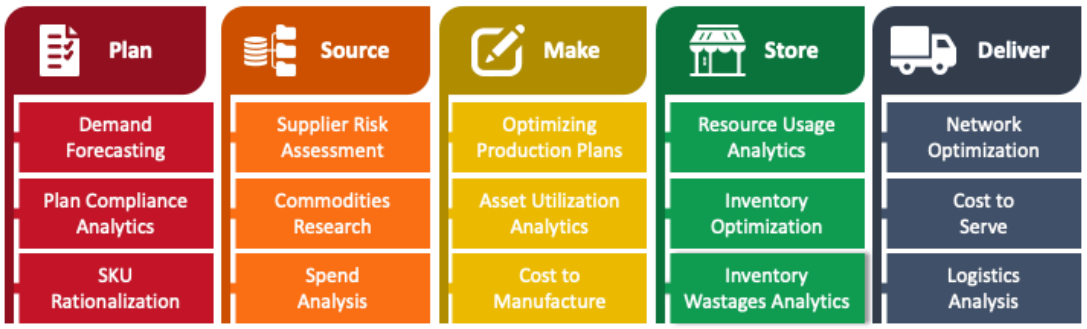

Figure 1.1 Capabilities in Supply Chain Analytics

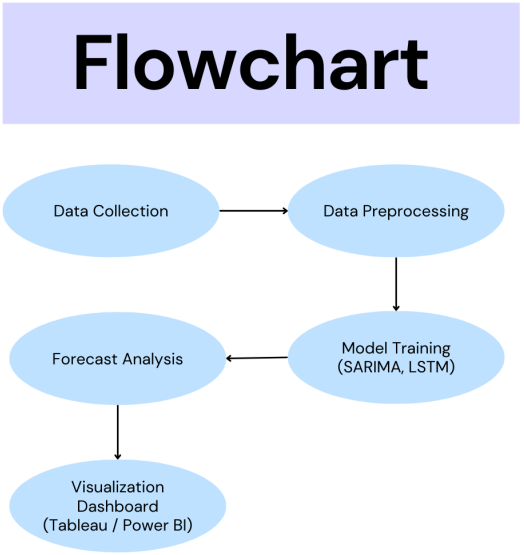

Figure 1.2 Flowchart of predictive analytics for SME supply chain optimization

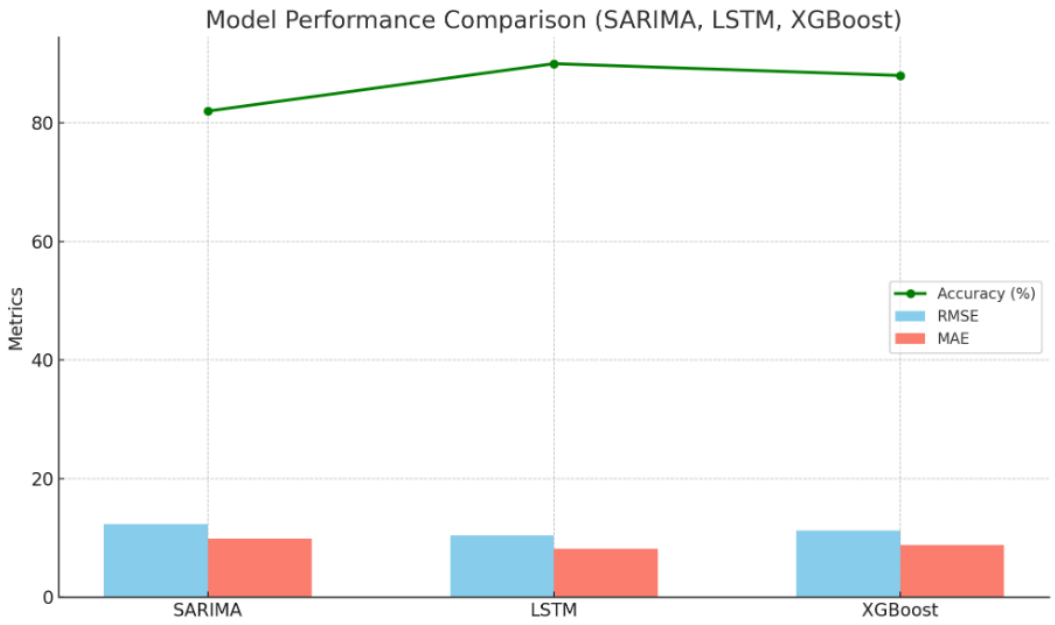

Figure 1.3 The Model Performance Comparison (SARIMA, LSTM, XGBoost)

1.6 Quotation

After reflecting on the significance of data in decision-making, one renowned statistician notes:

Without data, you're just another person with an opinion.

(Deming, 1986:45)

1.7 Equation

$$Y_t = \mu + \sum_{i=1}^{p} \phi_i Y_{t-i} + \sum_{i=1}^{q} \theta_i \epsilon_{t-i} + \epsilon_t + \sum_{s=1}^{S} \gamma_s Y_{t-s}$$

This is the SARIMA model's equation, where

- Y_t: Current value
- ϕ_i: Autoregressive coefficients
- θ_i: Moving average coefficients
- ϵ_t: Error term
- S: Seasonal components

The SARIMA stands for

- S - Seasonal Component. It refers to repeating patterns in the data
- AR - Autoregressive Components. It measures the relationship between current data points and past values of a dataset
- I - Integrated Component. I stand for differencing that manipulates non-stationary data into stationary data.
- MA - Moving Average Component. Moving Average Component indicates the dependency between current data points and past prediction errors