PROPOSED DASHBOARD DESIGN FOR SALES PERFORMANCE IMPROVEMENT USING SELF-SERVICE BUSINESS INTELLIGENCE APPROACH (CASE STUDY: PT. LINTAS BINTANG MULIA NUSANTARA)

UNDERGRADUATE THESIS

Submitted to International Program Department of Industrial Engineering
Faculty of Industrial Technology in Partial Fulfilment of the Requirement for the degree of Sarjana Teknik Industri

Written by:

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ISLAMIC UNIVERSITY OF INDONESIA

2021

AUTHENTICITY STATEMENT SHEET

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Yogyakarta, January 14th, 2021

Muhammad Farhan Hidayat

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DEDICATION PAGE

Assalamu'alaikum Wr. Wb.

Al-hamdu lillahi rabbil 'alamin and Gratitude are presented to Allah *Subḥānahu* wataʿālā for blessing, love, opportunity, health, mercy, Who granted the author primary inspiration and stamina all along to complete the Undergraduate Thesis which entitled "Proposed Dashboard Design for Sales Performance Improvement Using Self-Service Business Intelligence Approach (Case Study: PT. Lintas Bintang Mulia Nusantara ". Greeting devoted to our beloved Prophet Muhammad *Sallā -llāhu ʿalayhī wa-ʾālihī wa-sallam,* who has brought humankind to the world full of knowledge as it is today.

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Wassalamu'alaikum warahmatullahi wabarakatuh

Yogyakarta, July 2021

Muhammad Farhan Hidayat

MOTTO

“For indeed, with hardship [will be] ease.” “Indeed, with hardship [will be] ease.”

- Q.S. Al-Insyirah [94]: 5-6

“So, which of the favors of your Lord would you deny?”

- Q.S. Ar-Rahman [55]: 61

“Sesungguhnya mereka yang membencimu, cuma tak mampu mengalahkan akhlak dan kebaikanmu, jadi tak perlu marah apalagi membalas”

- Syaikh Ali Saleh Mohammed Ali Jaber

ABSTRACT

PT. Lintas Bintang Mulia Nusantara is a retail company focused on the fashion clothing industry. PT. Lintas Bintang Mulia Nusantara has more than 25 branches in Indonesia by early 2021, supplying and distributing approximately 500 different products to all store locations. Product overstock nor shortage often occurs in many products. So far, there is no applied bundling system to make marketing more attractive. The research focused on the dashboard design for company top management to generate informative insight. The dashboard expected can improve the sales performance and minimize the losses due to product overstock and shortages. The approach of self-service business intelligence used for developing and designing the dashboard. There are two strategies namely demand forecasting are proposed for reducing the supply demand high gap and market basket analysis for bundling system to making marketing more attractive. The result of the research, there are five dashboard are designed with the coverage of sales performance, demand forecasting and market basket analysis.

Keywords: *Information System, Dashboard Design, Self-Service Business Intelligence, Sales Performance*

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CHAPTER 1
INTRODUCTION

1.1 Background

Fashion is one of the few industrial sectors that continues to expand and grow at a quick pace. The fashion trend's popularity is contingent upon how society perceives and assesses it (Saravanan, 2015). The word of fashion is very general and it is involved so many product types namely :

1. Apparel
2. Sportswear
3. Footwear
4. Bag and Handbag
5. Accessory
6. Vintage and Secondhand
7. Cosmetics

There are two broad categories of fashion. To begin, fashion requires a certain size that cannot be generalized since each user's size is unique, such as clothing, shoes, and so on. Second, fashion that does not need a certain size, such as a purse, wallet, or accessory, and so forth.

PT. Lintas Bintang Mulia Nusantara is a retail company focused on the fashion clothing industry. Founded in 2004, the company offers a diverse range of items that span practically every area of general fashion. The corporation was divided into three brands: Starcross, VAST, and Supoyo. Among the three brands, Starcross is the most well-known. By early 2021, PT. Lintas Bintang Mulia Nusantara had established 25 branches across Indonesia, supplying and distributing over 500 different items to all shop locations. With the variety of product types supplied by the company, an effective and good information system is essential to aid in the decision-making process for manufacturing, product distribution, and strategic marketing.

PT. Lintas Bintang Mulia Nusantara restructured its business strategy on critical imperatives. Its primary objective was to shift the paradigm away from a company-centric

perspective and toward a more consumer-centric one, with an emphasis on meeting customers' demanding demands by supplying the appropriate items at the best possible pricing in a timely manner. The Company defined goals for adapting and improving its formats. These critical steps are intended to reaffirm the company's primary role as a modern clothing fashion retailer while also increasing its cost-efficiency. One of them is upgrading the company's information system.

Technically, an information system is a collection of linked components that collect (or retrieve), process, store, and send data in order to assist an organization's decision-making and control (Laudon & Laudon, 2018). Information systems play a critical function since they are engaged in practically every aspect of a business's everyday operating tasks (Grover & Lyytinen, 2015). PT. Lintas Bintang Mulia's primary issue is with information system management. PT. Lintas Bintang Mulia Nusantara previously used an integrated enterprise resource planning (ERP) system with Revota software. Apart from that, the corporation is still unable to optimize Revota's various outputs. PT. Lintas Bintang Mulia Nusantara has previously utilized Revota software as a supplementary tool for managing the company. With the different reports generated by Revota software, such as financial reports, product flow reports, and so on, the company is unable to use such information to aid in decision-making.

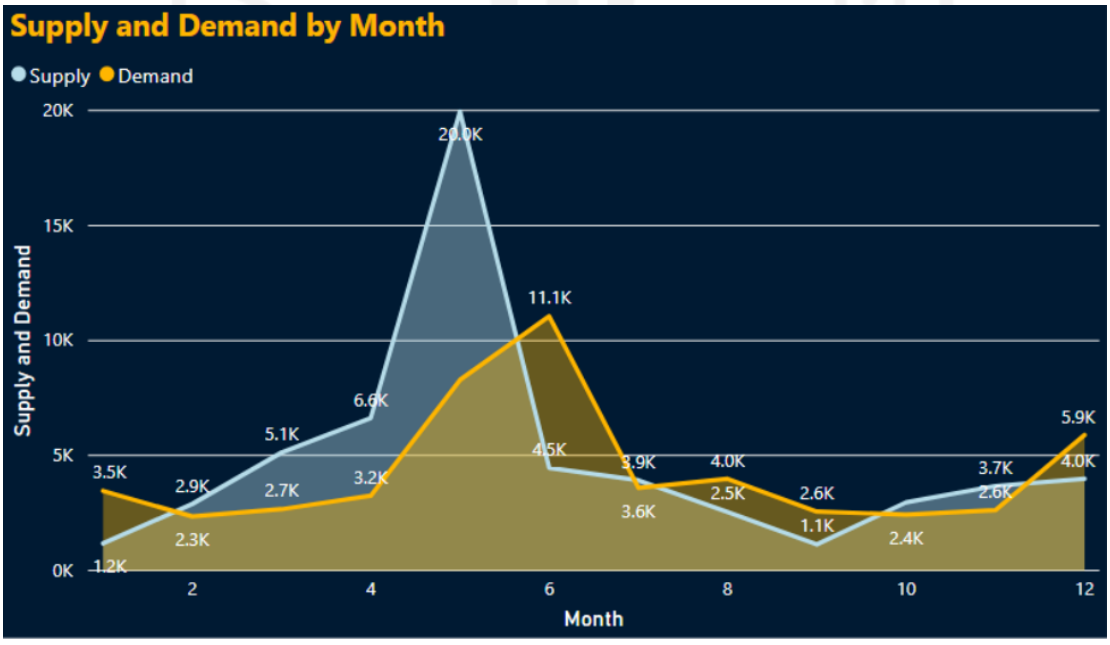


Figure 1. 1.Starcross Demand and Supply (Source: Abrar, 2020)

The figure below compares demand and supply in 2018 and 2019, as calculated by Abrar (2020) for his undergraduate thesis. As can be seen, demand and supply are very volatile, resulting in an oversupply in month five and a shortage in month six. This occurrence reflects the company's failure to forecast demand correctly. Additionally, PT. Lintas Bintang Mulia Nusantara relies entirely on the proprietor's intuition and the production & design division to estimate future demand and determine the number of products provided. Furthermore, the company often sell their products at discounted prices without having a solid basis. The discounted prices of the products are provided when the products are not selling well and/or particular events occur.

Despite the great complexity of business systems, which are characterized by complicated situational changes, some simplifications may be made to explain the selection of an information technology system that logically better meets the demands of a specified company (Biemans, et al., 2001). Given that PT. Lintas Bintang Mulia Nusantara lacks an information technology department, a business intelligence application would be the most appropriate solution for PT. Lintas Bintang Mulia Nusantara.

Business intelligence is a collection of techniques and tools that make use of technology and the internet in order to transform unstructured data into meaningful information (Vercellis, 2009). The primary objective of business intelligence is to facilitate data interpretation by converting raw data into a dashboard view or report that is visually engaging and intelligible and can also be utilized for decision making (Sad, 2014). On the other side, implementing Business Intelligence is not a simple task, as shown by prior research that concluded a high failure rate of BI implementations. Garcia and Pinzon (2017) said that both technical and administrative issues contribute to the failure of business intelligence deployment efforts at a rate of 70% to 80%. From technical and administrative challenges to failures caused by unrealistic concepts, a lack of expertise, and an over-reliance on the information technology department, and so on.

According to an online survey conducted by Logi Analytics (2015), which included over 800 company leaders and technology professionals, the approach to business intelligence has already shifted. The outcome indicates that the organization must be able to handle its data simply rather than hiring additional IT experts to adopt Business Intelligence. Furthermore, 91% of

respondents believed that having quick access to their data without the help of an IT specialist was crucial. The concept of Self-Service Business Intelligence was born as a result of this.

Claudia Imhoff and Colin White proposed the concept of Self-Service Business Intelligence in 2011. According to their research (2011), self-service business intelligence is a feature of the business intelligence environment that allows business intelligence users to become more self-sufficient and less dependent on the IT department. In other words, Self-Service Business Intelligence (SBI), also known as Do-It-Yourself Business Intelligence (DIY BI), refers to an environment that enables users to easily access, analyze, and share data without relying on IT dependency.

There are various software packages available for doing SSBI. According to Rafif (2019), Power BI and Tableau are the industry leaders nowadays. The researcher determined that Tableau would be the best tool for developing SSBI in this investigation. The study examined the challenges faced by PT. Lintas Bintang Mulia Nusantara in estimating future demand using Self-Service Business Intelligence. The use of forecasting aims to replace PT. Lintas Bintang Mulia Nusantara's current method of demand forecasting, which relies on the owner's intuition and the production and design division, resulting in a large gap between demand and supply and amplifying the potency of overstock and understock events.

Furthermore, the researcher proposed Association Rule Market Basket Analysis (AR-MBA) in order logical and scientific justification in providing prices discounts on several products. The use of MBA is able to aid several product bundlingdiscounts. The creation of Self-Service Business Intelligence for the organization in order to optimize the output generated by Revota software into information that can be used to assist decision-making with little reliance on IT experts. The usage of Tableau enables forecasting estimates using either the researcher's customized forecasting or the built-in forecasting analysis supplied by Tableau. The Market Basket Analysis was processed using Tableau software as well. In addition, a dashboard providing sales performance as well would be developed. Additionally, the dashboard result might be web-based, allowing customers more flexibility in accessing and analyzing their data.

1.2 Research Question

The following problem formulation is based on the findings of the above-mentioned background identification.

- How are the design of the dashboard for sales performance improvement with the Self-Service Business Intelligence approach using Tableau desktop?

1.3 Research Objective

Each conducted research must have an objective in mind. The research objective is crucial because it serves as guide for the research to be conducted. As a result, the researcher formulates several research objectives based on the problem formulation as follows.

- Proposed dashboard design for sales performance.

1.4 Research Limitations

The researcher establishes research limitations in order to avoid ineffective discussions. The following defines the research limitations of this study:

1. The research was conducted in PT. Lintas Bintang Mulia Nusantara.
2. The research used solely Tableau as a self-service business intelligence tool.
3. The research employs historical sales data from PT. Lintas Bintang Mulia Nusantara.
4. The study uses the Demangan branch store's 2019 and 2020 monthly sales reports.
5. The study uses the Demangan branch store's 1st January – 15th January daily sales reports.
6. The outcome of this study is simply a prototype and has not yet reached the level of implementation.

1.5 Research Benefits

By conducting this research, it is hoped that it can be beneficial for all parties. The expected benefits include:

1. For institutions (PT. Lintas Bintang Mulia Nusantara)
    a. The company can transform its raw data into visually appealing information that business people can simply comprehend and process.
    b. Self-Service Business Intelligence can show and analyze data rapidly and accurately, it may be utilized as a decision-making tool in the organization.
    c. The SSBI findings enable the company to ascertain the sales performance of each of its products, which can then be utilized as a reference for distribution and marketing.
    d. By examining forecasting dashboard findings, the company may minimize losses due to product overstock and shortages.
    e. By examining market basket analysis dashboard findings, the company may be able to design bundling package and provided discounts for several of their product.

2. For researcher

The research has the potential to provide new insights into the integration of Business Intelligence and its use in the industrial environment. Additionally, this study examines the processes involved in developing and deploying Self Service Business Intelligence, as well as the process of constructing dashboards utilizing Tableau software.

CHAPTER 2
LITERATURE REVIEW

2.1 Inductive Study

An inductive study provides context for the current study. The objective is to use prior research to inform the development of methodologies and issues in current research. Many prior research studies employ business intelligence for various purposes. Lesakova & Katarina (2016) used a Balanced Scorecard for Slovakia Republic public administration performance study. Aziza, et al. (2019) used an integrated performance measurement system (IPMS) for setting goals and identifying KPI. Both of mentioned prior research used business intelligence for creating a dashboard of identified key performance attributes. The study by Gaarboe, et al. (2017) implemented BI to IS of healthcare information. It was experimentally tested on 12 public hospitals in Denmark for this research. The findings of this research reveal that several elements, including system quality, information quality, and user happiness, influence the effectiveness of business intelligence. Devi & Priya (2016) successfully implemented BI on the SME's in India for invoice purposes. A sampling algorithm was used for analyzing input data for the application and provide a graphical BI solution. Lennerholt, et al. (2018) focused their study on the implementation problem of self-service BI by conducting a literature study. Six SSBI difficulties relating to "data access and usage" and four issues relating to "self-reliant users" are discussed in this paper's literature study.

The practicality of a BI system was evaluated by Silahtaroglu & Alayoglu (2016). The top executives of companies doing business in different areas were interviewed as part of this research. According to the research's results, eight of the companies did not employ any strategic management tools, as was predicted before the investigation. The study by Peters, et al. (2016) for determining the ability to evaluate the quality of a BI system helps to enhance the quality of management control systems. The findings of this research revealed that BI has an impact on the quality of performance measuring skills. These talents are linked to gaining a competitive edge. Vajirakachorn & Chongwatpol (2017) did research on integrating a business intelligence framework to manage and run data into insight for festival tourism. To get insight from visitor

data, the researcher used a system that incorporated database administration, business analytics, business performance management, and data visualization.

Radenkovic, et al. (2018) looked at the analytical components of smart grids and how they may be transformed into business intelligence development. Business intelligence, according to this study, leads to more efficient performance monitoring and market management. Lastly, Immawan, et al. (2019) performed performance measurements on SME's through the use of SMART system with AHP and OMAX scoring system. The output of the research is 31 KPI used for SME performance measurement are listed. Furthermore, the dashboard only for presenting key attributes was developed for assessing SMEs for their appropriate reparation solution.

Rahman (2018) employed self-service business intelligence developed using Microsoft Power BI. Fictitious business case studies from Adventure Works are used and all data received in the form of SQL, which will be processed in the application PowerBI through the ETL process. The outcome of this study is a dashboard display that assists the business in making decisions, particularly about sales performance. Followed by Rafif (2019) used the same business case in order to conduct a comparison study between Power BI and Tableau desktop. The result of the Rafif comparison study identified that with MCDM method, Tableau provides the greater value of benefit with a score of 2.89 by 3 than Power BI does with a score of 2.79 by 3.

Nguyen (2019) dealt with the use of the extension API to create extensions writeback for the visualization Business intelligence used Tableau tool. The outcome of those studies will be a functioning interactive report in which data may be entered and then interpreted with a forecasting function as the main focus. Bakri, et al. (2020) designed an application that contains two statistical analysis methods, namely Market Basket Analysis and Sales Forecasting using the shiny dashboard package for a convenience store in Makasar. This application system was developed to assist store owners in optimizing their sales. Lastly, Abrar (2020) conducted a study for developing SSBI. Furthermore, Abrar focused on creating a dashboard for sales performance within the study case of a clothing retail enterprise.

To ascertain the distinctions between the current research and earlier research, it is important to visualize a research state of the art of prior research studies.

Table 2. 1. State of the Art

No	Author	Year	Scope of Research								Object		
			Performance or Sales Measurement	Forecasting	Market Basket Analysis	Dashboard Development	Business Intelligence	SSBI	Internal Data Sources	External Data Sources	Implementation	Small-Medium Enterprise	Public Enterprise	Retail-Great Enterprise
1	Lesakova & Katarina	2016	✓			✓	✓		✓	✓			✓	
2	Aziza, et al.	2019	✓			✓	✓		✓			✓		✓
3	Gaardboe, et al.	2017					✓		✓		✓		✓	✓
4	Devi & Priya	2016				✓	✓		✓		✓	✓		
5	Lennerholt, et al.	2018					✓	✓						
6	Silahtaroglu & Alayoglu	2016	✓				✓		✓			✓		✓
7	Peters, et al.	2016	✓				✓		✓					
8	Vajirakachorn & Chongwatpol	2016				✓	✓		✓	✓		✓	✓	
9	Radenkovice, et al.	2018	✓			✓	✓		✓					
10	Immawan, et al	2019	✓			✓			✓			✓		
11	Rahman	2018	✓			✓	✓	✓	✓					
12	Rafif	2019	✓			✓	✓	✓	✓					
13	Nguyen	2019		✓		✓	✓	✓	✓					
14	Bakri, et al.	2018	✓	✓	✓	✓	✓		✓					✓
15	Abrar	2020	✓			✓	✓	✓	✓					✓
16	Hidayat	2021	✓	✓	✓	✓	✓	✓	✓					✓

2.2 Deductive Study

Deductive studies explain the theoretical basis for the research. The theoretical basis used in this research includes the concept of information system, Business Intelligence, Self-Service Business Intelligence, ETL, data warehouse, Entity Relationship Diagram (ERD), pseudocode, Online Analytical Processing (OLAP), time series analysis, forecasting analysis, and AR-MBA.

2.2.1 Information System

Individuals and organizations use the information on a regular basis. The word "information system" refers to the components that comprise it. An information system (IS) is a collection of interconnected components that gather, modify, store, and distribute data and information, as well as offer a mechanism for feedback, in order to accomplish a goal (Ramiller, et al., 2009). It is the feedback that enables businesses to achieve their objectives, such as increasing revenue or improving performance. Organizations may benefit from information systems by increasing sales and reducing costs (Lurie & Swaminathan, 2009).

2.2.2 Data Flow Diagram

Martin in his 1987 article, introduced a programming algorithm using the combination of circle and arrow symbols to represent data flow. This notation is useful in communicating with system users to grasp logic during the analysis step (Dennis, et al., 2006). Then, the notation was later known as Data Flow Diagram (DFD). DFD is often used to describe an existing system or a new system that will be developed logically without considering the physical environment in which the data flows (telephone, mail, et cetera) (Azis, 2007).

Furthermore, DFD is defined as a relationship within the rules that represent the interconnected system (Sutabri, 2003). DFD isis divided into levels, with level 0 being the most basic or refers as a context diagram. Context diagram based on Yuniar (2004) is a special form of DFD that describes the overall relationship between data flows, data stores, and terminators. Below are the symbols involved in DFD:

– Entity or Terminator

Entity or terminator symbolized by a rectangle and representing the external entity, which the system communicates with. Terminator symbolizes a person or group of people.

Figure 2. 1. Entity or Terminator Symbol

– Data Flow

Data flow is represented by arrows leading to the process or from the process. The purpose of the data flow is to demonstrate graphically the data is being done in reality, since every process should have the appropriate meaning. Data or information from one part to another part of the system such as data storage. The arrowheads indicate where the data is moving to or from the process, storage or terminator, or both. The flow that is depicted as an arrow with two ends represents the occurrence of dialogue.

Figure 2. 2. Data Flow Symbol

– Process

A process can also be called bubbles, functions, or transformations. The process shows the transformation from the input to output. In this case, several inputs can become only one output or vice versa. Processes are represented in the form of a circle or oval.

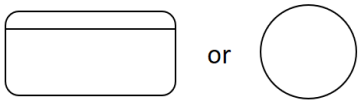


Figure 2. 3. Process Symbol

– Data Store

Data store is used to model data sets or data packets. The symbol used is parallel lines or rounded rectangles.

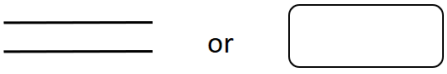


Figure 2. 4. Data Store Symbol

2.2.3 Business Intelligence

Business intelligence is a wide term that refers to a number of activities, methods, and technologies used to collect, store, analyze, and disseminate data in order to improve decision-making (Wanda & Stian, 2015). Simply described, business intelligence is the process of distilling data and information into actionable management knowledge and insight (Correia, et al., 2019). As a result, a proper BI description must incorporate both the business goal and technology capabilities.

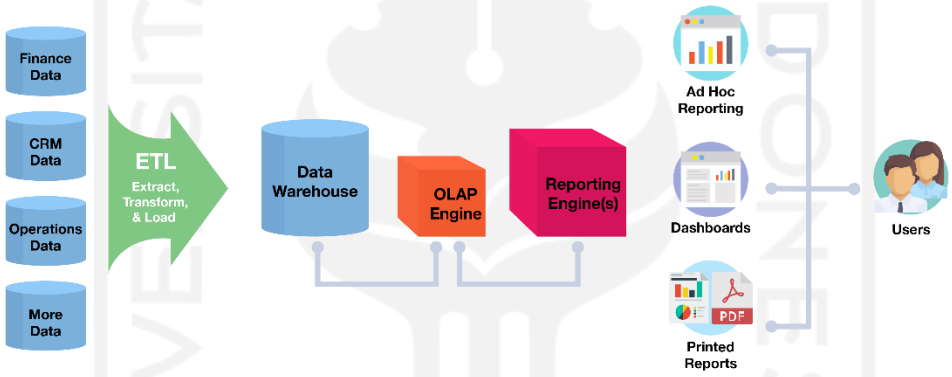


Figure 2. 5. Business Intelligence Structure (Retrieved from www.bigdataframework.org/analytics-business-intelligence-and-biwhats-the-difference/)

As seen above, business intelligence works by combining data from many sources to form a business intelligence system. According to Olszak and Ziemba (2006), four distinct components for producing business intelligence are as follows:

1. ETL (Extract, Transform, and Load)

   Extraction processes and tools for data from legacy systems and other sources, followed by pre-processing and conversion to a useable format for loading into data warehouse architecture.

2. Data Warehouse

   A collection of data organized by topic that is used to aid in organizational decision-making.

3. OLAP (Online Analytical Processing

   It is used for reporting, analysis, modelling, and planning with the objective to optimize the business via the provision of multidimensional, summary perspectives of business data. OLAP techniques and software may be beneficial for data warehouses designed for sophisticated business intelligence systems.
4. Data Mining

   Resources inside the data warehouse are purpose-built to identify patterns, correlations, and rules.

Thus, various advantages identified by Václav, et al. (2020) may be utilized in the field of decision-making and planning, including the following:

1. Its implementation results in the enhancement of a variety of business operations, as well as enhanced performance.
2. It may be advantageous at all levels of a company's management.
3. Business Intelligence enables the discovery of reserves, the rise of revenue, the reduction of expenses, and the rise of profits.
4. In today's competitive environment, business intelligence may be a critical success element for many businesses.

Additionally, Watson (2009) found that business intelligence may provide various benefits. Several of these are quite straightforward to evaluate, such as the cost savings associated with combining many data marts into a single warehouse. Others, such as the potential rewards associated with contributing to the fulfillment of strategic company objectives, are more difficult to measure. Some have a local influence, such as a departmental application, while others have a worldwide influence, such as a company-wide dashboard or scorecard application.

2.2.4 Self-Service Business Intelligence

Self-Service Business Intelligence may be described in a variety of ways. For instance, according to Abelló, et al. (2013), the primary goal of SSBI is to allow non-expert users to add data in their studies that are not available in the data warehouse. According to Schlesinger and Rahman (2015), end-users must comprehend the semantic layer of the organizational data

warehouse in order to become less dependent on the IT department while accessing the data warehouse's data. The semantic layer conveys data in a business-like way, employing language that end-users should recognize. Imhoff & White (2011), the authors of the SSBI concept, described self-service BI as a characteristic of the business intelligence environment that enables business intelligence users to become more self-sufficient and less dependant on the IT department. Self-service business intelligence is sometimes referred to as Do-It-Yourself business intelligence (DIY BI), referring to the environment that enables users to easily access, review, and trade data with minimum IT participation. Additionally, Imhoff & White noted that the emergence of business intelligence has inspired considerable interest among corporate users. Many variables motivate business intelligence developers to explore self-service BI, including the following:

1. Changing market conditions
2. IT's inability to react quickly to new requirements
3. The need to transform into a data-driven company
4. Information access is delayed or unreliable
5. Business users' dissatisfaction with IT-delivered business intelligence capabilities

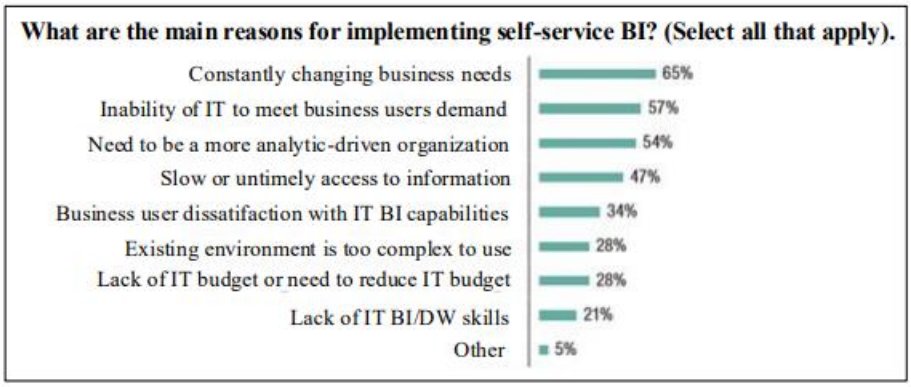


Figure 2. 6. Self-Service BI Driven Factor

The motivations for implementing self-service business intelligence are illustrated in the figure above. This poll was conducted on the basis of 587 replies to a 1999 survey.

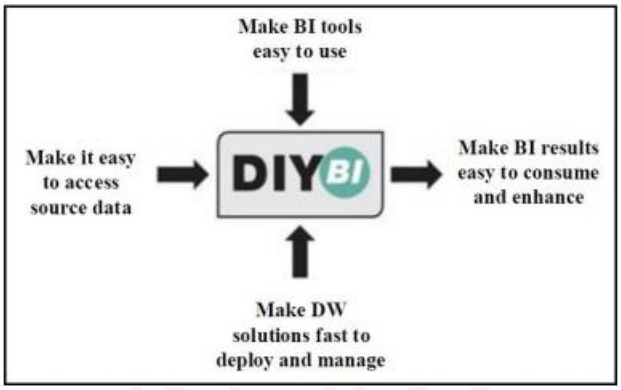


Figure 2. 7. Self-Service BI Main Objective

According to the figure above, self-service business intelligence has four primary goals which are to make BI resources more accessible, to make it easier to obtain source data, to make BI discoveries more easily ingested and improved, and to make data warehouse solutions more quickly deployable and manageable.

2.2.5 Extract, Transform, and Load (ETL)

Before data is imported into the data warehouse from the operational database and external sources, the data goes through a process of Extract, Transform, Load (ETL) (Sappagh & Hendawi, 2013). The ETL process is shown in the Figure below.

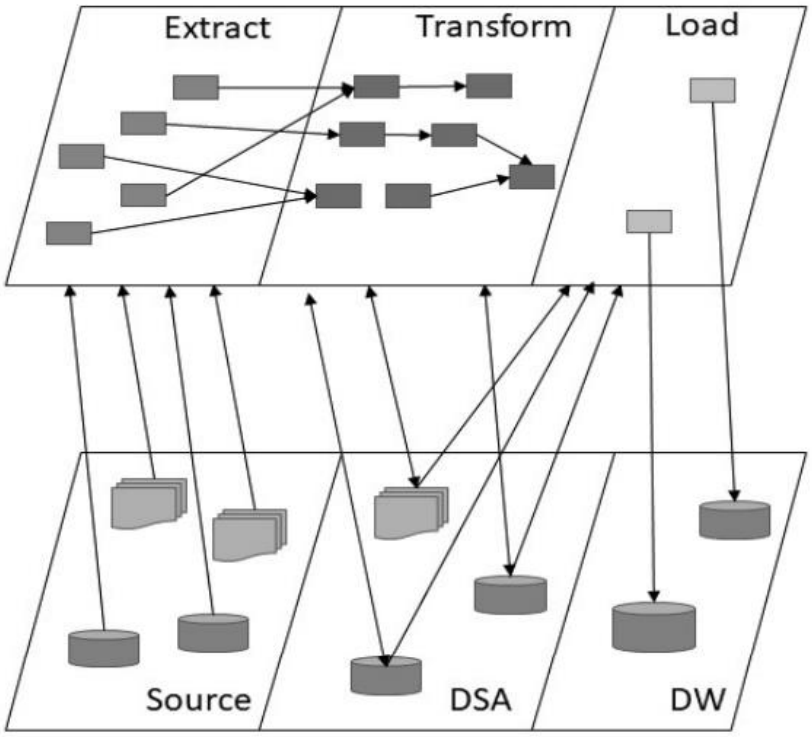


Figure 2. 8. ETL process (adapted from Vassiliadisa, et al., 2005)

The bottom layer is used to store data that is accessed throughout the procedure. The top layer corresponds to the various stages of the ETL process. The extraction phase (Extract) starts with the acquisition of data from a variety of sources, including operational databases and files with a variety of different formats (text, xls, xml, etc.). The data in this step are acquired using extraction algorithms that give information on the original data source, either identical or changed (Vassiliadisa et al., 2005). These data are cleaned and validated to compensate for inconsistencies, missing, or incorrect values.

Normally, data is transmitted from the transformation (Transform) to the data staging area, which combines data in standard formats and applies business rules that map data to the data warehouse's schema. The ETL process finished with the loading of the clean data in the data warehouse (Load). According to some authors, the ETL process is designed around the mapping of data attributes from one or more sources to attributes of data warehouse (Vassiliadisa et al., 2005). In the same meaning, the ETL process is responsible for extracting and integrating data from different sources into the data warehouse at predetermined times (Pusadan, 2013).

2.2.6 Data Warehouse

According to Chaudhuri and Dayal (1997), a data warehouse is a repository for business data that is generated directly from operational databases and certain external data sources. Furthermore, Kimbal & Caserta (2004) stated that a data warehouse is a system that extracts, cleans, customizes, and provides data sources for multidimensional data, as well as enables and executes suitable queries and analysis for decision-making purposes.

According to Inmon, who originated the term "data warehouse" in 1992, a data warehouse is a non-volatile, subject-oriented, integrated, time-varying collection of data that is mainly utilized for corporate decision-making (Inmon, Strauss& Neushloss, 2010). Based on that statement, a data warehouse in case of store management is a copy of transaction data that has been organized especially for information-related query and analysis, analysis and decision support, or transaction processing-related query analysis (Kimball & Ross, 2011).

2.2.7 Entity Relationship Diagram (ERD)

Entity-relationship is a database design technique that begins with identifying the data that must be handled in the system, then classifying the connection between one piece of data and another as an entity, and then combining numerous entities using basic object modeling techniques (Abrar, 2019). Chen (1970) invented and proposed the concept of Entity Relationship Diagram which is often used in database architecture to describe the logical connections and semantics of data. Rosmalina & Ramdani (2020) summarize that Entity Relationship Diagram is a graphical notation used in conceptual data modeling to represent a data model that defines the relationship between entities. Entity Relationship Diagram employs three main components which are listed below:

1. Entity

   An entity is a distinct identity for an object in the actual world. Scholars, lecturers, and departments are all examples of entities.
2. Attributes

Attributes are mandatory components in all entities. Attributes define the properties of an entity. Additionally, attributes serve as a means of distinguishing the contents of one element from the contents of other elements. Lecturer characteristics include lecturer numbers, degree, email addresses, specialty, and et cetera.

3. Relations

   Relations is an association or interaction between two entities that are not members of the same entity group. Relationships that may be established between two distinct entity sets in a single database include the following:

   a. One to one

      Each entity in an entity set can have only one relation with another entity set.

   b. One to many

      Each entity in an entity set may be linked to many entities in another entity set.

   c. Many to many

      Numerous entities included inside an entity set may be linked to numerous entities located within other sets.

2.2.8 Pseudocode

Pseudocode is a made-up, informal language that assists developers in the creation of algorithms (Amal, et al., 2016). Although pseudocode representations of a solution are not executable on computers, they serve as a template for creating an executable program by translating them to a particular programming language (Iman & Alnsour, 2019). Due to the fact that pseudocode is written in plain language, it enables the software development team to check that the solution adheres to the design requirements without the need to learn a proprietary description language. Since finding logical flaws at this point is less expensive than finding them later in the development process, the pseudocode is called a CASE (non-software) tool (Sedgewick & Wayne, 2011).

In contrast to programming languages and other artificial languages such as Math, pseudocode does not have a predefined set of terms; instead, it is up to the developer to select terms capable of delivering a certain solution. Due to the lack of a defined style or structure,

pseudocode takes on a broad variety of forms. Any term that accomplishes this objective may be used to represent input, output, and processing operations. For instance, the term "input" may be used instead of "read," and "display" may be used instead of "write" (Parekh & Nilesh, 2016).

2.2.9 Online Analytical Processing (OLAP)

The most well-known methods for knowledge finding are OLAP (Online Analytical Processing) and data mining (Turban, et al., 2018). OLAP enables users to examine and analyze vast quantities of data via sophisticated computations, their connections, and visual representations of the findings from many viewpoints (Haryono, 2012). OLAP tools integrate analytical processing processes with a graphical user interface (Chaudhuri, et al., 2011).

OLAP data is stored in a multidimensional database. If a rational database has two dimensions, a multidimensional database has multiple dimensions that may be partitioned into many sub-attributes using OLAP. Roll-up, drill-down, slice, and dice are all OLAP procedures. OLAP functionalities may be implemented utilizing relational databases or multidimensional databases (Talithania, et al., 2013).

2.2.10 Time Series Analysis

A time series is a collection of numbers for the same statistical indicator that is organized chronologically (Rui & Hu, 2021). If a variable can be observed in a time series and the past data contains information about the variable's future changes, a characteristic of past observation data may be used to forecast its future value. Whereas Chatfield (2000) characterized the time series analysis's primary aims as follows:

1. Description

   To portray the findings using summary statistics and graphical approaches. A time visualization of the data is really beneficial.

2. Modeling

   To develop a mathematical model that accurately describes the data generation process. A univariate model for a specific variable is constructed entirely from the variable's past

values, while a multivariate model is constructed entirely from the variable's previous values and the present and previous values of additional variables.

3. Forecasting

   To estimate the series future values.

4. Control

   Effective projections allow the analyst to take action in order to monitor a certain process, whether it is an industrial process, an economic process, or something altogether else.

2.2.11 Forecasting Analysis

Forecasting is a significant topic that touches on a broad variety of fields, including business and industry, economics, environmental research, health, social science, politics, and finance (Montgomery, et al., 2008). Forecasting is often categorised according to three distinct time horizons, namely:

1. Forecasting in the short term

   Forecasting issues in the short term involve predicting events that occur within a few days, weeks, or months.

2. Forecasting for the medium term

   Forecasts for the following one or two years are produced.

3. Forecasting for the long term

   Long-term forecasting challenges may result in projections extending several years into the future.

As a result of the above categorization, it is clear that tasks ranging from operations management to budgeting and choosing new research and development initiatives all need short- and medium-term forecasting. Long-term projections influence issues such as strategic planning.

2.2.12 Association Rule - Market Basket Analysis

Association Rule is a data mining method for determining which characteristics will be acquired when a combination of items or a task is combined. Market Basket Analysis is one application of the Association Rule. Market Basket Analysis is a mathematical method that

marketing experts often use to show similarities between particular goods or groups of individuals (Bakri, et al., 2018). With this information, management may arrange for the positioning of products or create marketing campaigns that include discount coupons for certain combinations of products (Suwarningsih, 2008). Large amounts of transaction data will increase the validity of the information to be used (Prasetia, et al., (2015)

There are two well-known algorithms, which applied to AR-MBA, First, the apriori algorithm described as an algorithm for condensing the search space for combination items, allowing for faster analysis. Additionally, rules produced by apriori algorithms may be re-identified to identify which rules offer the most information using support and lift ratio metrics. Then, the association rules that have been developed may be utilized to inform company strategy decisions. There are two processes on the apriori algorithm namely join (merging) and prune (pruning) (Han & Kamber, 2006). While the merging process combines each item with other items until no more combinations exist, the pruning process trims merged items to the user-specified minimum support level. The FP-Growth algorithm is a modification of the Apriori algorithm that addresses the Apriori method's limitations. Frequent Pattern Growth (FP-Growth) is one of the alternative methods for determining the collection of data that occurs most often in a data collection (frequent item set) (Fachruzi, 2014).

CHAPTER 3
RESEARCH METHODOLOGY

The research methodology is utilized in this research to guarantee that the researcher does not depart from established goals and instead attempts to answer the issue in a more organized and directed way in order to accomplish the objective.

3.1 Research Object

The study will concentrate on developing self-service business intelligence and designing a dashboard presenting sales performance, demand forecasting, and market basket analysis. As a result, the subject of this study includes everyone engaged, including the decision-makers in the manufacturing and design divisions, the general store manager, and the owner of PT. Lintas Bintang Mulia Nusantara.

3.2 Data Collection Types

The research used both primary and secondary data. Both data kinds are required to complement and support one another for the study to be successful. The following is an analysis and explanation of the disparity between the two sets of data:

1. Primary data

   Primary data is data obtained directly from data sources in the field, without the involvement of middlemen who provide data to the researcher. This research gathered primary data via group discussions, interviews, brainstorming, and observation.

2. Secondary data

   Secondary data is data obtained from organizational documents, books, papers, and articles, among other sources, through intermediaries or earlier studies. Secondary data was employed in this research to bolster the research and to confirm qualitative classifications. Secondary data are utilized to supplement and augment qualitative descriptions throughout the research process.

3.3 Data Collection Method

Data collection was carried out on the production & design division of the company. In this research, the data collected was divided into 2 types namely primary data and secondary data. Below are the data collection methods for each data type:

1. Primary data
   a. Interview

      A data-gathering technique in which specific corporate partners are contacted for information. In terms of this study, interviews were done with the company's owner, general store manager, and head of production and design.

   b. Direct observation

      Specifically, by keeping a direct sight of the associated activities in connection to the processes being conducted.
2. Secondary data

   Secondary data were collected and analyzed from supporting documents. Previous research scientific sources or publications, as well as literature studies, are consulted.

3.4 Data Processing

Data processing will briefly describe how to construct a business intelligence system and create multiple dashboards after the data collection stage was executed.

3.4.1 System Requirement Analysis

The first step of business intelligence development is the analysis of system requirements. System requirement analysis's purpose is to determine the system requirements that must be created, which include the system's functional needs. The process of system requirement analysis would be carried after obtaining system purposes of the system and several reliable reports. Based on the problem formulation and research objective, it can be seen that sales performance, demand forecasting, and market basket analysis are needed to be developed using Self-Service BI to create a proposed dashboard for displaying each result.

3.4.2 Business Intelligence

Following an analysis of the system requirements, the next phase is to visually create the system so that it provides business intelligence for the company in making decision-making become simpler. Sherman (2015) described a six-step process for developing a self-service business intelligence solution. There are six phases: scope and planning phase, analyze and define phase, architect and design phase, construction testing and refinement phase, implementation phase, and deployment and roll-out phase. However, only the first four stages were completed, the implementation phase and roll-out phase were skipped since the research is still in the design phase of establishing a dashboard and has not yet progressed to the implementation stage.

1. Scope and Plan

   This stage focuses on defining the scope of the BI that will be created from research. The proposed BI system covers three areas namely sales performance, demand forecasting, and market basket analysis. These three BI coverages were determined during the preliminary study.

2. Analyze and Define

   After defining the scope of BI system, the following phase is to determine what data is required to generate business intelligence and where the data is gathered. As a result of this step, the researcher may define what data is required and where to collect it.

3. Architect and Design

   The third phase is used to create the database architecture and dashboard prototype that will be developed. This stage is broken into two sub-phases, which are as follows:

   a. Data warehouse modeling

      This step is used to establish the relationships between the entities in the BI warehouse model that has been created. At this point, a model connection between the two data warehouse models, namely sales performance including forecast and market basket, is produced.

   b. Dashboard prototype visualization

The current sub-phase is used to create a prototype of the business intelligence dashboard that will be produced. The prototype design will subsequently be used as a reference for designing the final dashboard in Tableau.

4. Build and Test

In broad terms, the build & test phase is the core of this research, it tries to establish a business intelligence system utilizing the Tableau desktop. This phase is divided into four sub-phases, which are as follows:

a. Transform data

This step involves converting all obtained report data to the same format to improve the convenience of the organization of the BI system. For the research, all data will be transformed to excel format. After all data are recorded in excel format, the ETL (Extraction, Transformation, and Loading) process begins. The ETL method involves deleting data that are not necessary for the research (data cleansing) and then organizing the table structure into multiple components (data transformation). The current sub-phase is used to establish a warehouse database that meets the criteria of the expected system. Two warehouse databases will be constructed in this study namely one for sales performance including forecasting and one for the market basket.

b. Importing data

After completing all data transformation, the data warehouse prepared in excel format must be imported into the Tableau desktop.

c. Data slices and joins

After importing the data warehouse, the following sub-phase is to establish connections and define slices and joins between the data warehouse's tables. The connection between tables established throughout the architect and design phase will serve as a guide for developing the relationship model during this stage.

d. Dashboard development

Following the previous sub-phases, the dashboard can be created to visualize the data stored in the data warehouse. As a final result from the built test and refine phase, more than one dashboard was developed that visualize sales performance,

demand forecasting, and market basket analysis. Furthermore, the determined components are adapted from the phase of architect and design.

3.5 Research Flow

The flowchart below illustrates the method through the research was conducted in order to get a better knowledge and to construct a self-service business intelligence system with a dashboard model as a final. The figure below depicts the research's flowchart:

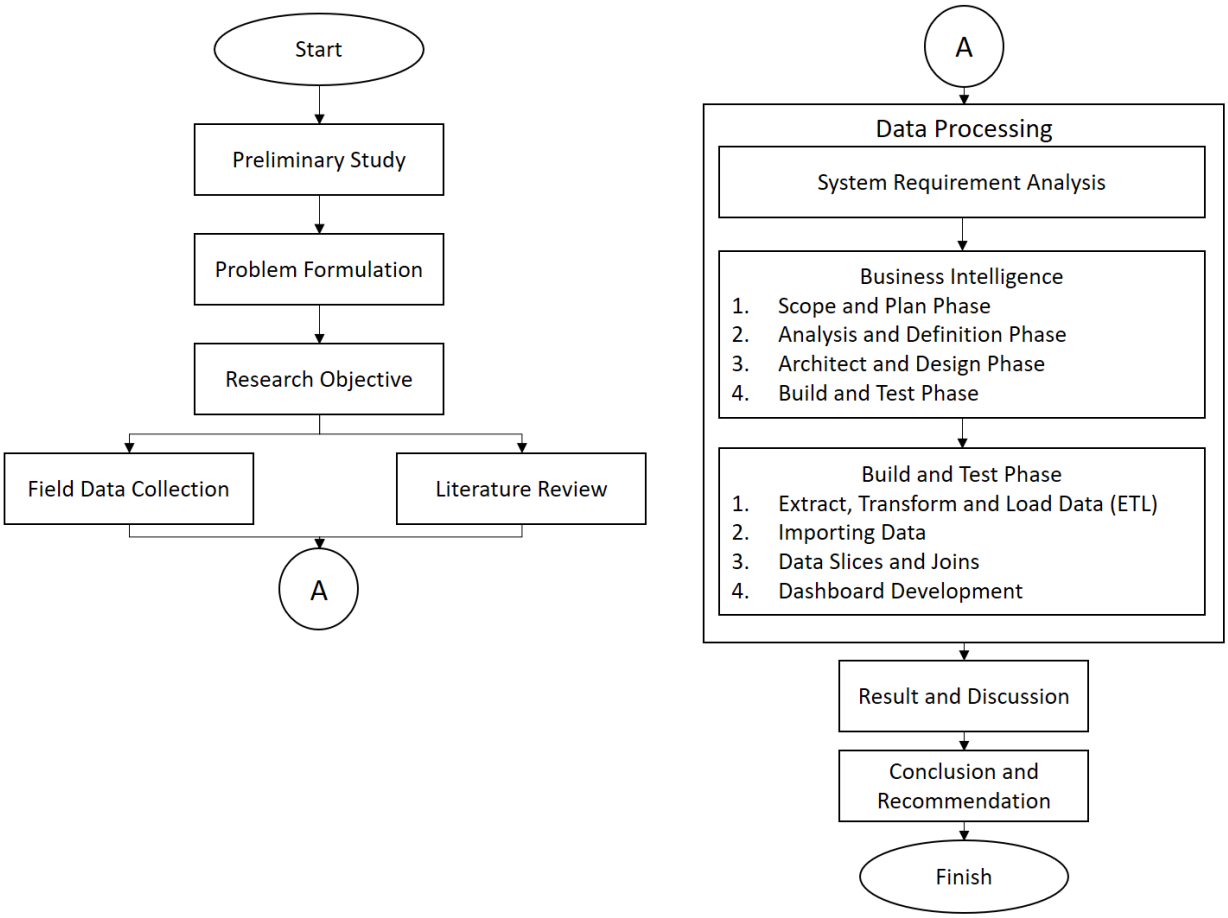


Figure 3. 1. Research Flow

CHAPTER 4
DATA COLLECTION AND PROCESSING

4.1 Data Collection

Data Collection was carried out by conducting interviews and a focus group discussion with several stakeholders at PT. Lintas Bintang Mulia Nusantara. Furthermore, data collection used was carried out at PT. Lintas Bintang Mulia Nusantara through direct observation and secondary data namely reports provided by the company and others sources. The data needed for this research includes reports on general sales and cashier recap detail. Apart from that, this research requires a general company overview as described below.

4.1.1 Company Description

4.1.1.1 Ownership Status

Starcross is a local retail clothing company that was founded on August, 2004. Starcross, which originally concentrated on distribution using the guerilla system. Starcross was inaugurated on 4 September 2004 which is part of a limited company of CV Multiline. Along as time goes by now the Starcross brand has become a company independent under the name PT. Lintas Bintang Mulia Nusantara where its type of business is a Limited Liability Company (PT / Corporations / Corporates): a company that has an entity legal law owned by two or more persons with responsibility only applies to the company without involving personal property and members of the shareholders limited to the shares it owns.

4.1.1.2 Company Product

PT. Lintas Bintang Mulia Nusantara is a creative industry that is engaged in the field of lifestyle where a variety of lifestyle products with the theme of pop, action sports, music, and street. The products produced by this company are very diverse with more than hundreds of item

types, but the bestseller items from PT. Lintas Bintang Mulia Nusantara, especially the Starcross brand, include:

a. T-shirts

   T-shirts are the best selling products from Starcross. T-shirts produced by Starcross use the best materials, namely Chinese bamboo fabrics, imported from China. This bamboo cloth is above the standard cloth used by clothing in general (combed 30s cotton). Bamboo China is smoother and cooler. The screen printing used by Starcross also varies, from screen printing types 22 printing, plastisol, color, and so on. With great quality, a t-shirt produced by Starcross is not easily damaged.

b. Shirts & polo shirts

   The shirts and polo shirts are also produced by Starcross. The shirt produced also has good quality and neat stitching. For the shirt, polo shirts, and t-shirts, Starcross products are very exclusive because 1 design is only in production 5 times (sizes S, M, L, XL, XXL).

c. Jacket, jamper, hoodie

   Starcross also has jackets, jampers, hoodies, coach jackets, et cetera. with diverse designs and collaboration with other brands as well

d. Pants

   Starcross provides pants, ranging from short to long pants. The material also varies, there are jeans, fabrics, cardets, et cetera

e. Bag

   At the beginning of the Starcross brand in 2004, Starcross started by selling bags, until now the bag has become one of the bestseller items that has various types and designs.

f. Accessories and more

   The accessories produced by Starcross are quite a lot like hats, vets, wallets, belts, wallets, bracelets, watches. For watch products, Starcross imported them from China but for other products, its originally produced by Starcross, and part of it is subcontracted.

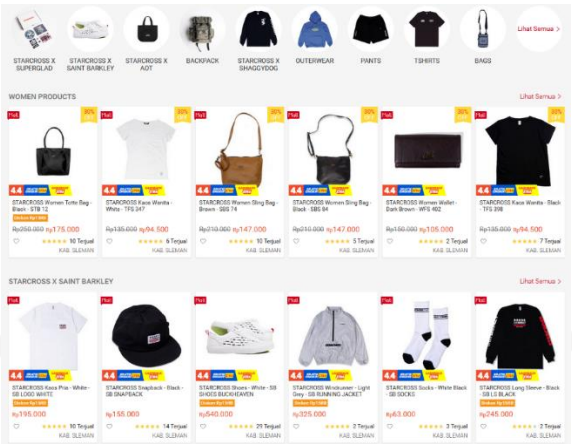


Figure 4. 1. Starcross Product

4.1.2 Company Production System and Management

4.1.2.1 Forecasting Method and Capacity Planning

Production planning and forecasting are carried out by the owner and the division of production & design in particular by conducting a general meeting involving the whole workers from PT. Lintas Bintang Mulia Nusantara every quarter for discuss production planning. Production planning is simply generated with reference to historical sales data, inventory stock, and the intuition of the owner and production & design division. Apart from production planning, it is also carried out distribution planning by the distribution department. Distribution planning involves the division of the number of product articles to be delivered with proper quantity to all Starcross brand store branches around Indonesia. Number of product articles for each store will be different depending on the number of sales from each store.

4.1.2.2 Aggregate and Material Planning

PT. Lintas Bintang Mulia Nusantara conducts aggregate planning of products that will be sold with the latest models quarterly, meaning within a year there would be aggregate planning takes place four times. Aggregate planning is pretty well implemented where the company is able to establish long-term planning. With this planning, the company can afford for managing its

production activities properly. So that the production target can be achieved and fulfill consumer desires.

This also applies to material planning, material planning as well done quarterly in the sense of four times a year. From that, every quarter the company would update their catalogues to adapt to the new design, therefore the new material needed is needed and it is necessary to do material planning in accordance with the number of products that would be planned for production.

4.1.2.3 Scheduling

At PT. Lintas Bintang Mulia Nusantara the planning process was not carried out only on the quantity of production, but until the target products are distributed to each shop. Therefore, it is necessary to have good scheduling to achieve the desired target. Scheduling is done for the production process from each vendor and the distribution process of products, these two processes are very vital to scheduling is done because when these two processes are not implemented within good scheduling then the whole production planning will fall apart. PT. Lintas Bintang Mulia Nusantara has done both of these scheduling quite well.

4.1.2.4 Production and Subcontracting Process

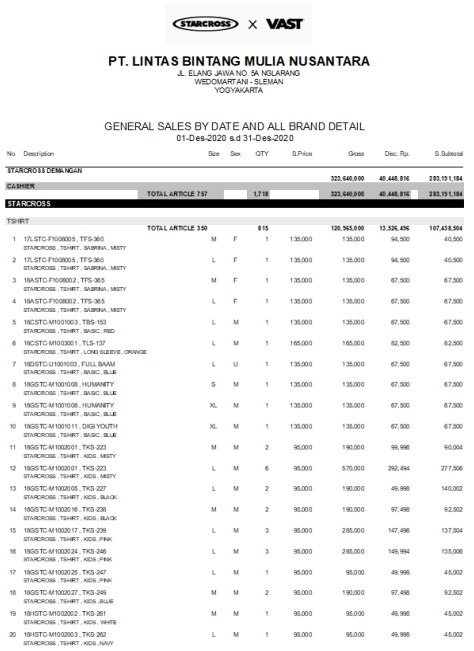
PT. Lintas Bintang Mulia Nusantara has three ways of producing goods, namely by producing their products, secondly by doing subcontracting or entrusting other vendors to produce the products, the third by buying finished products directly to the factory. For comparison, the number of products produced is 20% of the products self-produced and 80% of products produced by other vendors (subcontracting). It is very rare to purchase finished products. As can be seen from the comparison is PT. Lintas Bintang Mulia Nusantara often used vendors to produce their products, this is because the number of articles that are produced is quite high and various that the production house of PT. Lintas Bintang Mulia Nusantara is only able to produce about 20% of the total products produced.

4.1.3 Company Management Information System

PT. Lintas Bintang Mulia Nusantara employs an integrated ERP system developed by PT. Ava Revota. Revota is a corporate information system and technology enterprise focused on the garment sector (fashion, clothing, distributions). Revota provides adaptable and integrated supply chain solutions (design, production, distribution, store, post, consignment, wholesale, online store). The company may monitor all aspects of its operations via Revota software, including the number of inbound products, goods out, and overall shop sales. This system is linked through the internet and utilizes a server to manage and report on data for the business.

Figure 4. 2. Revota

Revota is used to ensure that each department is aware of the activities occurring inside the business for instance warehouse input and output monitoring including product flow for each branch store. Revota will record all entering and departing products, as well as any automated sales transactions. Thus, the business may simply generate financial reports, sales reports, arriving and outgoing products reports, and other reports using the various data records.



STARCROSS × VAST

PT. LINTAS BINTANG MULIA NUSANTARA
JL. ELANG JAWA NO. 5A, NGLARANG
WEDOMARTANI - SLEMAN
YOGYAKARTA

GENERAL SALES BY DATE AND ALL BRAND DETAIL
01-Des-2020 s.d 31-Des-2020

No	Description	Size	Sex	QTY	S.Price	Gross	Disc. Rp.	S.Subtotal
STARCROSS DEMANGAN								
						323,640,000	40,448,816	283,191,184
CASHIER								
	TOTAL ARTICLE 757			1,718		323,640,000	40,448,816	283,191,184
STARCROSS								
TSHIRT								
	TOTAL ARTICLE 350			815		120,965,000	13,526,496	107,438,504
1	17LSTC-F1009005 , TFS-360 STARCROSS , TSHIRT , SABRINA , MISTY	M	F	1	135,000	135,000	94,500	40,500
2	17LSTC-F1009005 , TFS-360 STARCROSS , TSHIRT , SABRINA , MISTY	L	F	1	135,000	135,000	94,500	40,500
3	19ASTC-F1009002 , TFS-365 STARCROSS , TSHIRT , SABRINA , MISTY	M	F	1	135,000	135,000	67,500	67,500
4	19ASTC-F1009002 , TFS-365 STARCROSS , TSHIRT , SABRINA , MISTY	L	F	1	135,000	135,000	67,500	67,500
5	19CSTC-M1001003 , TBS-153 STARCROSS , TSHIRT , BASIC , RED	L	M	1	135,000	135,000	67,500	67,500
6	18CSTC-M1003001 , TLS-137 STARCROSS , TSHIRT , LONG SLEEVE , ORANGE	L	M	1	165,000	165,000	82,500	82,500
7	19DSTC-U1001003 , FULL BAM- STARCROSS , TSHIRT , BASIC , BLUE	L	U	1	135,000	135,000	67,500	67,500
8	19GSTC-M1001008 , HUMANITY STARCROSS , TSHIRT , BASIC , BLUE	S	M	1	135,000	135,000	67,500	67,500
9	19GSTC-M1001008 , HUMANITY STARCROSS , TSHIRT , BASIC , BLUE	XL	M	1	135,000	135,000	67,500	67,500
10	19GSTC-M1001011 , DIGI YOUTH STARCROSS , TSHIRT , BASIC , BLUE	XL	M	1	135,000	135,000	67,500	67,500
11	19GSTC-M1002001 , TKS-223 STARCROSS , TSHIRT , KIDS , MISTY	M	M	2	95,000	190,000	99,996	90,004
12	19GSTC-M1002001 , TKS-223 STARCROSS , TSHIRT , KIDS , MISTY	L	M	6	95,000	570,000	292,494	277,506
13	19GSTC-M1002005 , TKS-227 STARCROSS , TSHIRT , KIDS , BLACK	L	M	2	95,000	190,000	49,998	140,002
14	19GSTC-M1002016 , TKS-236 STARCROSS , TSHIRT , KIDS , BLACK	M	M	2	95,000	190,000	97,498	92,502
15	19GSTC-M1002017 , TKS-239 STARCROSS , TSHIRT , KIDS , PINK	L	M	3	95,000	285,000	147,496	137,504
16	19GSTC-M1002024 , TKS-246 STARCROSS , TSHIRT , KIDS , PINK	L	M	3	95,000	285,000	149,994	135,006
17	19GSTC-M1002025 , TKS-247 STARCROSS , TSHIRT , KIDS , PINK	L	M	1	95,000	95,000	49,998	45,002
18	19GSTC-M1002027 , TKS-249 STARCROSS , TSHIRT , KIDS , BLUE	M	M	2	95,000	190,000	97,498	92,502
19	19HSTC-M1002002 , TKS-261 STARCROSS , TSHIRT , KIDS , WHITE	M	M	1	95,000	95,000	49,998	45,002
20	19HSTC-M1002003 , TKS-262 STARCROSS , TSHIRT , KIDS , NAVY	L	M	1	95,000	95,000	49,998	45,002

Figure 4. 3. Report Example

Figure 4. 3. represent one of the report examples on general sales results at the Demangan branch store, where all transactions are recorded and neatly organized into a sales report. The report above is the results of the revota software, a business solution for report management and administration process.

4.1.4 Management Information System Conceptual Model for Developing Dashboard

The conceptual model would be presented by data flow diagram for the study. The data flow diagram is a diagram that employs notations to represent the flow of data in a system, and its use is extremely useful for understanding the system logically, organized, and clearly. DFD may also be used to describe or explain a system's work process. Context diagram, often known as level 0 DFD is the most global form of the system. This is the top-level diagram, which comprises general processes and serves as an input system for external entities. The context diagram depicts the early phase of the interaction between supporting components. The context diagram for future company management information systems in order to develop the dashboard is presented in the figure below.

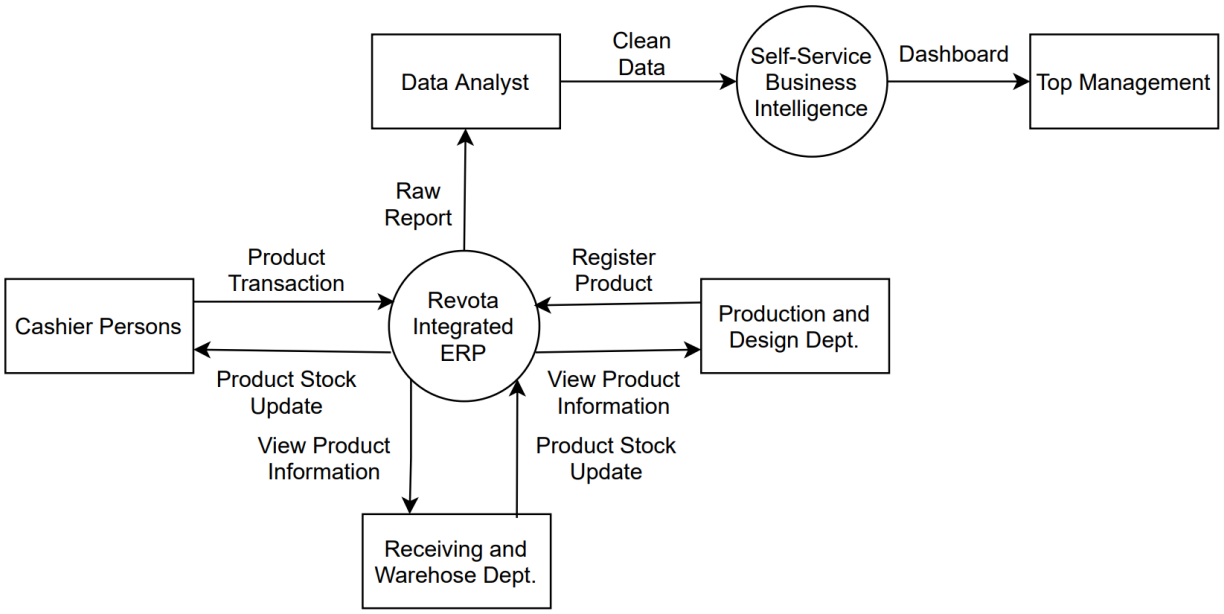


Figure 4. 4. Context Diagram / DFD Level 0

Figure 4. 4., indicates the level of access rights of different users in the system. For example, the cashier persons only have the right to give product transaction records then the Revota automatically updated the product stock. Then, the report from Revota can be utilized in order to develop certain dashboard by the data analyst. Context diagrams are described in more detail with the development of DFD level 1 in the figure below.

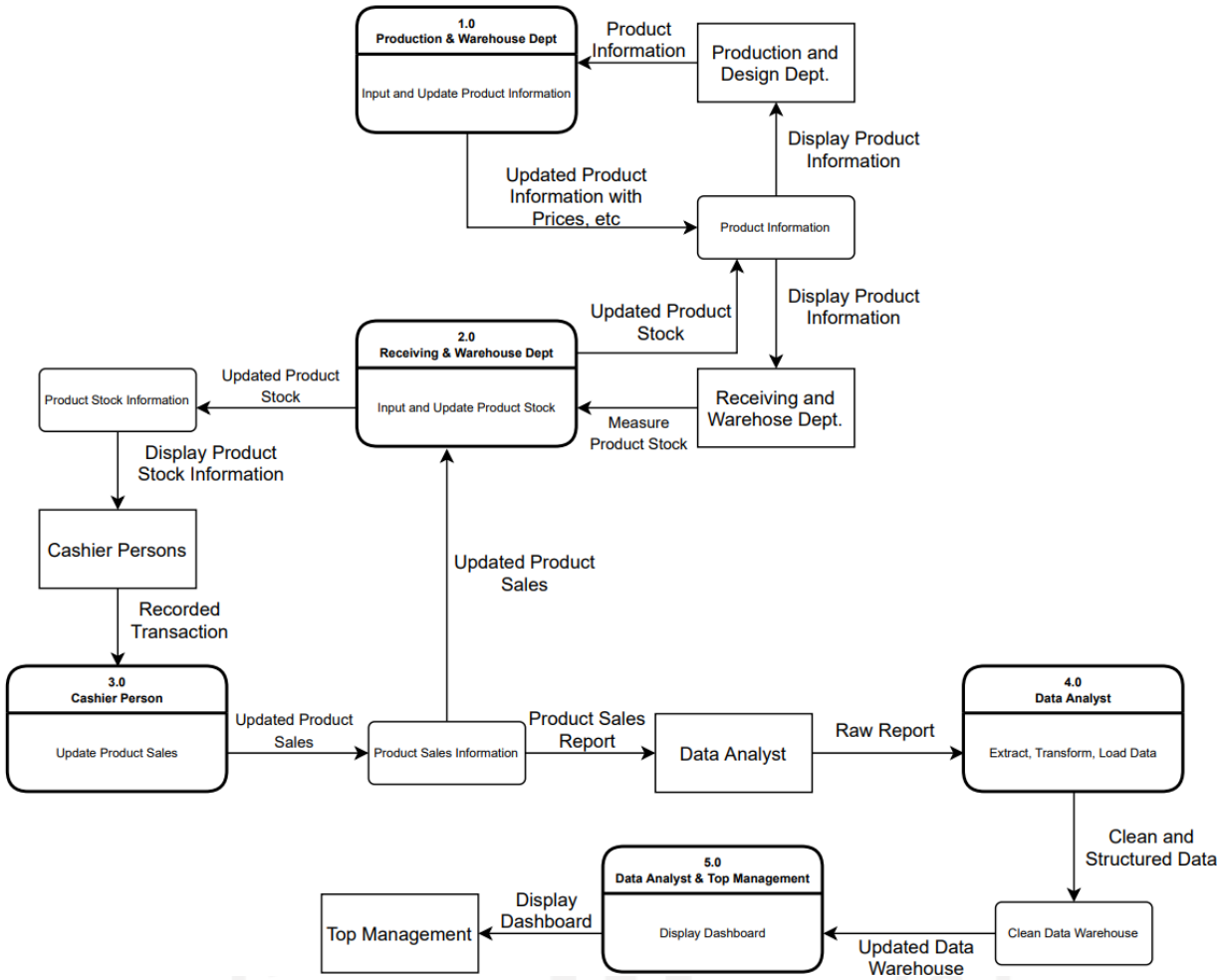


Figure 4. 5. DFD Level 1

Figure 4. 5., represent DFD level 1 which is more detailed than the context diagram (DFD level 0). DFD level 1 shows the system's more detailed access rights for various users. It specifies the user's access rights to the various process or modules in the system. The process is labeled with users who have access rights and are numbered from 1.0 to 5.0. DFD level 1 involves five processes. A further explanation of the process involved in DFD level 1 can be seen in the table below.

Table 4. 1. Process Involved in DFD Level 1

No	Process	Description
1.0	Input and Update Product Information	Production Department registered new product along with its price and others detail such quantity procured. The product information is then used by receiving and warehouse department to measure product stock.

No	Process	Description
2.0	Input and Update Product Stock	Product stock inputted into the precise quantity after receiving and warehouse department measuring product stock. Then, the product stock can be updated automatically since the updated product sales process is integrated within this process.
3.0	Update Product Sales	After a transaction happens, the system automatically records and updates the product sales information. Then, the product stock is updated since the latest transaction which makes the stock decrease.
4.0	Extract, Transform, Load Data	After the raw report is retrieved from the Revota by the data analyst, ETL process is done to establish clean and structured data. The clean and structured data is then imported to the data warehouse.
5.0	Display Dashboard	For displaying the dashboard, a clean data warehouse is imported to the used SSBI tools. After the dashboard is developed, then the top management hopes can retrieve insight for making a business strategy.

4.2 Data Processing

4.2.1 Problem Analysis

According to the findings of observations and interviews with various stakeholders at PT. Lintas Bintang Mulia Nusantara, the issue arises in the flow of information systems and decision-making systems are as follows:

1. The decision-making mechanism for forecasting production levels, the types of products to be ordered, and the quantity of products to distribute to each branch store are still relied mainly on the owner's and production & design department intuition.
2. There are no decision-support tools, particularly when forecasting the amount of production, the products that should be created, and the number of products that must be delivered to each store, which results in frequent overstock or failure to satisfy consumer demand.
3. The absences of bundling sales system for certain products and the arrangement of products in each store are based only on aesthetics judgment.

4. Discounts on certain products are still determined solely by specific events and the sales performance of the product which can contribute to one of the reasons behind the decline in profits as well as the occurrence of losses.
5. There are no decision-support tools, particularly when determining products bundling and product arrangement layout for branch stores.
6. Lack of data analyst position inside the company that can utilize the potential of the reports issued as the output from Revota.

4.2.2 System Requirement Analysis

The findings of the problem analysis indicate that the company requires an information system for the general sales performance analysis, forecasting analysis, and market basket analysis. Prior to developing the information system for the three components, the researcher must ascertain the system's requirements, which include functional requirements. The following are the breakdown of system requirements for sales performance analysis, forecasting analysis, and market basket analysis:

4.2.2.1 Sales Performance Analysis

Sales performance analysis serves various product sales performance from a variety of perspectives, including the product category, sales period, discount incurred, quantity sold, and et cetera. Sales performance helps to assist with the resolution of relevant decision-making issues.

a. Input Requirement Analysis

   a.1. Sales

   Sales provide data in accordance with an aggregate of sales activities namely Product Name, Size, Sex, Quantity, Standard Price, Total Price, Product Category, Sales Period, and Quarter.

b. Output Requirement Analysis

   The following are the output data requirements produced by the sales performance analysis information system:

   b.1. The number of transactions in a selected period of time.

b.2. Quantity of preferred product category sales in a selected period of time.

b.3. Gross sales of preferred product category sales in a selected period of time.

b.4. Discount incurred of preferred product category sales in a selected period of time.

b.5. Subtotal sales of preferred product category sales in a selected period of time.

b.6. Quantity of all product sales of preferred product category sales in a selected period of time.

b.7. Subtotal of all product sales of preferred product category sales in a selected period of time.

b.8. Historical demand in a monthly data point.

c. Table of Data Input

Table 4. 2. Data Input of Sales Performance Analysis

No	Data Attributes	Form	Data Types	Explanation
1	ProductID	Sales	Varchar	Product unique identifier code
2	Product Name		Text	Name of the product
3	Size		Integer	Size of the product
4	Sex		Text	Gender type of a product
5	Quantity		Integer	Number of the product purchased
6	Standard Price		Integer	Product per unit price
7	Gross		Integer	Price per unit based on the quantity of the product purchased
8	Discount		Integer	Discount given for specified transaction
9	Subtotal		Integer	Gross with discounted price
10	Product Category		Text	Specified product category
11	Sales Period		Date	Product transaction month
12	Quarter		Date	Product transaction quarter

4.2.2.2 Forecasting Analysis (Custom)

Custom demand forecasting provides five methods of forecasting that are calculated manually by the researcher namely: moving average-3, moving average-4, weighted moving average-3, exponential smoothing, and seasonal index combined with linear regression. To evaluate the result obtained, tracking signals are used. The demand for each category of product is expected to be provided.

a. Input Requirement Analysis

a.1. Monthly Forecast

A monthly dorecast is a datasheet that contains the calculation of each category of products through five different methods of forecasting calculation. Each of the forecasting results is provided with a tracking signal. Monthly forecast data would be based on monthly data point calculation for its forecasting calculation. The data contained in Monthly Forecast are: Product Category, Sales Period, Forecast Method, t, Whole Monthly Demand, Forecast, Error, RSFE, |Error|, Cumulative |Error|, MAD, and Tracking Signal.

a.2. Quarterly Forecast

Quarterly forecast mostly same with monthly forecast datasheet. The difference lied in quarterly data point calculation are used by Quarterly Forecast for its forecasting calculation. The data contained in Quarterly Forecast are Product Category, Quarter, Forecast Method, t, Whole Quarterly Demand, Forecast, Error, RSFE, |Error|, Cumulative |Error|, MAD, and Tracking Signal.

a.3. Scoreboard

The scoreboard comprises information needed for forecasting result evaluation. The data comprised in Scoreboard are Product Category, Time Range, Forecast Method, MAD, and Average Tracking Signal.

b. Output Requirement Analysis

Based on the input provided, the output obtained from custom demand forecasting is expected to be a solution based on the research objective. The output generated from the custom demand foresting includes:

b.1. The total quantity of each category of product sales is based on a monthly data point and quarterly data point.

b.2. Forecasted results of each category of product sales.

b.3. Forecasted result of five different forecasting techniques.

b.4. Tracking signal of each category of product sales.

b.5. Tracking signal of five different forecasting techniques.

b.6. MAD of five different forecasting techniques.

b.7. Average tracking signal of five different forecasting techniques.

c. Table of Data Input

Table 4. 3. Data Input of Forecasting Analysis (Custom)

No	Data Attributes	Form		Explanation
1	Product Category	Monthly Forecast	Text	Specified product category
2	Sales Period		Date	Product transaction month
3	Forecast Method		Text	Specified forecast techniques
4	t		Integer	Period
5	Whole Monthly Demand		Integer	Historical product sales on a monthly data point
6	Forecast		Integer	Forecasted future demand
7	Error		Integer	The gap between the actual value and forecasted value
8	RSFE		Integer	Running Sum of Forecast Error
9	|Error|		Integer	Error absolute
10	Cumulative |Error|		Integer	Running sum of error absolute
11	MAD		Integer	Mean Absolute Deviation
12	Tracking Signal		Integer	Forecast bias indicator

No	Data Attributes	Form		Explanation
13	Product Category	Quarterly Forecast	Text	Specified product category
14	Quarter		Date	Product transaction quarter
15	Forecast Method		Text	Specified forecast techniques
16	t		Integer	Period
17	Whole Quarterly Demand		Integer	Historical product sales on a quarterly data point
18	Forecast		Integer	Forecasted future demand
19	Error		Integer	The gap between the actual value and forecasted value
20	RSFE		Integer	Running Sum of Forecast Error
21	|Error|		Integer	Error absolute
22	Cumulative |Error|		Integer	Running sum of error absolute
23	MAD		Integer	Mean Absolute Deviation
24	Tracking Signal		Integer	Forecast bias indicator
25	Product Category	Scoreboard	Text	Specified product category
26	Time Range		Text	Specified data point time range
27	Forecast Method		Text	Specified forecast techniques
28	MAD		Integer	Mean Absolute Deviation
29	Average Tracking Signal		Integer	Mean of Tracking Signal

4.2.2.3 Forecasting Analysis (Tableau Built-in)

Built-in demand forecasting used the built-in forecasting analysis by the Tableau software.

a. Input Requirement Analysis

Together with Sales Performance, there is only one datasheet that is required as input namely:

a.1. Sales

Sales datasheet contains data about all sales activities such as Product Name, Size, Sex, Quantity, Standard Price, Total Price, Product Category, Sales Period, and Quarter.

b. Output Requirement Analysis

The output generated from the built-in demand foresting displays:

b.1. The total quantity of each category of product sales is based on a monthly data point and quarterly data point.

b.2. Forecasted results of each category of product sales.

b.3. The upper limit for each forecasted result.

b.4. The lower limit for each forecasted result.

c. Table of Data Input

Table 4. 4. Data Input of Forecasting Analysis (Tableau Built-in)

No	Data Attributes	Form	Data Types	Explanation
1	ProductID	Sales	Varchar	Product unique identifier code
2	Product Name		Text	Name of the product
3	Size		Integer	Size of the product
4	Sex		Text	Gender type of a product
5	Quantity		Integer	Number of the product purchased
6	Standard Price		Integer	Product per unit price
7	Gross		Integer	Price per unit based on the quantity of the product purchased

No	Data Attributes	Form	Data Types	Explanation
8	Discount		Integer	Discount given for specified transaction
9	Subtotal		Integer	Gross with discounted price
10	Product Category		Text	Specified product category
11	Sales Period		Date	Product transaction month
12	Quarter		Date	Product transaction quarter

4.2.2.4 Market Basket Analysis

Market basket analysis serves as an objective in order to discover the relation between product sales. It functions by searching for objects that are commonly purchased together in the same transaction.

a. Input Requirement Analysis

A single datasheet is used for developing this system namely:

a.1. Cashier Recap

Cashier recap provides daily transaction details data which are: TransactionID, Cashier Name, Product Name, Size, Sex, Quantity, Standard Price, Gross, Discount, Subtotal, Product Category, Sales Period, and Brand.

b. Output Requirement Analysis

The information as output generated from the market basket analysis represents:

b.1. Additional items, which are purchased together with a selected product category.

b.2. General view of the relation of product which purchased together

b.3. Cashier performance of preferred sales period and selected brand.

b.4. Sales that have been processed by each cashier of preferred sales period and selected brand.

b.5. Quantity of product sales of preferred sales period and selected brand.

c. Table of Data Input

Table 4. 5. Data Input of Market Basket

No	Data Attributes	Form		Explanation
1	TransactionID	Cashier Recap	Varchar	Transaction unique identifier code
2	Cashier Name		Text	Cashier person in charge
3	Product Name		Text	Name of the product
4	Size		Integer	Size of the product
5	Sex		Text	Gender type of a product
6	Quantity		Integer	Number of the product purchased
7	Standard Price		Integer	Product per unit price
8	Gross		Integer	Price per unit based on the quantity of product purchased
9	Discount		Integer	Discount given for specified transaction
10	Subtotal		Integer	Gross with discounted price
11	Product Category		Text	Specified product category
12	Sales Period		Date	Product transaction month
13	Brand		Text	Brand of specifed product

4.2.3 Business Intelligence

After reviewing the system requirements, the next step is to visualize the system of business intelligence. Sherman (2015) proposed a six-step method for developing a self-service business intelligence system in his research. There are scope and plan phase, analyze and define phase, architect and design phase, built test and refine phase, implement phase, deploy and roll-out phase.

However, only the first four stages were completed; the deploy and roll-out phases were not carried out because the research is still in the design process and not yet in the implementation stage. Below are the four stages of Self-Service BI:

4.2.3.1 Scope and Plan

The researcher will decide the scope of the system design of business intelligence after reviewing the issue and discussing it with related parties at PT. Lintas Bintang Mulia Nusantara. Following are the scope of the system:

1. Sales Performance
2. Monthly Forecasting
3. Quarterly Forecasting
4. Built-in Forecasting
5. Market Basket Analysis

The five scopes mentioned above are the system design and development limitations. This business intelligence system used data from PT. Lintas Bintang Mulia Nusantara, which was analyzed in the section on system requirements. The system output is a dashboard that contains the data from the sub-chapter of system requirements and will be used by PT. Lintas Bintang Mulia Nusantara for decision-making and other purposes.

The researcher performed the validation with PT. Lintas Bintang Mulia Nusantara after establishing the scope and plan of the business intelligence system for the study. This validation seeks to match the findings of the scope and plan of the business intelligence system that the researcher will develop with the research object, PT. Lintas Bintang Mulia Nusantara.

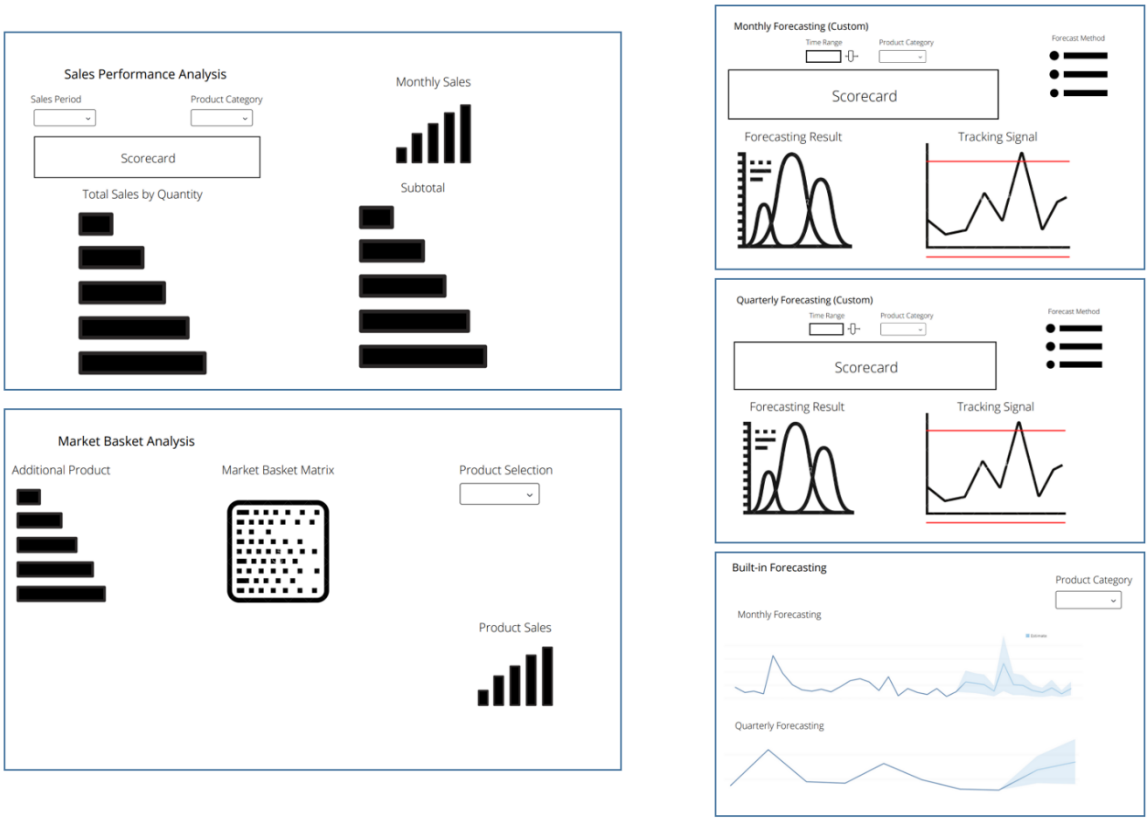
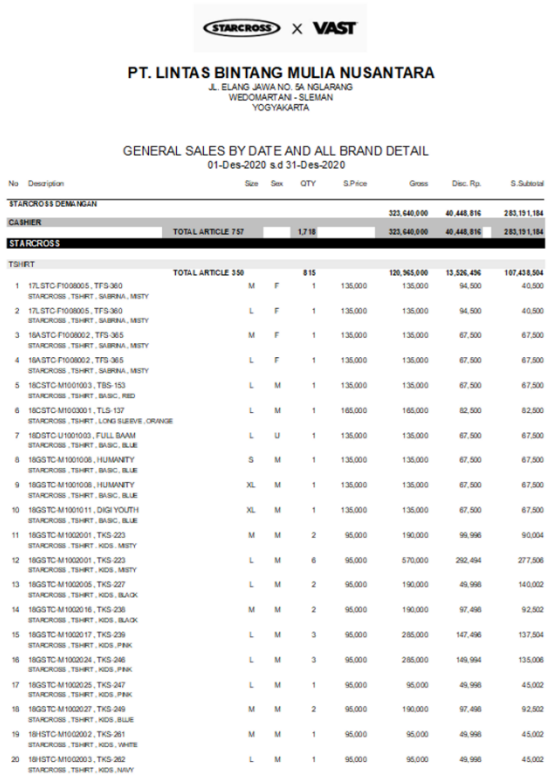


Figure 4. 6. Validated Dashboard Design

The validation process is carried out in consultation with PT. Lintas Bintang Mulia Nusantara's general store manager and owner. The consultation is used to establish a common ground between the findings of the researcher's design and the business intelligence system needs of the company. Figure 4.4 represents five dashboard prototypes which have been validated.

4.2.3.2 Analyze and Define

All of the data employed in establishing a dashboard comes from the internal of the company. There are no such external data employed for the development of a business intelligence system. The sales report data from 2019 to 2020 from the Demangan branch store was used to build the dashboard of sales performance and forecasting analysis at PT. Lintas Bintang Mulia Nusantara. Furthermore, a daily cashier recap is used to build additional market basket analysis. All information was gathered from Revota software, which is a software used by PT. Lintas Bintang Mulia Nusantara for general ledger documentation. Following are the example of used Revota report:

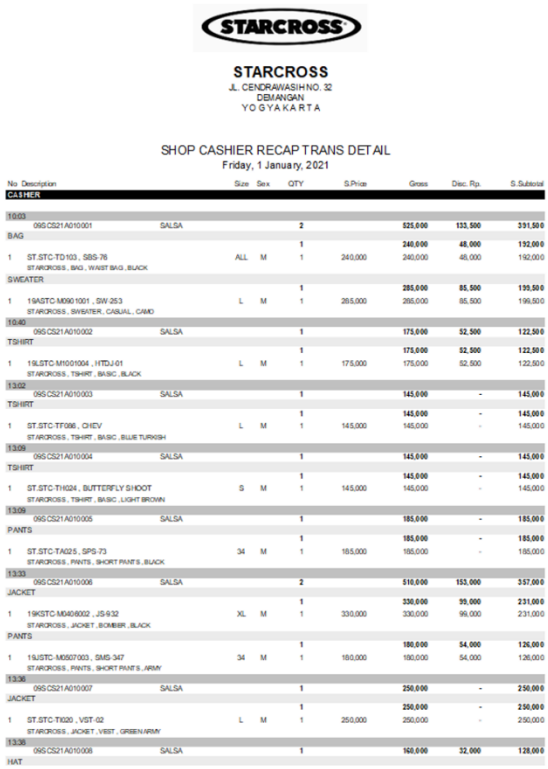


STARCROSS × VAST

PT. LINTAS BINTANG MULIA NUSANTARA
JL. ELANG JAWA NO. 5A NGLARANG
WEDOMARTANI - SLEMAN
YOGYAKARTA

GENERAL SALES BY DATE AND ALL BRAND DETAIL
01-Des-2020 s.d 31-Des-2020

No	Description	Size	Sex	QTY	S.Price	Gross	Disc. Rp.	S.Subtotal
STARCROSS DEMANGAN								
						323,640,000	40,448,816	283,191,184
CASHIER								
	TOTAL ARTICLE 757			1,718		323,640,000	40,448,816	283,191,184
STARCROSS								
TSHIRT								
	TOTAL ARTICLE 350			815		120,965,000	13,526,496	107,438,504
1	17LSTC-F1008005 , TFS-360 STARCROSS , TSHIRT , SABRINA , MISTY	M	F	1	135,000	135,000	94,500	40,500
2	17LSTC-F1008005 , TFS-360 STARCROSS , TSHIRT , SABRINA , MISTY	L	F	1	135,000	135,000	94,500	40,500
3	18ASTC-F1008002 , TFS-365 STARCROSS , TSHIRT , SABRINA , MISTY	M	F	1	135,000	135,000	67,500	67,500
4	18ASTC-F1008002 , TFS-365 STARCROSS , TSHIRT , SABRINA , MISTY	L	F	1	135,000	135,000	67,500	67,500
5	18CSTC-M1001003 , TBS-153 STARCROSS , TSHIRT , BASIC , RED	L	M	1	135,000	135,000	67,500	67,500
6	18CSTC-M1003001 , TLS-137 STARCROSS , TSHIRT , LONG SLEEVE , ORANGE	L	M	1	165,000	165,000	82,500	82,500
7	18DSTC-U1001003 , FULL BAAM STARCROSS , TSHIRT , BASIC , BLUE	L	U	1	135,000	135,000	67,500	67,500
8	18GSTC-M1001008 , HUMANITY STARCROSS , TSHIRT , BASIC , BLUE	S	M	1	135,000	135,000	67,500	67,500
9	18GSTC-M1001008 , HUMANITY STARCROSS , TSHIRT , BASIC , BLUE	XL	M	1	135,000	135,000	67,500	67,500
10	18GSTC-M1001011 , DIGI YOUTH STARCROSS , TSHIRT , BASIC , BLUE	XL	M	1	135,000	135,000	67,500	67,500
11	18GSTC-M1002001 , TKS-223 STARCROSS , TSHIRT , KIDS , MISTY	M	M	2	95,000	190,000	99,996	90,004
12	18GSTC-M1002001 , TKS-223 STARCROSS , TSHIRT , KIDS , MISTY	L	M	6	95,000	570,000	292,494	277,506
13	18GSTC-M1002005 , TKS-227 STARCROSS , TSHIRT , KIDS , BLACK	L	M	2	95,000	190,000	49,998	140,002
14	18GSTC-M1002016 , TKS-238 STARCROSS , TSHIRT , KIDS , BLACK	M	M	2	95,000	190,000	97,498	92,502
15	18GSTC-M1002017 , TKS-239 STARCROSS , TSHIRT , KIDS , PINK	L	M	3	95,000	285,000	147,496	137,504
16	18GSTC-M1002024 , TKS-246 STARCROSS , TSHIRT , KIDS , PINK	L	M	3	95,000	285,000	149,994	135,006
17	18GSTC-M1002025 , TKS-247 STARCROSS , TSHIRT , KIDS , PINK	L	M	1	95,000	95,000	49,998	45,002
18	18GSTC-M1002027 , TKS-249 STARCROSS , TSHIRT , KIDS , BLUE	M	M	2	95,000	190,000	97,498	92,502
19	18HSTC-M1002002 , TKS-261 STARCROSS , TSHIRT , KIDS , WHITE	M	M	1	95,000	95,000	49,998	45,002
20	18HSTC-M1002003 , TKS-262 STARCROSS , TSHIRT , KIDS , NAVY	L	M	1	95,000	95,000	49,998	45,002



STARCROSS

STARCROSS
JL. CENDRAWASIH NO. 32
DEMANGAN
YOGYAKARTA

SHOP CASHIER RECAP TRANS DETAIL
Friday, 1 January, 2021

No	Description	Size	Sex	QTY	S.Price	Gross	Disc. Rp.	S.Subtotal
CASHIER								
10:03								
	09SCS21A010001 SALSA			2		525,000	133,500	391,500
BAG								
				1		240,000	48,000	192,000
1	ST.STC-TD103 , SBS-76 STARCROSS , BAG , WAIST BAG , BLACK	ALL	M	1	240,000	240,000	48,000	192,000
SWEATER								
				1		285,000	85,500	199,500
1	19ASTC-M090 1001 , SW-253 STARCROSS , SWEATER , CASUAL , CAMO	L	M	1	285,000	285,000	85,500	199,500
10:40								
	09SCS21A010002 SALSA			1		175,000	52,500	122,500
TSHIRT								
				1		175,000	52,500	122,500
1	19LSTC-M1001004 , HTDJ-01 STARCROSS , TSHIRT , BASIC , BLACK	L	M	1	175,000	175,000	52,500	122,500
13:02								
	09SCS21A010003 SALSA			1		145,000	-	145,000
TSHIRT								
				1		145,000	-	145,000
1	ST.STC-TF096 , CHEV STARCROSS , TSHIRT , BASIC , BLUE TURKISH	L	M	1	145,000	145,000	-	145,000
13:09								
	09SCS21A010004 SALSA			1		145,000	-	145,000
TSHIRT								
				1		145,000	-	145,000
1	ST.STC-TH024 , BUTTERFLY SHOOT STARCROSS , TSHIRT , BASIC , LIGHT BROWN	S	M	1	145,000	145,000	-	145,000
13:09								
	09SCS21A010005 SALSA			1		185,000	-	185,000
PANTS								
				1		185,000	-	185,000
1	ST.STC-TA025 , SPS-73 STARCROSS , PANTS , SHORT PANTS , BLACK	34	M	1	185,000	185,000	-	185,000
13:33								
	09SCS21A010006 SALSA			2		510,000	153,000	357,000
JACKET								
				1		330,000	99,000	231,000
1	19KSTC-M0406002 , JS-932 STARCROSS , JACKET , BOMBER , BLACK	XL	M	1	330,000	330,000	99,000	231,000
PANTS								
				1		180,000	54,000	126,000
1	19JSTC-M0507003 , SMS-347 STARCROSS , PANTS , SHORT PANTS , ARMY	34	M	1	180,000	180,000	54,000	126,000
13:36								
	09SCS21A010007 SALSA			1		250,000	-	250,000
JACKET								
				1		250,000	-	250,000
1	ST.STC-TI020 , VST-02 STARCROSS , JACKET , VEST , GREEN ARMY	L	M	1	250,000	250,000	-	250,000
13:38								
	09SCS21A010008 SALSA			1		160,000	32,000	128,000
HAT								

Figure 4. 7. Used Report Example

The data from the Revota software must be processed, and aimed to the coverage that will be addressed in this research are sales performance, custom forecast (monthly and quarterly forecast), built-in forecast, and market basket analysis. After processed, the latest data can be used as a warehouse database for PT. Lintas Bintang Mulia Nusantara's. The data collected from the software are in pdf format, and it will be imported to Tableau after it has been processed to meet the data requirements.

4.2.3.3 Architect and Design

a. Data Warehouse Model

As an output of the sub-chapter of analysis system requirements, there are three logics models which required to be composed. Below are the logics models composed.

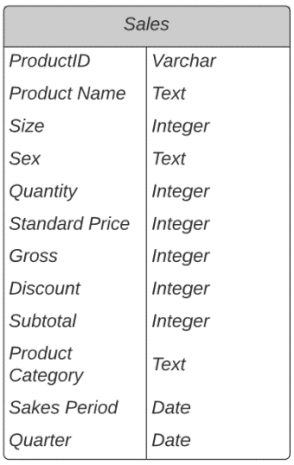


Figure 4. 8. Sales Performance & Tableau Built-in Forecasting Warehouse model

Figure 4.6 represented the data table employed for sales performance analysis and Tableau built-in forecasting analysis. There are no data connections since only one data table is employed for the data warehouse that handles sales performance and built-in forecasting.

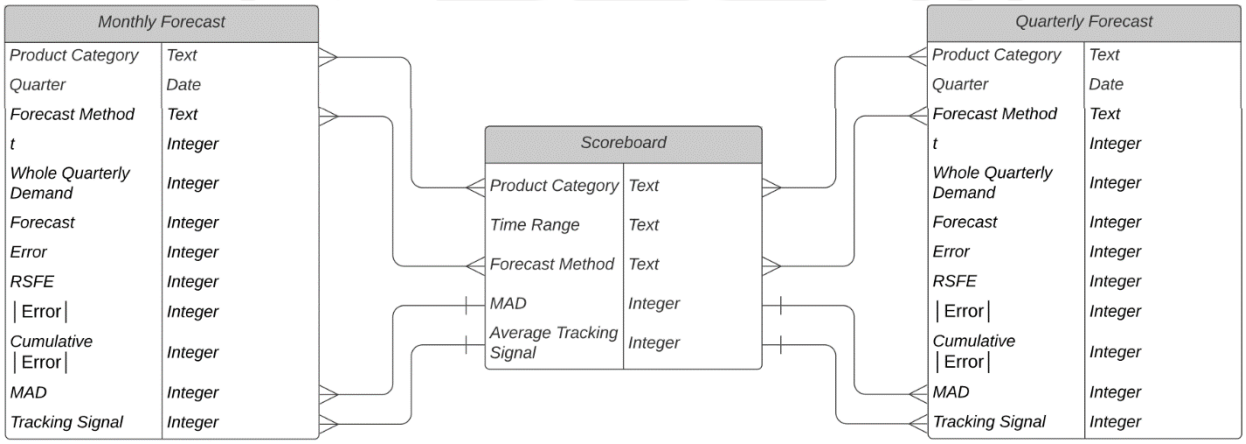


Figure 4. 9. Custom Forecasting Warehouse model

Figure 4.7 involved data tables and their connections with others tables that are used in order for establishing custom forecast analysis.

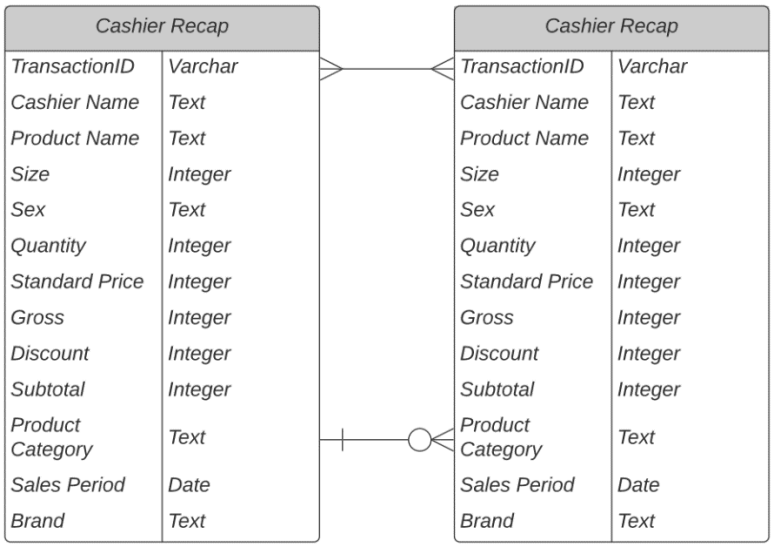


Figure 4. 10. Market Basket Analysis Warehouse model

The third figure of warehouse model intended for constructing market basket analysis. The clone or dummy of the table created with a purposes for obtaining data slices for the convenience of the programming logic in developing market basket analysis.

b. Visualization Design

a. Sales Performance Dashboard Design

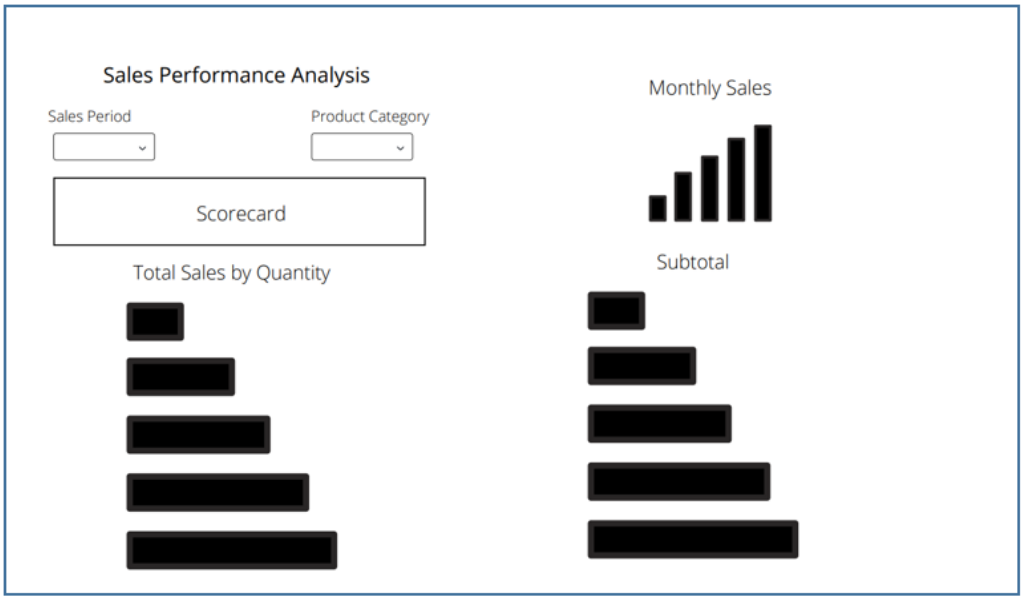


Figure 4. 11. Sales Performance Dashboard Design

Figure 4.9 presented the design of sales performance. User selection is employed for selecting specified sales periods and product categories. A scorecard would present the total transactions,

sales quantity, gross sales, discount incurred, and subtotal prices. The total quantity of each product based on the selected product category and in determining sales period are then formulated as well as with subtotal prices of each product. Lastly, monthly sales are involved in analysing the peak period for the company.

b. Monthly Forecasting and Quarterly Forecasting (Custom) Dashboard Design

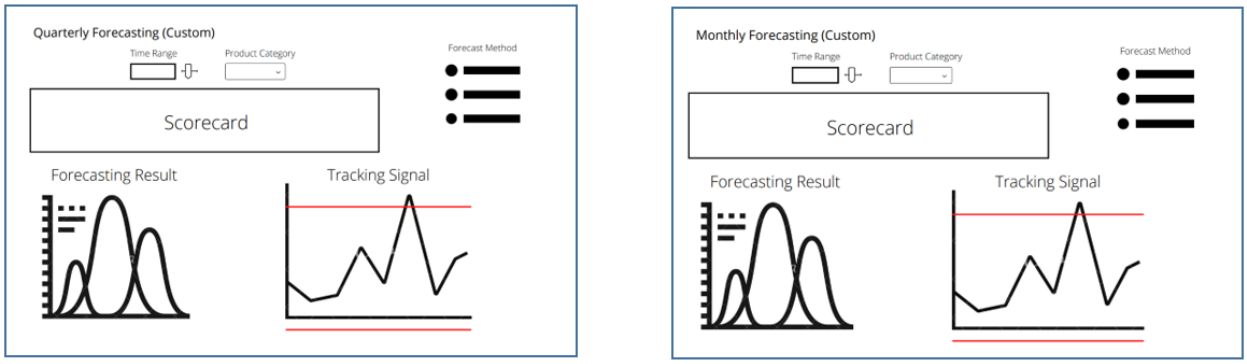


Figure 4. 12. Monthly Forecasting and Quarterly Forecasting (Custom) Dashboard Design

There are lastly three user selections are made for the custom forecast dashboard. The purpose of the dashboard is providing five methods of forecasting namely: moving average-3, moving average-4, weighted moving average-3, exponential smoothing, and seasonal index combined with linear regression. The user can select the specified product category as well as with intended forecast method. The scorecard is developed to present MAD value and average tracking signal for each forecasting method. The forecasting result of the selected forecast method is then presented in the line chart. To evaluate the result obtained, the graph of tracking signal result is formed.

c. Built-in Forecasting Dashboard Design

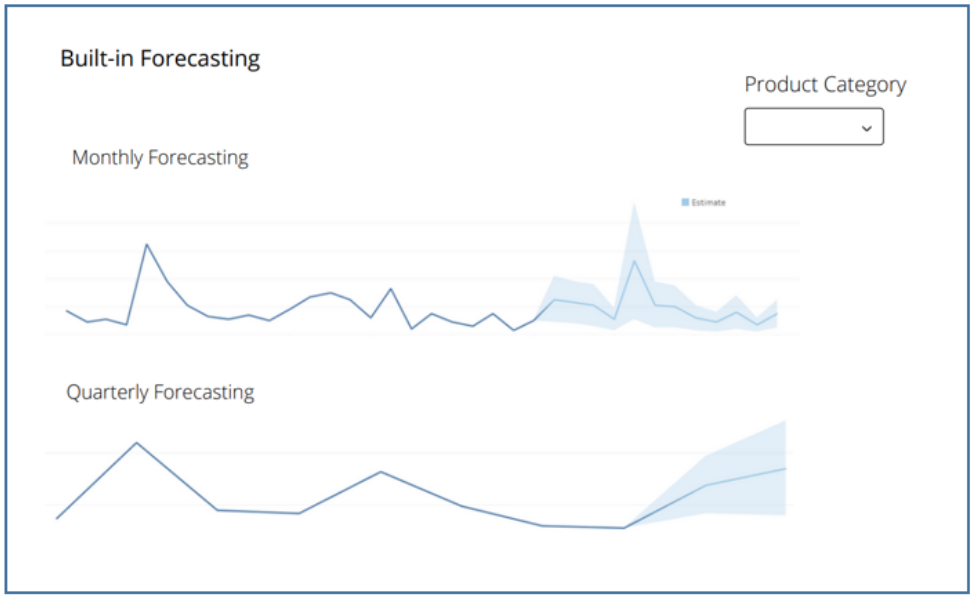


Figure 4. 13. Built-in Forecasting Dashboard Design

Built-in forecasting dashboard used the built-in forecasting analysis by the Tableau software. A single user selection is intended for determining the specified product category employed. The result of forecasting is split into two distinct sections according to the timeframe point. Furthermore, lower limit and upper limit of forecasting results are provided in both charts.

d. Market Basket Analysis Dashboard Design

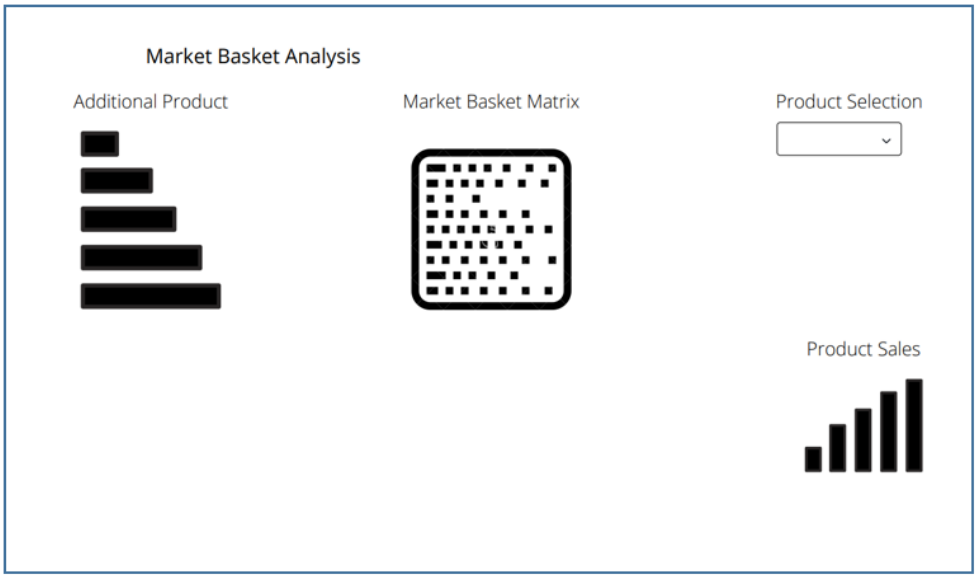


Figure 4. 14. Market Basket Analysis Dashboard Design

The design of the market basket dashboard provides the result of other products that are bought together within the selected product category in a stacked bar chart. Furthermore, the market basket matrix is provided for a comprehensive overview of each product category relation which the relation presented how many both of them are purchased together.

4.2.3.4 Build and Test Phase

4.2.3.4.1 Extract, Transform, and Load Data (ETL)

A researcher can process the data collected in multiple stages to construct a warehouse database. The first stage is transforming the PDF report format to Excel is necessary because Tableau can only read a limited number of data formats, such as Excel, SQL, and Python. The data from the sales report, which is still in pdf format, will be converted to excel. Data that are already in excel format will go through the ETL (Extraction, Transformation, Load) process, which is a process of eliminating data that does not apply to the research objective (cleaning data), and then the data will be divided into parts (transformation).

This procedure is performed to build a warehouse database that meets the system's requirements. The warehouse database is ready to be imported into Tableau after going through the ETL process. Three warehouse databases will be established in this study namely one for sales performance and one for supply and demand. Following are the ETL procedure for each warehouse database.

a. Sales Performance and Built-in Forecasting Database

   One table in the sales performance and built-in database will be subjected to the ETL namely the sales table. The ETL procedure produced the following results for the sales table.

   a.1. Sales

      Sales tables are the main and single data report employed for sales performance and built-in forecasting database. The sales table contains a general view of aggregated sales that occurred in the preferred branch store.

ProductID	Product Name	Size	Sex	Quantit	Standard Price	Gross	Discount	Subtotal	Product Category	Sales Period	Quarter
TS-TTP-WHITE	TSHIRT TANK TOP WHITE	XL	M	1	100000	100000	50000	50000	Tshirt	Jan-19	Q1-2019
TS-SBR-MISTY	TSHIRT SABRINA MISTY	S	F	1	160000	160000	64000	96000	Tshirt	Jan-19	Q1-2019
TS-BSC-WHITE	TSHIRT BASIC WHITE	S	M	1	125000	125000	0	125000	Tshirt	Jan-19	Q1-2019
TS-R3/4-MISTY RED	TSHIRT REGLAN 3/4 MISTY RED	L	M	1	150000	150000	60000	90000	Tshirt	Jan-19	Q1-2019
TS-BSC-BLACK	TSHIRT BASIC BLACK	XL	M	1	135000	135000	40500	94500	Tshirt	Jan-19	Q1-2019
TS-BSC-WHITE	TSHIRT BASIC WHITE	XL	M	1	135000	135000	40500	94500	Tshirt	Jan-19	Q1-2019
TS-BSC-RED	TSHIRT BASIC RED	XL	M	1	135000	135000	40500	94500	Tshirt	Jan-19	Q1-2019
TS-BSC-BLUE	TSHIRT BASIC BLUE	M	M	1	135000	135000	40500	94500	Tshirt	Jan-19	Q1-2019
TS-LSV-BLACK	TSHIRT LONG SLEEVE BLACK	M	M	1	165000	165000	49500	115500	Tshirt	Jan-19	Q1-2019
TS-LSV-BLACK	TSHIRT LONG SLEEVE BLACK	XL	M	1	165000	165000	49500	115500	Tshirt	Jan-19	Q1-2019
TS-PKTS-MAROON	TSHIRT POCKET TEES MAROON	XL	M	1	135000	135000	40500	94500	Tshirt	Jan-19	Q1-2019
TS-BSC-RED	TSHIRT BASIC RED	XL	M	1	135000	135000	40500	94500	Tshirt	Jan-19	Q1-2019
TS-BSC-BLUE	TSHIRT BASIC BLUE	L	M	1	135000	135000	40500	94500	Tshirt	Jan-19	Q1-2019
TS-LSV-BLACK	TSHIRT LONG SLEEVE BLACK	XL	M	1	165000	165000	49500	115500	Tshirt	Jan-19	Q1-2019
TS-LSV-MISTY	TSHIRT LONG SLEEVE MISTY	S	M	1	165000	165000	49500	115500	Tshirt	Jan-19	Q1-2019
TS-R3/4-MISTY BLUE	TSHIRT REGLAN 3/4 MISTY BLUE	M	M	1	160000	160000	48000	112000	Tshirt	Jan-19	Q1-2019
TS-STP-WHITE BLACK	TSHIRT STRIPE WHITE BLACK	M	F	4	150000	600000	180000	420000	Tshirt	Jan-19	Q1-2019
TS-BSC-BROWN	TSHIRT BASIC BROWN	M	M	1	135000	135000	40500	94500	Tshirt	Jan-19	Q1-2019
TS-BSC-BLUE	TSHIRT BASIC BLUE	XL	M	1	135000	135000	40500	94500	Tshirt	Jan-19	Q1-2019
TS-BSC-RED	TSHIRT BASIC RED	XL	M	1	135000	135000	40500	94500	Tshirt	Jan-19	Q1-2019
TS-BSC-WHITE	TSHIRT BASIC WHITE	XL	M	1	135000	135000	40500	94500	Tshirt	Jan-19	Q1-2019
TS-TTPH-MISTY	TSHIRT TANK TOP HOODIE MISTY	M	M	2	135000	270000	81000	189000	Tshirt	Jan-19	Q1-2019

Figure 4. 15. Sales Data

Sales tables provide data in accordance with aggregated sales activities namely Product Name, Size, Sex, Quantity, Standard Price, Total Price, Product Category, Sales Period, and Quarter.

b. Custom Forecasting Database

In the custom forecasting database, three tables will go through the ETL process, namely the category monthly forecast, category quarterly forecast, and scorecard. The following are the results of the ETL process for each table in the custom forecasting database:

b.1. Category Monthly Forecast

A monthly forecast is a datasheet that contains the calculation of each category of products through five different methods of forecasting calculation. Each of the forecasting results provided a tracking signal. Monthly forecast data would be based on monthly data point calculation for its forecasting calculation.

Product Categor	Sales Period	Forecast Method	t	Whole Monthly Deman	Forecas	Error	RSFE	|Error|	Cumulative |Err	MAD	Tracking Sign
Accessories	Jan-19	Moving Average-3	1	63							
Accessories	Feb-19	Moving Average-3	2	46							
Accessories	Mar-19	Moving Average-3	3	50							
Accessories	Apr-19	Moving Average-3	4	58	53	5	5	5	5	5	1
Accessories	May-19	Moving Average-3	5	120	51.33333	68.66667	73.66667	68.66667	73.66666667	36.83333	2
Accessories	Jun-19	Moving Average-3	6	138	76	62	135.6667	62	135.6666667	45.22222	3
Accessories	Jul-19	Moving Average-3	7	95	105.3333	-10.3333	125.3333	10.33333	146	36.5	3.433789954
Accessories	Aug-19	Moving Average-3	8	95	117.6667	-22.6667	102.6667	22.66667	168.6666667	33.73333	3.043478261
Accessories	Sep-19	Moving Average-3	9	60	109.3333	-49.3333	53.33333	49.33333	218	36.33333	1.467889908
Accessories	Oct-19	Moving Average-3	10	68	83.33333	-15.3333	38	15.33333	233.3333333	33.33333	1.14
Accessories	Nov-19	Moving Average-3	11	78	74.33333	3.666667	41.66667	3.666667	237	29.625	1.406469761
Accessories	Dec-19	Moving Average-3	12	92	68.66667	23.33333	65	23.33333	260.3333333	28.92593	2.247119078
Accessories	Jan-20	Moving Average-3	13	86	79.33333	6.666667	71.66667	6.666667	267	26.7	2.684144819
Accessories	Feb-20	Moving Average-3	14	55	85.33333	-30.3333	41.33333	30.33333	297.3333333	27.0303	1.529147982
Accessories	Mar-20	Moving Average-3	15	95	77.66667	17.33333	58.66667	17.33333	314.6666667	26.22222	2.237288136
Accessories	Apr-20	Moving Average-3	16	17	78.66667	-61.6667	-3	61.66667	376.3333333	28.94872	-0.103631532
Accessories	May-20	Moving Average-3	17	82	55.66667	26.33333	23.33333	26.33333	402.6666667	28.7619	0.811258278
Accessories	Jun-20	Moving Average-3	18	39	64.66667	-25.6667	-2.33333	25.66667	428.3333333	28.55556	-0.081712062
Accessories	Jul-20	Moving Average-3	19	32	46	-14	-16.3333	14	442.3333333	27.64583	-0.59080633
Accessories	Aug-20	Moving Average-3	20	42	51	-9	-25.3333	9	451.3333333	26.54902	-0.954209749
Accessories	Sep-20	Moving Average-3	21	29	37.66667	-8.66667	-34	8.666667	460	25.55556	-1.330434783
Accessories	Oct-20	Moving Average-3	22	59	34.33333	24.66667	-9.33333	24.66667	484.6666667	25.50877	-0.365887208
Accessories	Nov-20	Moving Average-3	23	34	43.33333	-9.33333	-18.6667	9.333333	494	24.7	-0.755735493
Accessories	Dec-20	Moving Average-3	24	45	40.66667	4.333333	-14.3333	4.333333	498.3333333	23.73016	-0.604013378
Accessories	Jan-21	Moving Average-3	25		46						

Figure 4. 16. Category Monthly Forecast Data

The data contained in Monthly Forecast are: Product Category, Sales Period, Forecast Method, t, Whole Monthly Demand, Forecast, Error, RSFE, |Error|, Cumulative |Error|, MAD, and Tracking Signal.

b.2. Category Quarterly Forecast

Quarterly forecast mostly same with monthly forecast datasheet. The difference lied in quarterly data point calculation are used by Quarterly Forecast for its forecasting calculation.

Product Categor	Quarter	Forecast Method	t	Whole Quarterly Dema	Forecas	Error	RSFE	|Error|	Cumulative |Err	MAD	Tracking Sign
Accessories	Q1-2019	Moving Average-3	1	159							
Accessories	Q2-2019	Moving Average-3	2	316							
Accessories	Q3-2019	Moving Average-3	3	250							
Accessories	Q4-2019	Moving Average-3	4	238	241.6667	-3.66667	-3.66667	3.666667	3.666666667	3.666667	-1
Accessories	Q1-2020	Moving Average-3	5	236	268	-32	-35.6667	32	35.66666667	17.83333	-2
Accessories	Q2-2020	Moving Average-3	6	138	241.3333	-103.333	-139	103.3333	139	46.33333	-3
Accessories	Q3-2020	Moving Average-3	7	103	204	-101	-240	101	240	60	-4
Accessories	Q4-2020	Moving Average-3	8	138	159	-21	-261	21	261	52.2	-5
Accessories	Q1-2021	Moving Average-3	9		126.3333						
Accessories	Q1-2019	Moving Average-4	1	159							
Accessories	Q2-2019	Moving Average-4	2	316							
Accessories	Q3-2019	Moving Average-4	3	250							
Accessories	Q4-2019	Moving Average-4	4	238							
Accessories	Q1-2020	Moving Average-4	5	236	240.75	-4.75	-4.75	4.75	4.75	4.75	-1
Accessories	Q2-2020	Moving Average-4	6	138	260	-122	-126.75	122	126.75	63.375	-2
Accessories	Q3-2020	Moving Average-4	7	103	215.5	-112.5	-239.25	112.5	239.25	79.75	-3
Accessories	Q4-2020	Moving Average-4	8	138	178.75	-40.75	-280	40.75	280	70	-4
Accessories	Q1-2021	Moving Average-4	9		153.75						

Figure 4. 17. Category Quarterly Forecast Data

Based on Figure 4.15., the data contained in Quarterly Forecast are Product Category, Quarter, Forecast Method, t, Whole Quarterly Demand, Forecast, Error, RSFE, |Error|, Cumulative |Error|, MAD, and Tracking Signal.

b.3. Scorecard

The scoreboard comprises information needed for forecasting result evaluation. The data comprised in Scoreboard are Product Category, Time Range, Forecast Method, MAD, and Average Tracking Signal.

Product Categor	Time Range	Forecast Method	MAD	Average Tracking Sign
Accessories	Monthly	Moving Average-3	23.73016	1.010197888
Accessories	Monthly	Moving Average-4	24.4	0.859796211
Accessories	Monthly	Weighted MA-3	23.6	0.931016049
Accessories	Monthly	Exponential Smoothing	23.58233	0.678921877
Accessories	Monthly	Seasonal & Linear Reg.	16.48674	-0.129904677
Bag	Monthly	Moving Average-3	60.96825	0.378351527
Bag	Monthly	Moving Average-4	64.5125	-0.530040365
Bag	Monthly	Weighted MA-3	55.03333	0.290510595
Bag	Monthly	Exponential Smoothing	44.65071	0.092581808
Bag	Monthly	Seasonal & Linear Reg.	41.91277	1.412092505
Hat	Monthly	Moving Average-3	30.60317	1.004243202
Hat	Monthly	Moving Average-4	31.6375	0.228600665
Hat	Monthly	Weighted MA-3	33.38571	0.786132013
Hat	Monthly	Exponential Smoothing	37.47621	0.31266515
Hat	Monthly	Seasonal & Linear Reg.	16.75452	0.488245715
Jacket	Monthly	Moving Average-3	36.66667	-0.391637877
Jacket	Monthly	Moving Average-4	37.825	-0.011783132
Jacket	Monthly	Weighted MA-3	36.56667	-0.166837014
Jacket	Monthly	Exponential Smoothing	41.49001	-0.272589103
Jacket	Monthly	Seasonal & Linear Reg.	23.76294	-0.517985632
Pants	Monthly	Moving Average-3	104.3175	0.681702319
Pants	Monthly	Moving Average-4	109.6625	0.721345399

Figure 4. 18. Scorecard Data

c. Market Basket Analysis Database

One table with one clone or dummy table employed in the market basket analysis database will be subjected to the ETL process. The ETL procedure produced the following outputs for the table in the market basket analysis database:

c.1. Cashier Recap

Cashier recap provides daily transaction details data which are: TransactionID, Cashier Name, Product Name, Size, Sex, Quantity, Standard Price, Gross, Discount, Subtotal, Product Category, Sales Period, and Brand.

TransactionID	Cashier Name	Product Name	Size	Sex	Quantit	Standard Price	Gross	Discount	Subtotal	Product Category	Sales Period	Brand
09SC521A080012	DELLA TASYA	TSHIRT BASIC BLACK	L	M	1	150000	150000	0	150000	TSHIRT	Jan-21	STARCROSS
09SC521A020014	EGA	ACCESSORIES BELT BLACK	ALL	U	1	145000	145000	29000	116000	ACCESSORIES	Jan-21	STARCROSS
09SC521A050016	EGA	ACCESSORIES BELT BLACK	ALL	U	1	145000	145000	29000	116000	ACCESSORIES	Jan-21	STARCROSS
09SC521A130011	ANNA	ACCESSORIES BELT BLACK	ALL	U	1	145000	145000	29000	116000	ACCESSORIES	Jan-21	STARCROSS
09SC521A010010	SALSA	ACCESSORIES BELT BLACK ARMY	ALL	U	1	145000	145000	29000	116000	ACCESSORIES	Jan-21	STARCROSS
09SC521A030047	DELLA TASYA	ACCESSORIES EYEWEAR BLACK BROWN	ALL	U	1	75000	75000	52500	22500	ACCESSORIES	Jan-21	STARCROSS
09SC521A090037	DELLA TASYA	ACCESSORIES EYEWEAR BLACK BROWN	ALL	U	1	75000	75000	52500	22500	ACCESSORIES	Jan-21	STARCROSS
09SC521A050001	DELLA TASYA	ACCESSORIES EYEWEAR BLACK BROWN	ALL	U	1	75000	75000	52500	22500	ACCESSORIES	Jan-21	STARCROSS
09SC521A070011	SALSA	ACCESSORIES EYEWEAR BLACK BROWN	ALL	U	1	75000	75000	52500	22500	ACCESSORIES	Jan-21	STARCROSS
09SC521A070019	SALSA	ACCESSORIES EYEWEAR BLACK BROWN	ALL	U	1	75000	75000	52500	22500	ACCESSORIES	Jan-21	STARCROSS
09SC521A080006	SALSA	ACCESSORIES EYEWEAR BLACK BROWN	ALL	U	1	75000	75000	52500	22500	ACCESSORIES	Jan-21	STARCROSS
09SC521A080007	SALSA	ACCESSORIES EYEWEAR BLACK BROWN	ALL	U	1	75000	75000	52500	22500	ACCESSORIES	Jan-21	STARCROSS
09SC521A120008	ANNA	ACCESSORIES EYEWEAR BLACK BROWN	ALL	U	1	75000	75000	52500	22500	ACCESSORIES	Jan-21	STARCROSS
09SC521A080008	SALSA	ACCESSORIES GLOVES BLACK	ALL	M	1	70000	70000	21000	49000	ACCESSORIES	Jan-21	STARCROSS
09SC521A190001	ANNA	ACCESSORIES KEYCHAIN BLACK	ALL	U	1	75000	75000	0	75000	ACCESSORIES	Jan-21	STARCROSS
09SC521A100003	EGA	ACCESSORIES KEYCHAIN OLIVE	ALL	U	1	65000	65000	13000	52000	ACCESSORIES	Jan-21	STARCROSS
09SC521A050004	DELLA TASYA	ACCESSORIES KEYCHAIN RED	ALL	U	2	10000	20000	14000	6000	ACCESSORIES	Jan-21	STARCROSS
09SC521A050004	DELLA TASYA	ACCESSORIES KEYCHAIN RED	ALL	U	1	10000	10000	7000	3000	ACCESSORIES	Jan-21	STARCROSS
09SC521A050005	DELLA TASYA	ACCESSORIES KEYCHAIN RED	ALL	U	1	10000	10000	7000	3000	ACCESSORIES	Jan-21	STARCROSS
09SC521A060017	SALSA	ACCESSORIES KEYCHAIN RED	ALL	U	1	10000	10000	7000	3000	ACCESSORIES	Jan-21	STARCROSS
09SC521A150011	YOKO	ACCESSORIES KEYCHAIN RED	ALL	U	5	10000	50000	35000	15000	ACCESSORIES	Jan-21	STARCROSS
09SC521A190001	ANNA	ACCESSORIES KEYCHAIN RED	ALL	U	1	10000	10000	0	10000	ACCESSORIES	Jan-21	STARCROSS

Figure 4. 19. Cashier Recap Data

4.2.3.4.2 Importing Data

Tableau can only be worked if the data input meets system specifications and is matched in terms of connection and format. Those data is referred to as a warehouse database. Researchers can process the data collected in multiple stages to construct a warehouse database; the stages are as follows:

1. Transforming the PDF report format to Excel is necessary because Tableau can only read a limited number of data formats, such as Excel, SQL, and Python. The data from the sales report, which is still in pdf format, will be converted to excel.
2. Data that are already in excel format will go through the ETL (Extraction, Transformation, Load) process, which is a process of eliminating data that does not apply to the research objective (cleaning data), and then the data will be divided into parts (transformation). This procedure is performed in order to build a warehouse database that meets the system's requirements.
3. The warehouse database is ready to be imported into Tableau after going through the ETL process. The figure below presented the importing data process into Tableau desktop.

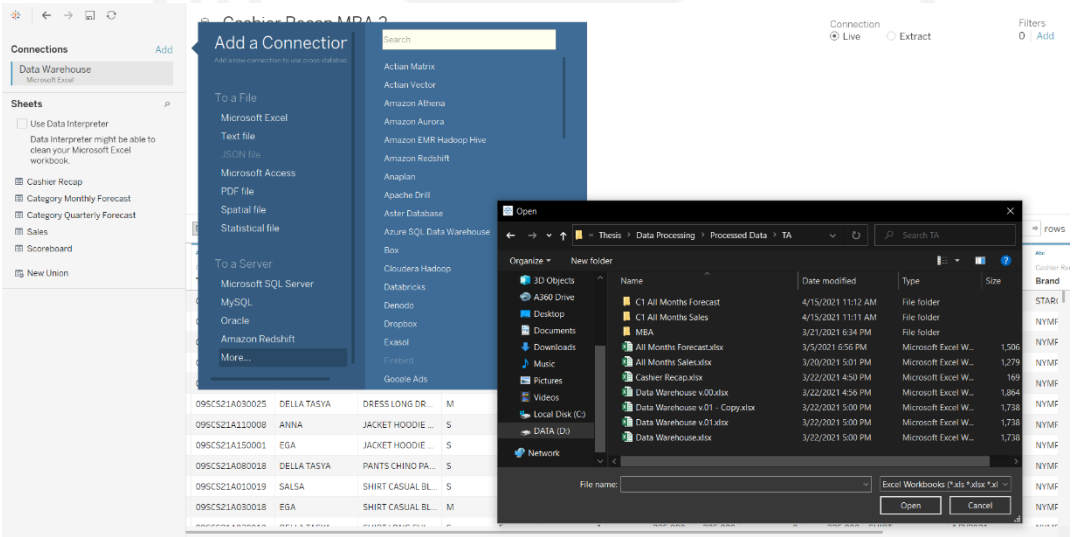


Figure 4. 20. Data Importing Process

4.2.3.4.3 Data Slices and Joins

Tableau requires defining relationships, slices, and joins of data after the data warehouse tables are designed and imported. This is critical because relationships between entities may be used to manage the relationships between the data mart's tables. Below are the data slices and joins on every data warehouse.

a. Sales Performance and Built-in Forecasting Data Warehouse

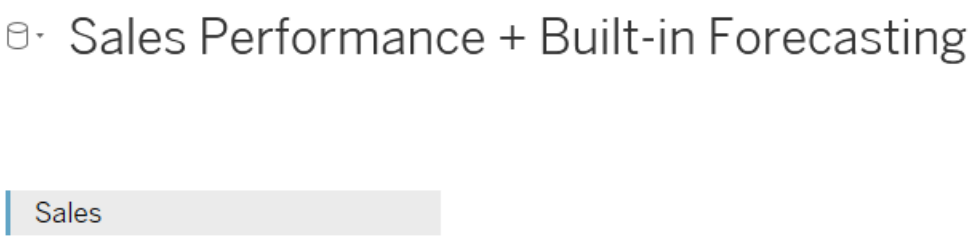


Figure 4. 21. Sales Performance and Built-in Forecasting Data Slice and Join

No data join created since there is only one data mart employed for constructing a sales performance and built-in forecasting. Sales data mart acts also as a data warehouse by reason of all of the data pertains to the aggregated sales that have been provided in detail.

b. Custom Forecasting Data Warehouse

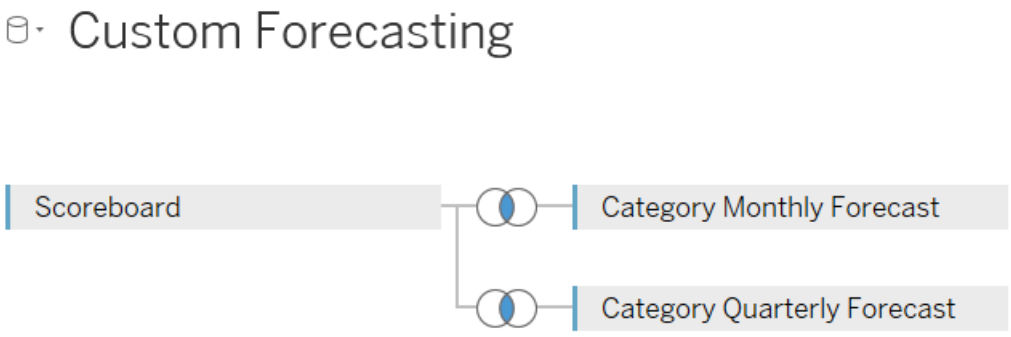


Figure 4. 22. Custom Forecast Data Slice and Joins

There are three data tables used for constructing a custom forecasting data warehouse. Category monthly forecast and category quarterly forecast provided calculation and the result of five different methods of forecasting. Both of them attached with inner join type to the scoreboard since the scoreboard data table compiled average tracking signal and MAD value for each

calculation method employed. Inner join type is used to drop value entirely when a value does not match across both tables.

c. Market Basket Analysis

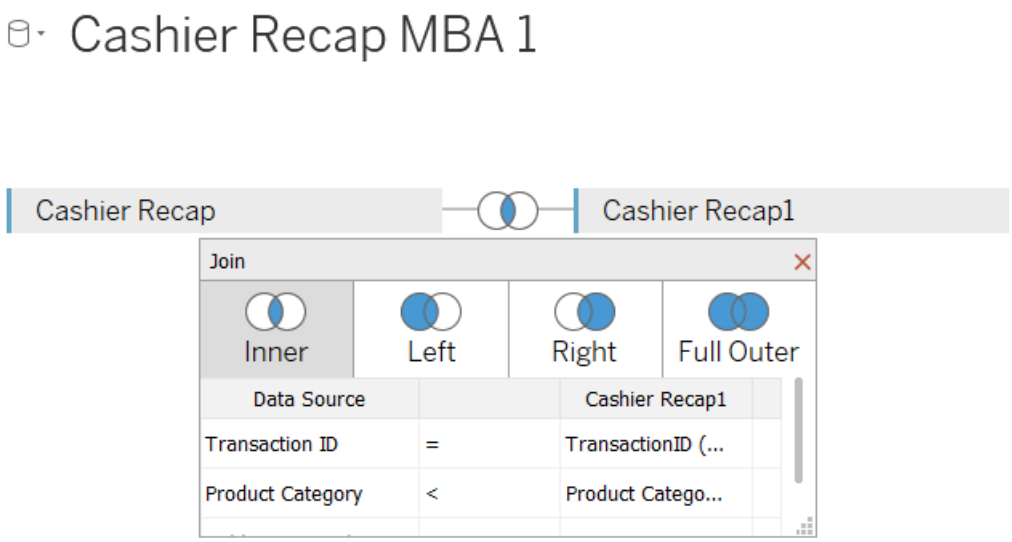


Figure 4. 23. Market Basket Analysis Data Slice and Joins

There is actually only one data table provided for developing the market basket dashboard. Self-join is set up based upon the Transaction ID to TransactionID. Furthermore, the proposed market basket on a product category for determining which product category are on the same orders in the most number of times. Therefore, self-join on product category would use less than (<) in purpose for seeking the slice of the product category. The data slice of product category represented the product which purchased together.

The parameter called user selection have been created with the single value list parameter control for giving the users flexibility in determining specified product category. In order to discover a subset of orders that contain the user selection, the calculated field must be created and the researcher named it by matches selection. The following figure is the pseudocode in creating matches selection.

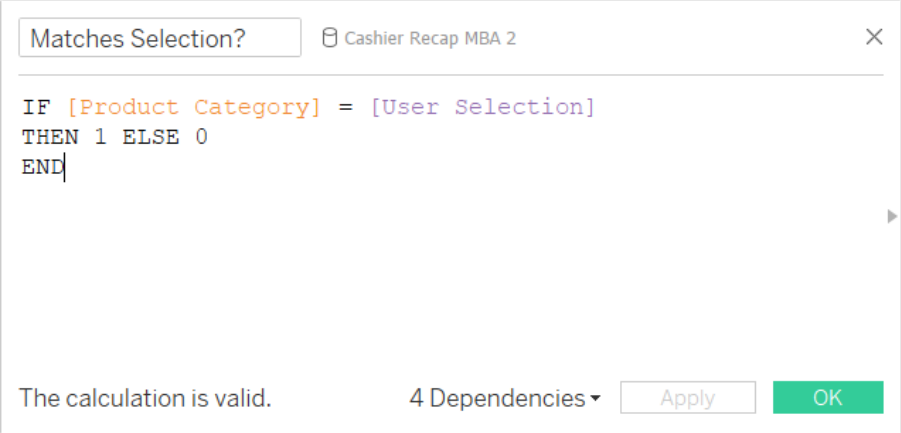


Figure 4. 24. Pseudocode for Developing Matches Selection Measure

Afterward, the researcher needs to build a set based on matches selection measures. The new set named by users has been created.

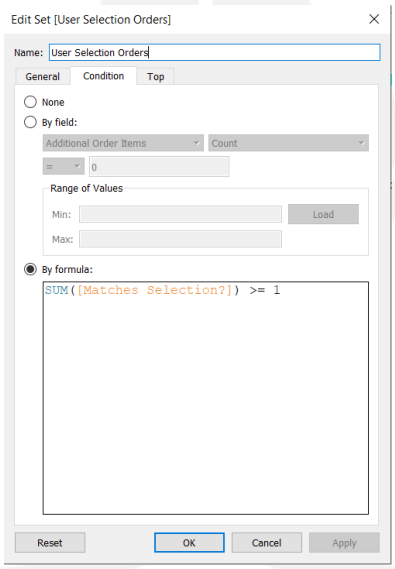


Figure 4. 25. Pseudocode for Developing User Selection Orders Set

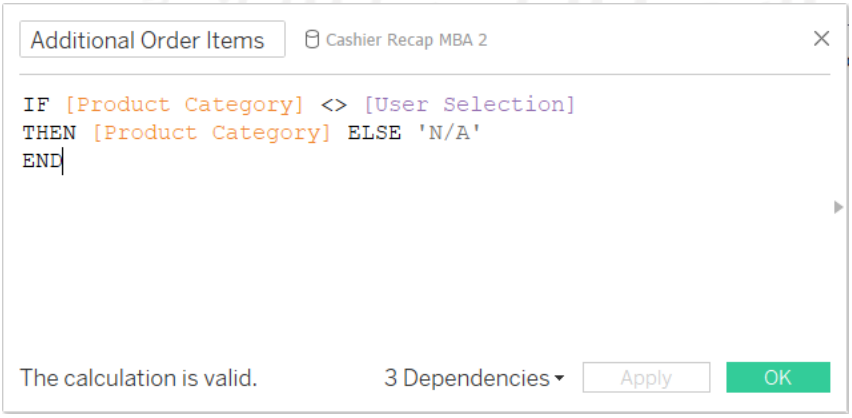


Figure 4. 26. Pseudocode for Additional Order Dimension

Then, a new dimension called additional order items is required to be developed. Figure 4.23represents the setting and pseudocode for developing a new set of user selection order. While Figure 2.24 represents pseudocode for developing a new dimension of additional order items.

4.2.3.4.4 Dashboard Development

As the final sub-process of the build and test phase, a dashboard can be created to visualize the data stored in the data warehouse. There are five dashboards developed, namely:

1. Sales Performance Analysis Dashboard

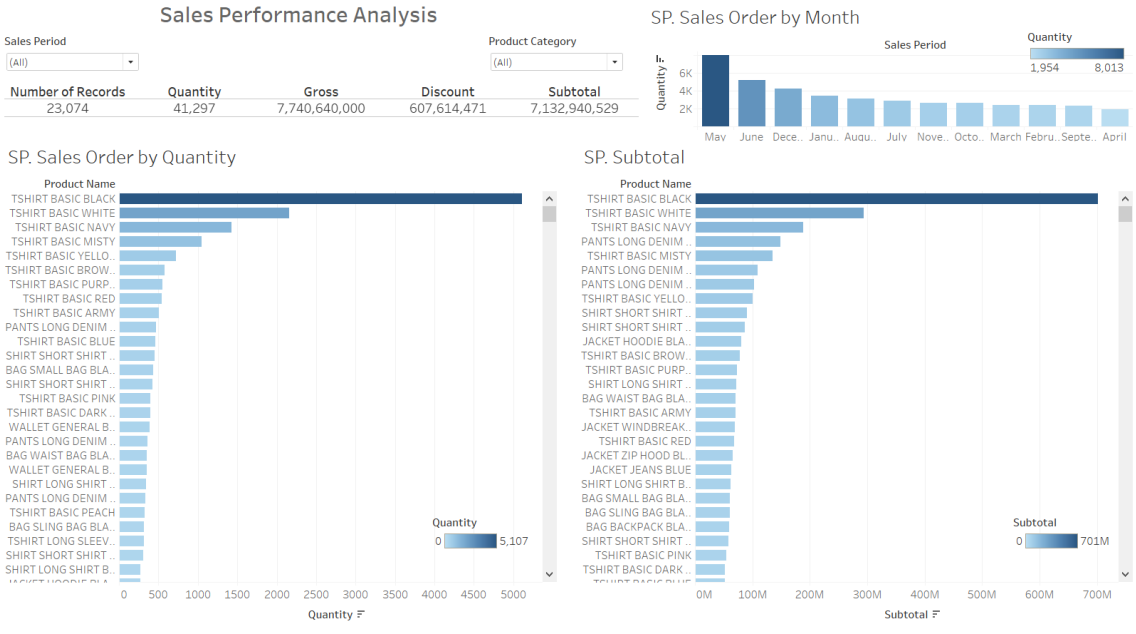


Figure 4. 27. Sales Performance Analysis Dashboard

The first developed dashboard represented sales performance analysis for aggregated product sales. The users are able to select desired sales period and product category since there are two filters provided. Sales period and product category can be selected with more than one option. As an example, figure 4.22 can provide the users' insight that within all periods and product categories, the product of t-shirt basic black is the best seller item. Furthermore, transactions counted in the number of 23074 with a total of 41297 products have been sold.

2. Monthly Forecasting Dashboard

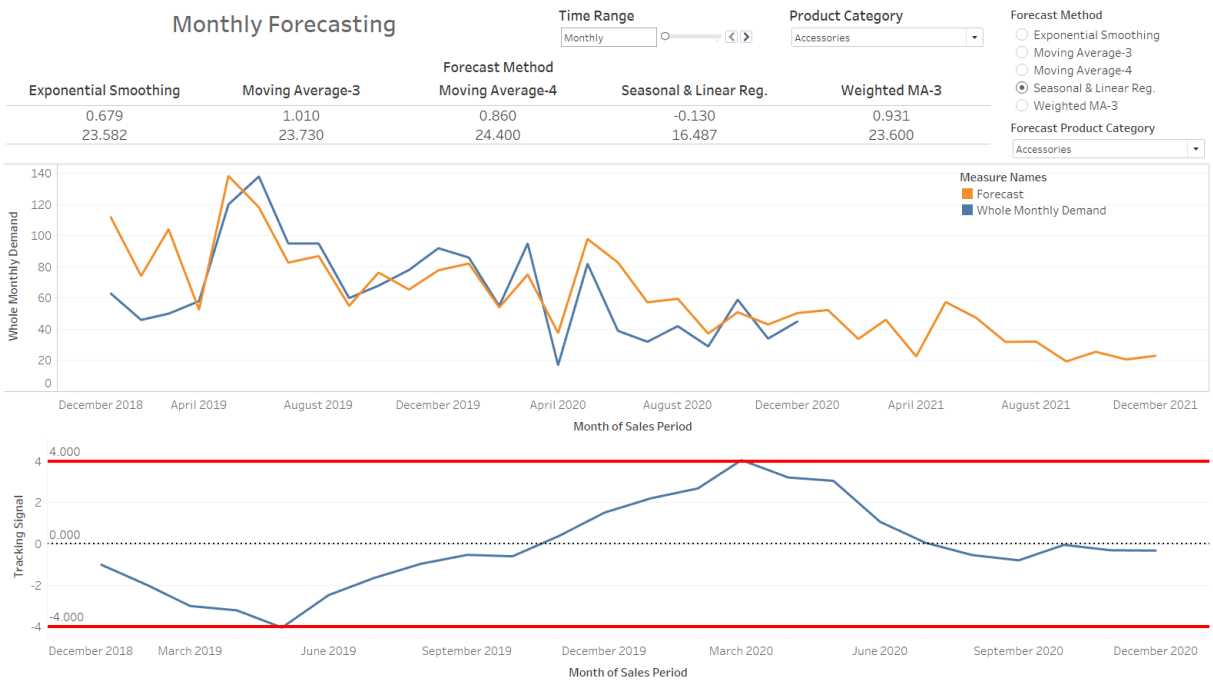


Figure 4. 28. Monthly Forecasting Dashboard

A monthly forecasting dashboard aims to visualize forecasting data for analysis and forecasting evaluation. Multiple data visualizations, filters, and cards are included, making it easier for interpretation and interactive display. Since the monthly forecasting dashboard are based on the five different forecasting method, the users can have flexibility in determining forecast method through single value (list) filter. The tracking signal is provided with the aim of forecasting result evaluation for each calculation method. Additionally, the scorecard compiled the average tracking signal and MAD value for each calculation method employed.

3. Quarterly Forecasting Dashboard

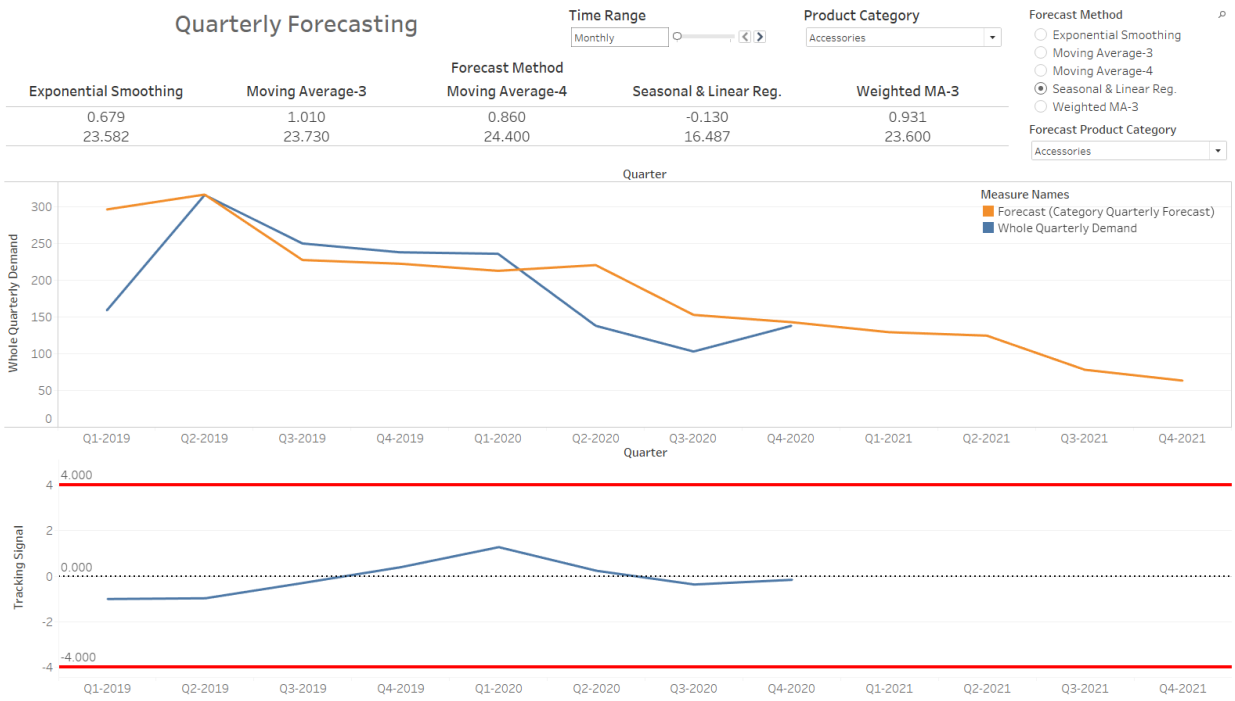


Figure 4. 29. Quarterly Forecasting Dashboard

The third dashboard is the quarterly forecasting dashboard, and it has nearly the same focuses as the second dashboard. The time point of historical sales and future forecasting is in quarterly based data point which makes it different from the second dashboard. Quarterly-based forecasting is required for the company since article design and production planning are done on a quarterly basis.

4. Built-in Forecasting Dashboard

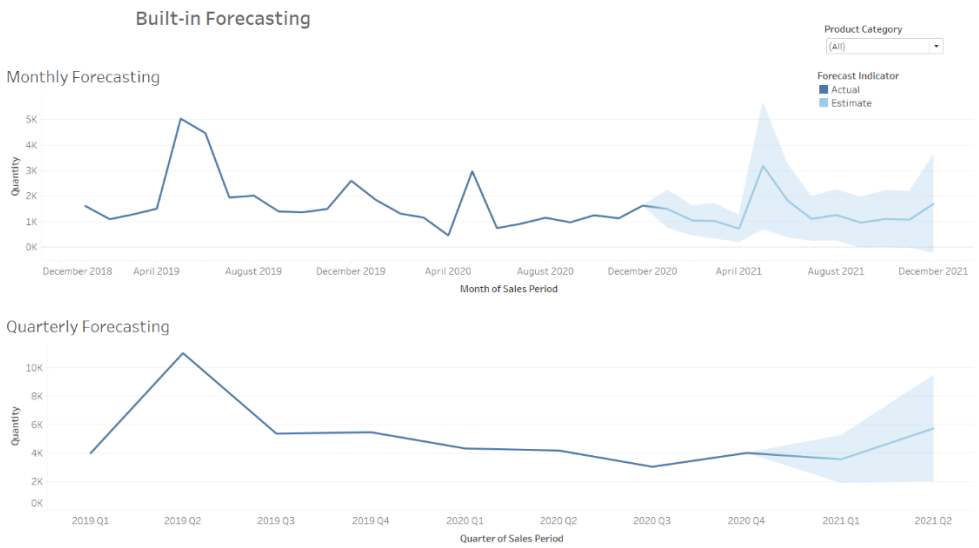


Figure 4. 30. Built-in Forecasting Dashboard

The dashboard above provided the future demand forecast for 12 months (1 year) projection. Furthermore, the upper and lower limit of forecasting projection is also presented in the graph. There is only one filter used that have the form of a single value – dropdown menu which giving the users ability for determining desired product category.

5. Market Basket Analysis Dashboard

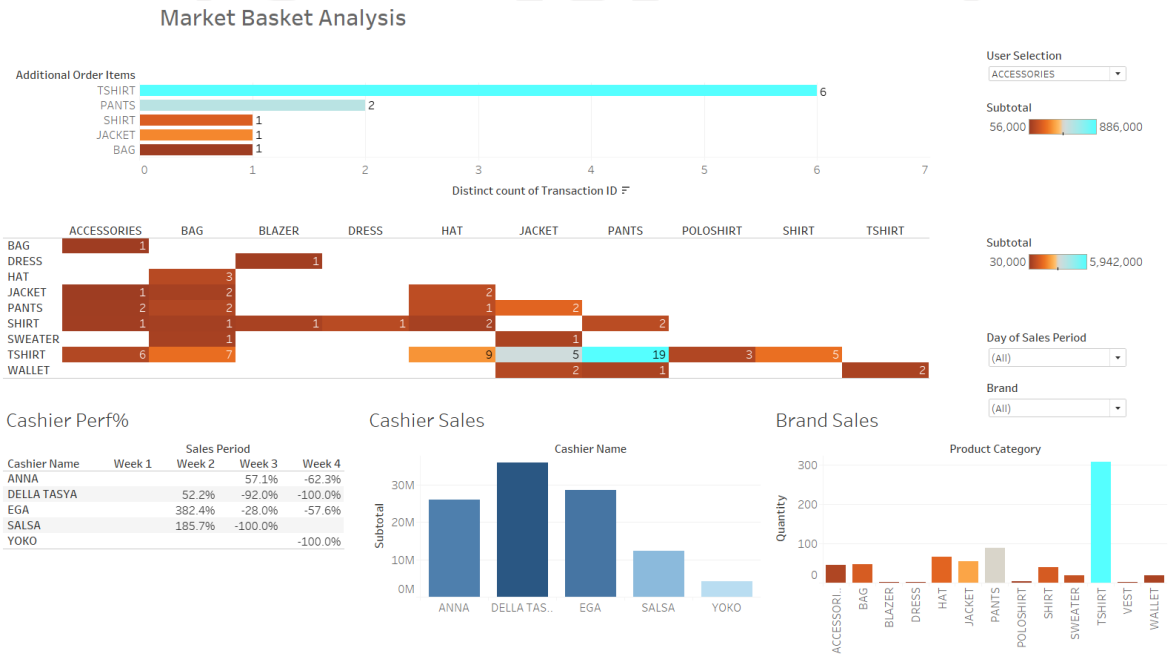


Figure 4. 31. Market Basket Analysis Dashboard

The last dashboard is the market basket analysis dashboard. The users can determine other products that are purchased together within the selected product through drop-down filter. Market basket matrix provided in purpose for a comprehensive overview of each product category relation which the relation presented how many both of them are purchased together. Furthermore, the scorecard of cashier performance indicated the individual performance percentage for handling the weekly transaction. Lastly, the bar graph of total sales in rupiah that has been recorded for each cashier person and product sales in quantity are provided.

CHAPTER 5
RESULT AND DISCUSSION

5.1 Result

The main goal of this research is to provide a solution to a problem that exists in the company. One of PT. Lintas Bintang Mulia Nusantara's key issues that can be formulated is the absence of resources to support the decision-making especially for future demand forecasting and lack of product bundling sales system. As a result, the business intelligence dashboard in the form of a report model could help resolving the problem. For simplifying the navigation between each dashboard, the story is developed. The story contains five dashboards is visualized in the figure below.

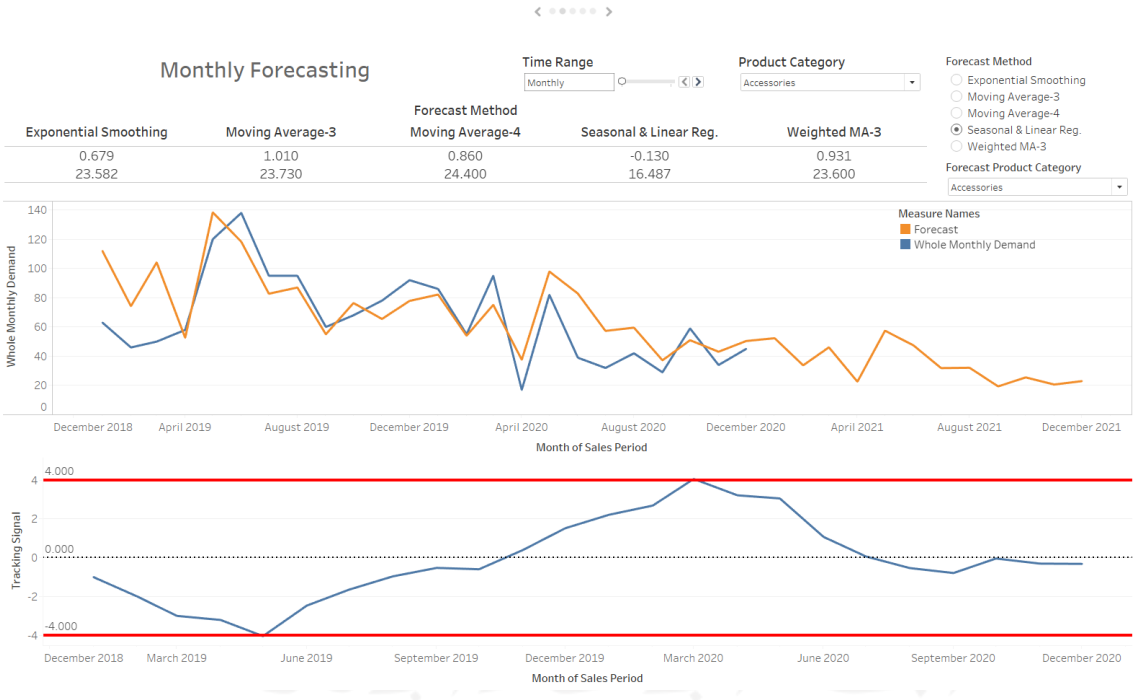


Figure 5. 1. Tableau Story Visualization

The results can be submitted to the Tableau Online site to be given and distributed to the company after designing and creating five dashboards on Tableau as mentioned in the previous sub-chapter and a story that combines each of them. From the Tableau Online site, here is a visualization of the story.

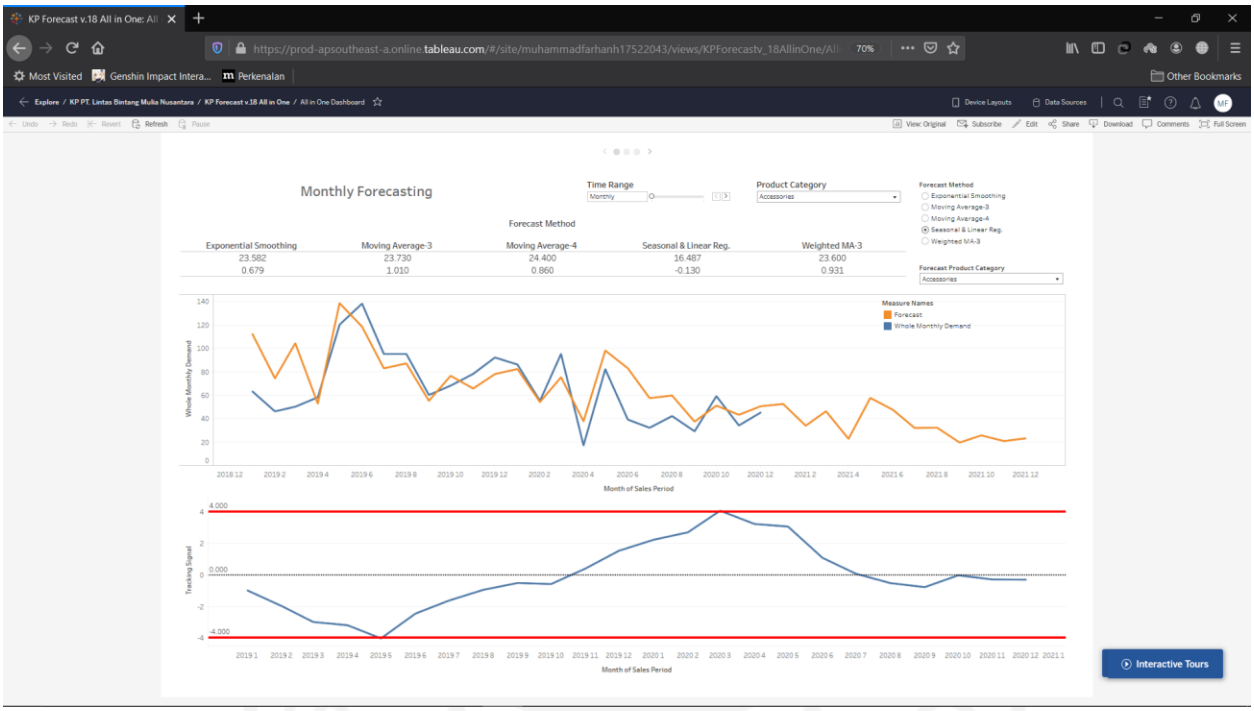


Figure 5. 2. Story Visualization on Tableau Online

The company can transform raw data from the Revota software results into valuable information that can be evaluated for decision-making by using the BI-based dashboard model. Business Intelligence will gather historical sales data and forecast the future demand. The decision would be easier because it is focused on analytical data for future demand forecasts from company data. Furthermore, product bundling can be developed as one of the marketing strategies of the company

5.2 Discussion

Five dashboards were designed in this study in the hope of improving sales. Five proposed dashboards involve sales performance analysis, monthly forecasting (custom), quarterly forecasting (custom), Tableau built-in forecasting, and market basket dashboard. The following section discusses the results of the five dashboards designed and proposed:

5.2.1 Sales Performance Dashboard Design

The overall sales results are analyzed using the sales performance dashboard. There are three graphs and a scorecard presented on the sales performance dashboard; the following is a description of each graph:

1. Total Sales Order by Quantity

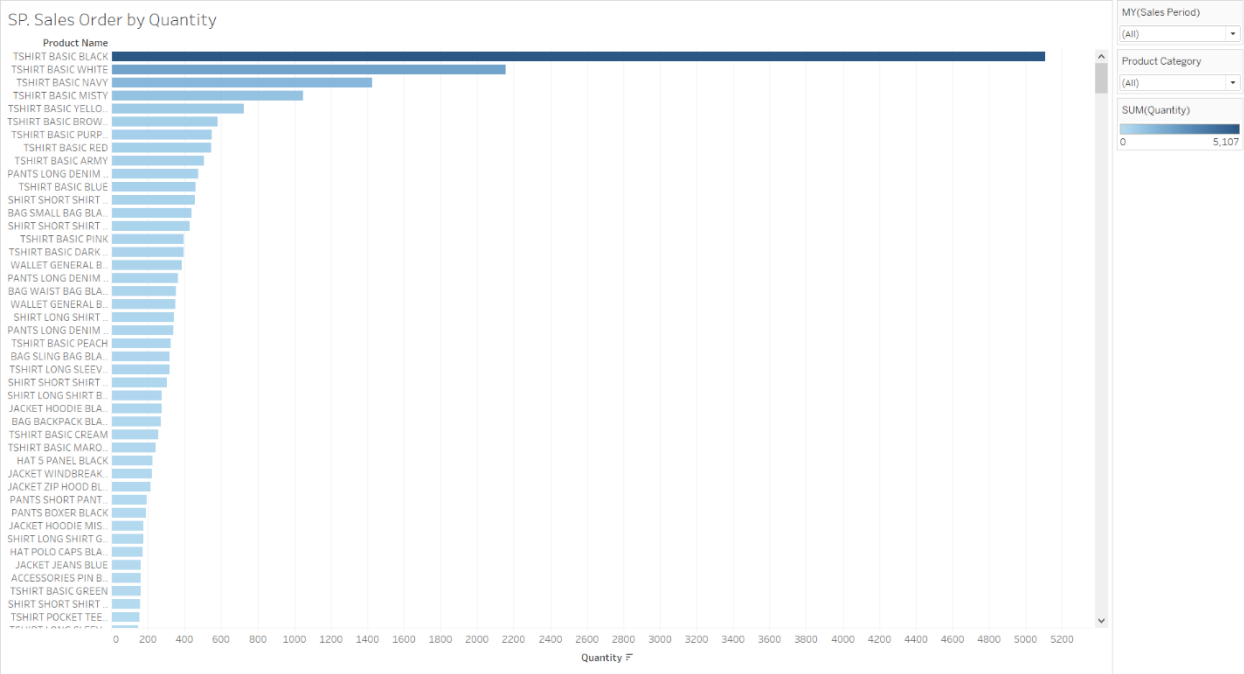


Figure 5. 3. Total Sales by Quantity Graph

The graph shows total sales by quantity for all particular products in the selected product category. The graph is constructed using two filters: sales period and product category. The option to determine more than one point of sales period is provided to users by sales period. Users can pick preferred product categories using a product category filter in the form of a single value dropdown. T-shirt basic black was the most popular product in the 2019–2020 period, according to Figure 5.3.

2. Total Sales Order by Month

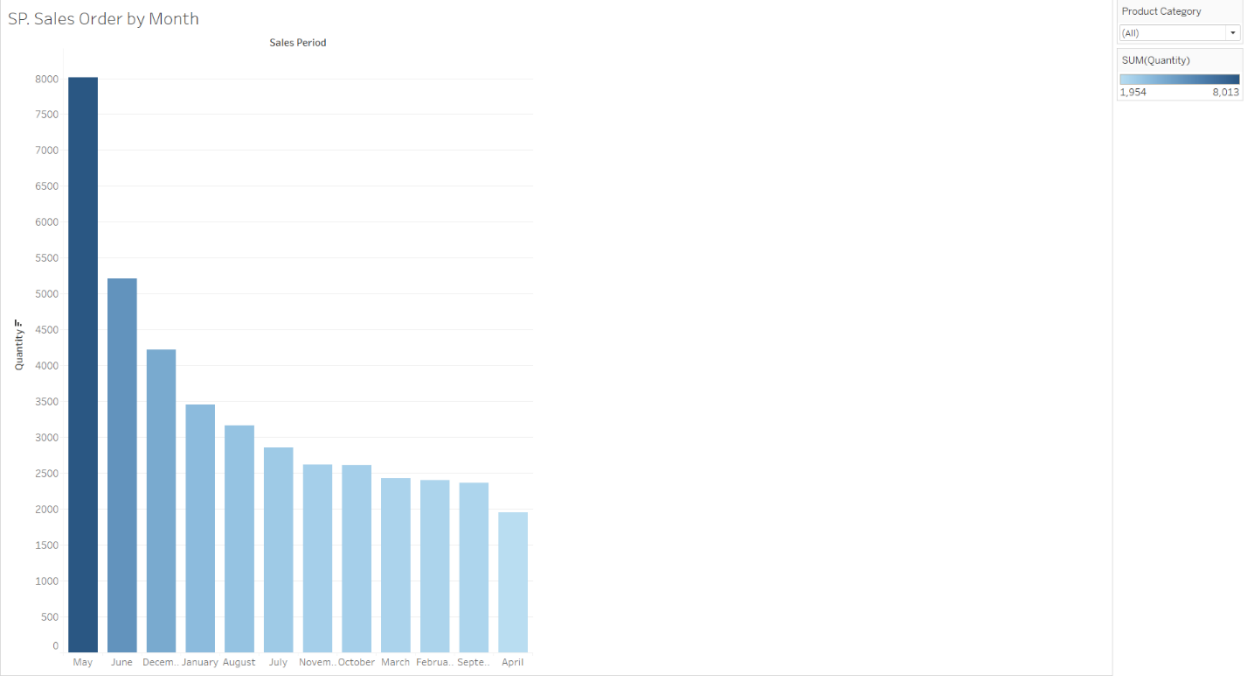


Figure 5. 4. Total Sales Order by Month Graph

The graph of a sales order by month analyzes the total quantity of desired product category each month. Single filter employed for the graph for selecting product category. The graph can aid the company in analyzing the busiest month of the year which certain products often experiences a drastic increase in demand. Figure 5.4 indicating May and June were the most hectic months because both months often coincide with Eid al-Fitr.

3. Subtotal Price Incurred

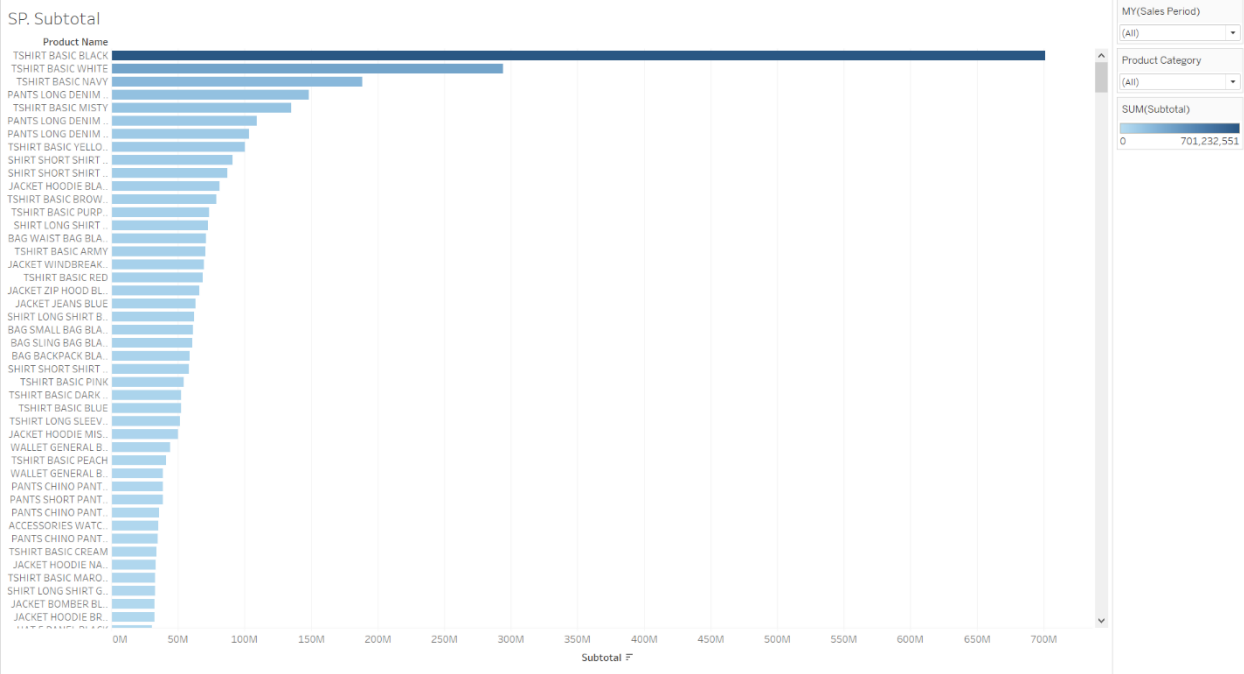


Figure 5. 5. Subtotal Price Graph

The graph of subtotal price employed identical filters and is presented in the same stacked bar chart format with the total sales in quantity graph. The graph is mostly the same as the total sales in quantity graph. The main distinction is in the information provided in which the subtotal price graph presents the sales gross income for the company. According to figure 5.5, the t-shirt basic black generates the grossest income of more than 701 million rupiahs.

4. Summary Scorecard

Figure 5. 6. Sales Performance Summary Scorecard

The summary scorecard summarizes the general information of sales performance. Two filters are used, both of which are similar to the two graphs that came before. The scorecard indicates within 2 years on all product categories, there is 23,074 recorded transactions with a total of 41,297 various products sold. Furthermore, more than 7.1 billion rupiahs were recorded as the gross income for the single store in the past two years.

5.2.2 Monthly Forecasting (Custom) Dashboard

A monthly forecasting dashboard visually represents demand forecasting for analysis and evaluation. From the monthly forecasting dashboard, it is known that there are two charts and one scorecard displayed, the following are the discussion:

1. Monthly Forecast Projection

Figure 5. 7. Monthly Forecast Projection Graph

In the shape of a line chart, the graph depicts product sales and forecasted future demand. Monthly data points are used to estimate future demand or product sales. This graph has two filters: forecast method, which is used to determine the forecast methodology calculation, and product category, which is used to selecting the product category that will be predicted.

2. Tracking Signal

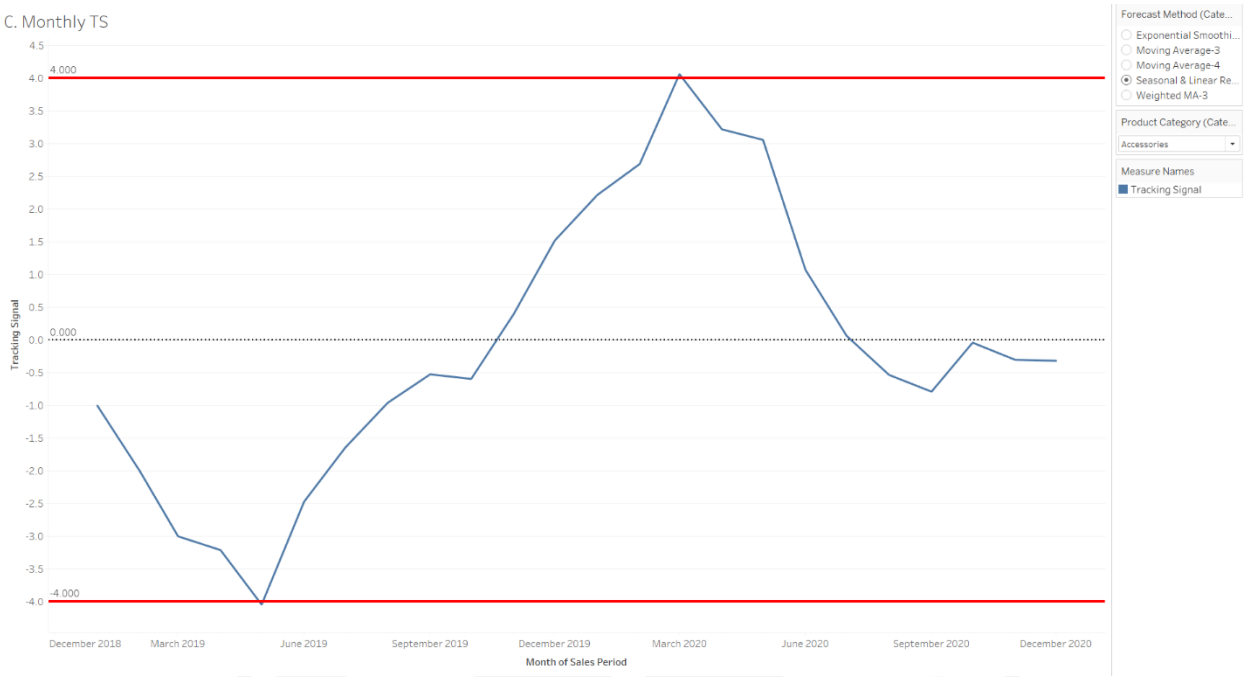


Figure 5. 8. Monthly Tracking Signal Graph

The graph, which takes the shape of a line chart, offers a tracking signal for a forecasted number that is known for its demand. The tracking signal equipped with two constant lines at 4 and -4 as control points, maintains track of any forecasts made in addition to actuals and warns when the results depart unexpectedly from the actuals demand. The graph was created using the same filters as the monthly forecast projection graph.

3. Summary Scorecard

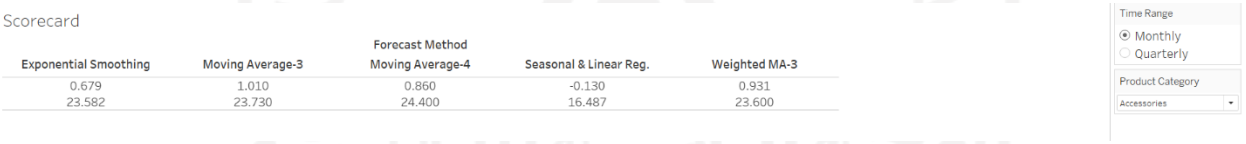


Figure 5. 9. Monthly Forecasting (Custom) Scorecard

The monthly forecast evaluation summary scorecard has two parameters that may be used to evaluate the best forecast approach for a certain product category. The forecasted outcome is evaluated using the Mean Absolute Deviation (MAD) and the average of the tracking signal. If there are one or more data points above or below the control limit on a tracking signal graph, the forecasting approach cannot be applied. The time period is used to determine whether the data is collected on a monthly or quarterly basis, and the product category is used to categorize the data.

5.2.3 Quarterly Forecasting (Custom) Dashboard

The quarterly forecasting dashboard is similar to the monthly dashboard in terms of purpose. The primary distinction is that forecasting is done a quarterly rather than monthly basis. Similarly to the previous dashboard, the quarterly dashboard displays two charts and one scorecard:

1. Quarterly Forecast Projection

Figure 5. 10. Quarterly Forecast Projection Graph

The graph displays product sales and the forecasted future demand in the form of a line chart. Product sales are represented by quarterly data points, which are used to forecast future demand. There are two filters in this graph: forecast form, which determines the forecast technique, and product category, which determines the product category that will be forecasted.

2. Tracking Signal

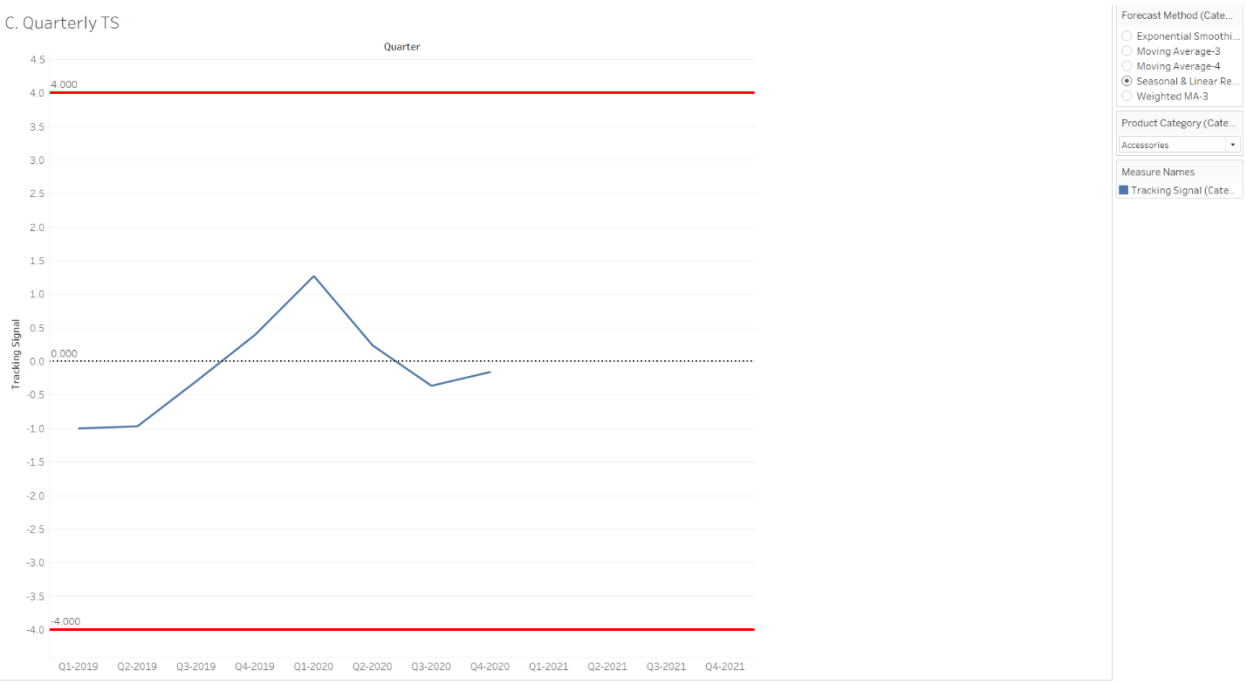


Figure 5. 11. Quarterly Tracking Signal Graph

A tracking signal for a forecasted value that is known for its demand is provided by a quarterly forecast tracking signal graph, which takes the shape of a line chart. The tracking signal, which has two control points at 4 and -4, maintains track of any forecasts made in addition to actuals and alerts when the results depart unexpectedly from the actuals demand. The filters used in this graph were the same as in the quarterly forecast prediction graph.

3. Summary Scorecard

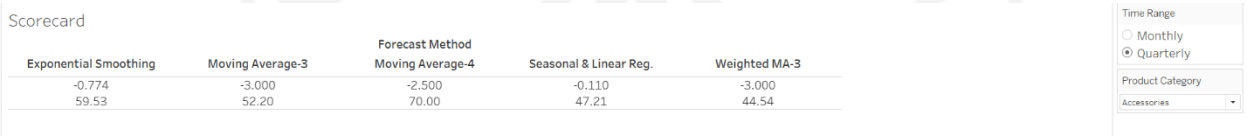


Figure 5. 12. Quarterly Forecasting (Custom) Scorecard

The quarterly forecast summary scorecard provides two criteria for determining the best forecasting approach for a certain product category. The Mean Absolute Deviation (MAD) and the average of the tracking signal are used to evaluate the forecast outcome. The forecasting approach cannot be utilized if one or more data points on a tracking signal graph are above or below the control limit. The filters used were the same as in the monthly forecast evaluation summary scorecard.

5.2.4 Built-in Forecasting Dashboard

It has been known that the built-in forecasting dashboard displays two graphs. The following sections examine each graph in detail:

1. Monthly Forecast

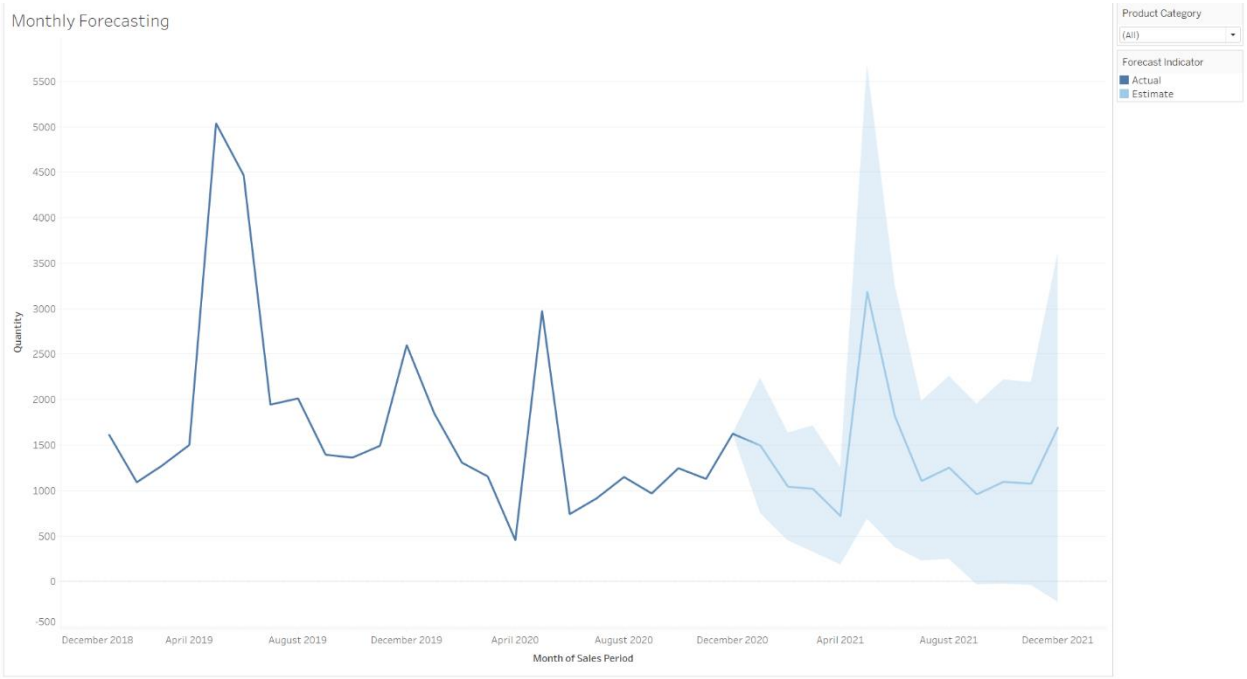


Figure 5. 13. Tableau Built-in Monthly Forecast Projection

The graph is a line chart that displays the forecast result together with the upper and lower control limits for 95% prediction intervals. Product sales are represented by monthly data points that are used to forecast future demand. Tableau provides the forecasting technique utilized automatically. The single filter is employed in order to provide users flexibility for determining the product category that would be forecasted.

2. Quarterly Forecast

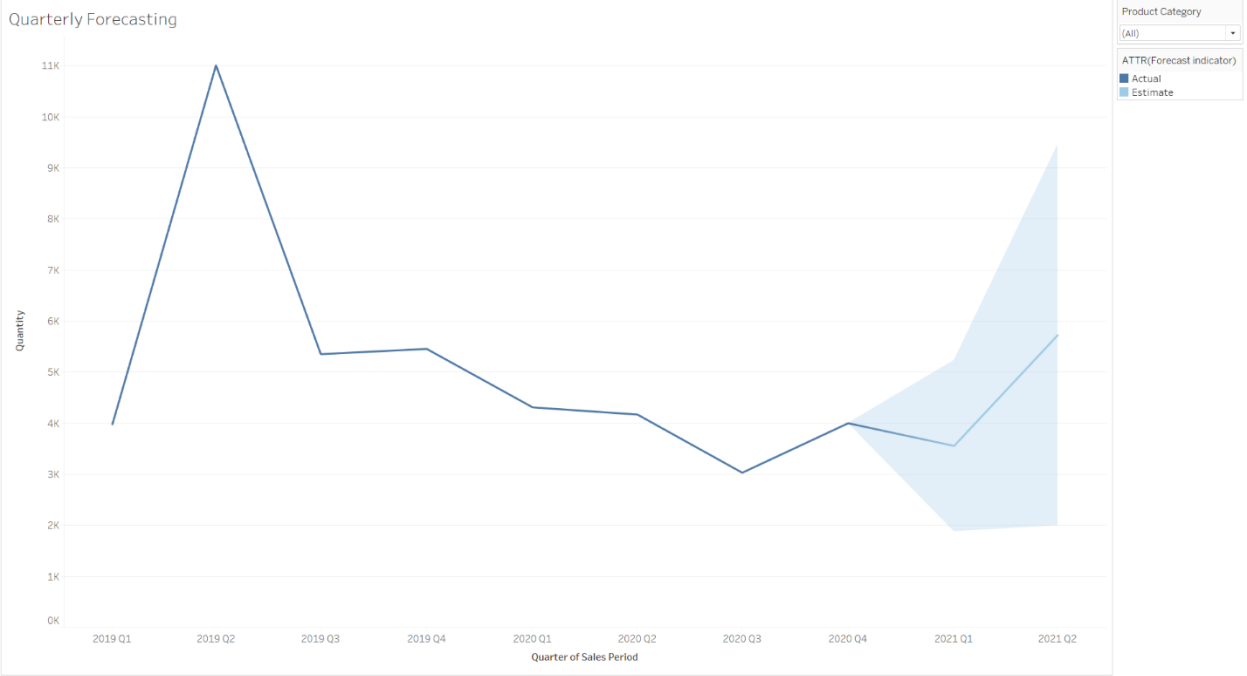


Figure 5. 14. Tableau Built-in Quarterly Forecast Projection

The graph is a line chart that displays the predicted result as well as the upper and lower control limits for 95% prediction intervals. Product sales are represented by quarterly data points that are used to estimate future demand. Single filter used namely product category, which determines the product category that will be forecasted. Forecasting calculation utilized automatically is provided by Tableau.

3. Forecast Evaluation Criteria

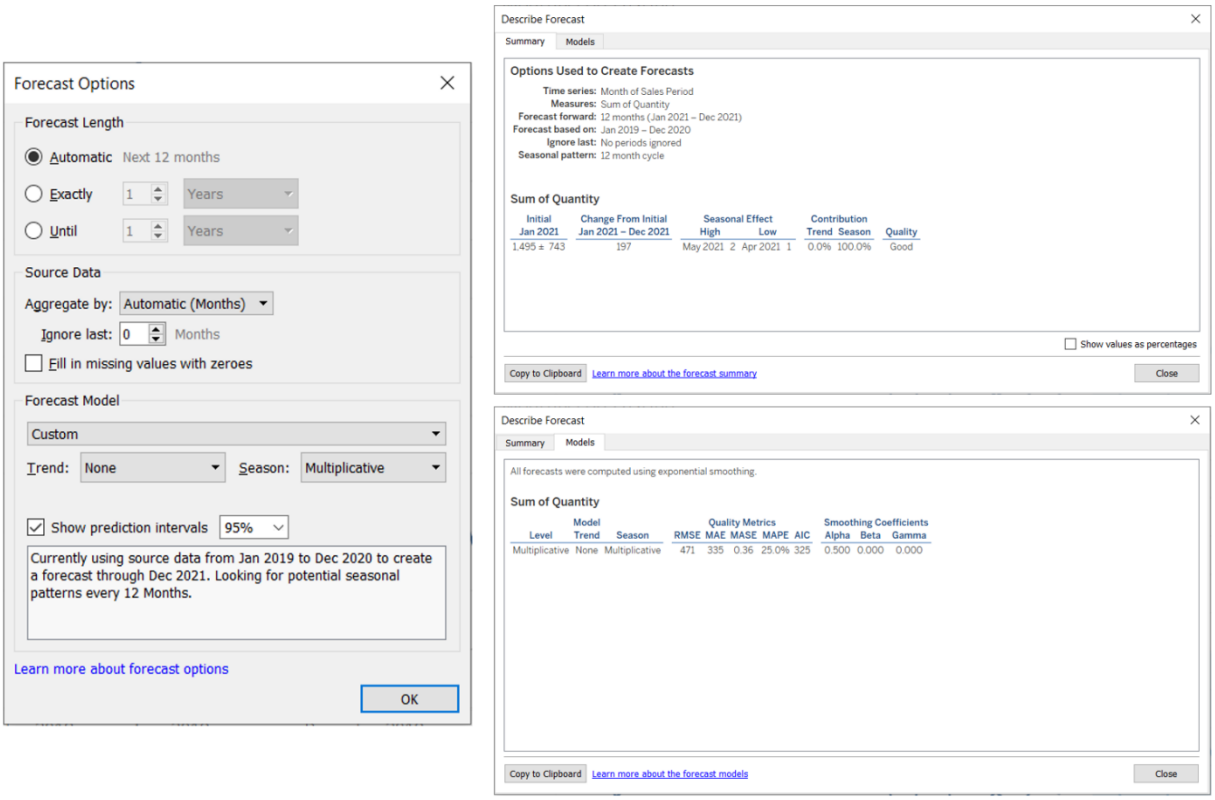


Figure 5. 15. Monthly Forecast Evaluation Option and Criteria

For using Tableau automatic forecasting features, forecast option and setting should be set up. First forecasting options are purposed for generated monthly forecast projection. As can be seen from the forecast option, the forecasting will last for the next twelve months with a multiplicative seasonal pattern and 95% prediction interval. With that option, the result of forecasting obtained the value of 0.36 MASE and categorize into good forecast quality

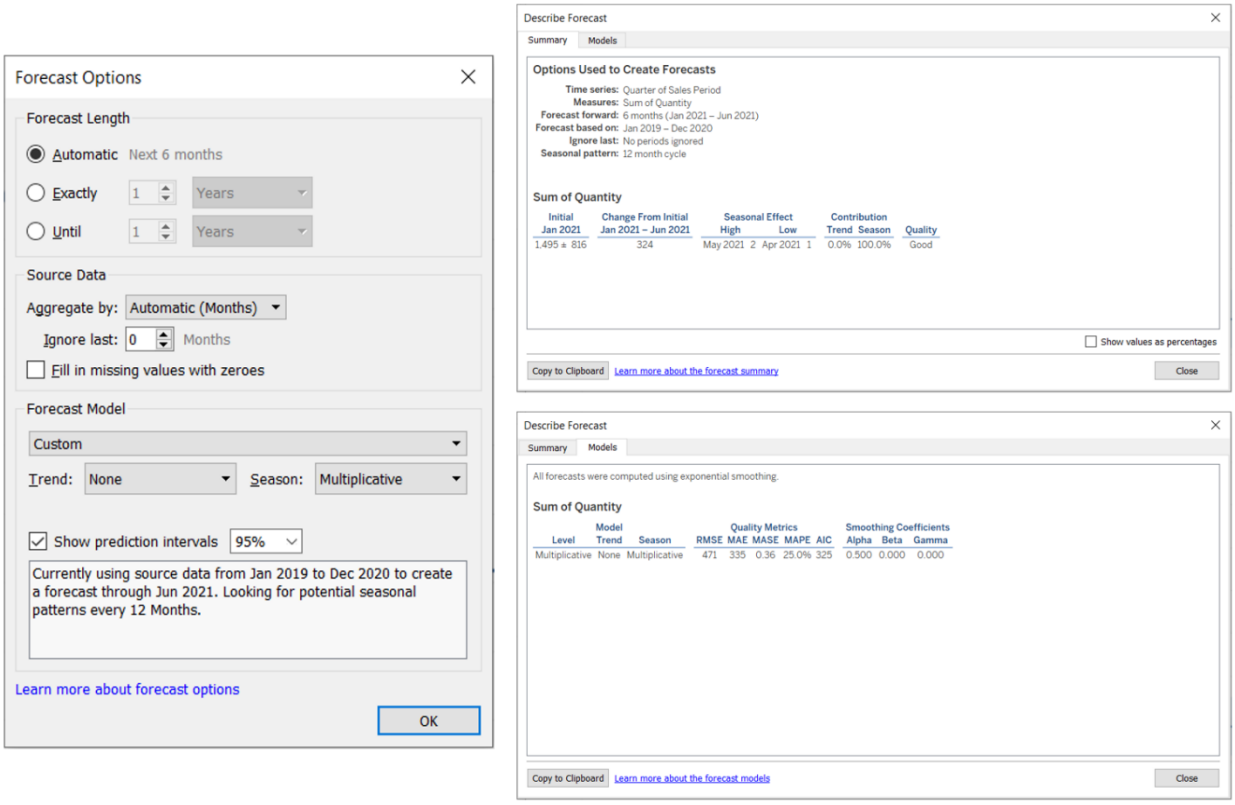


Figure 5. 16. Quarterly Forecast Evaluation Option and Criteria

The second forecasting option are purposed for generated quarterly forecast projection. As can be seen from the forecast setting, forecasting will run for the following six months, with a multiplicative seasonal pattern and a 95 percent prediction interval. The forecasting evaluation returned 0.36 MASE with that configuration, indicating good forecasting quality.

5.2.5 Market Basket Analysis Dashboard

Market basket analysis dashboard enables its users for obtaining insight into other products that are purchased together within the selected product. Furthermore, weekly cashier performance and total sales handled by each cashier are provided within a scorecard and a graph in the dashboard. Additional product sales graph, presenting product total sales by its brand is employed. Totally, there are three graphs, one matrix, and a scorecard presented.

1. User Selection Market Basket Analysis

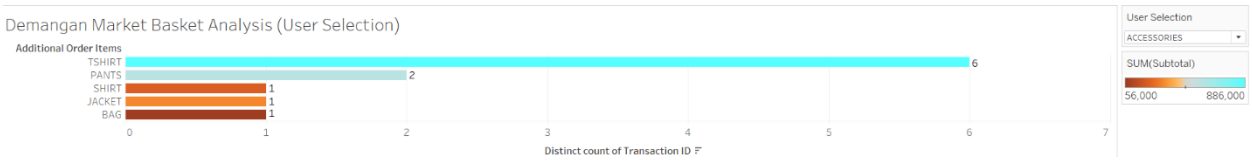


Figure 5. 17. User Selection Market Basket Analysis Graph

The graph presented the other products bought together at the same time as the selected product. The graph used a single filter for selecting product categories. The figure indicates that when the customer purchased accessories, they also bought the t-shirt, pants, shirt, jacket, or bag. Furthermore, the subtotal incurred of the customer as well provided.

2. Market Basket Analysis Matrix

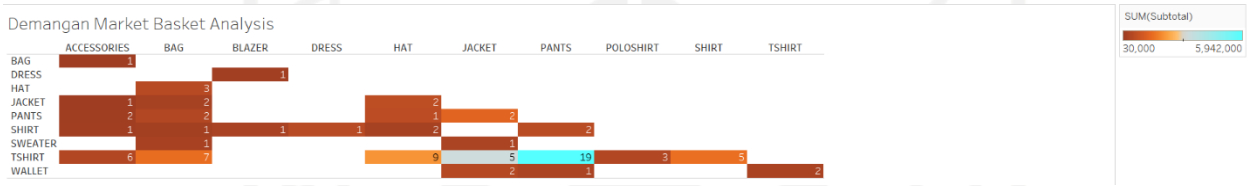


Figure 5. 18. Market Basket Analysis Matrix

Figure 5.18 represents a matrix of pertinent market basket analysis. There are none of the filters used since the matrix provides all of the relations (purchased together at the same time) between each product category. T-shirts and pants have the greatest correlation of 19 and gross profit of 5,942,000 rupiahs, according to the figure above. As a result, the marketing strategy can create a new bundling that sells t-shirts and pants together.

3. Cashier Performance Scorecard

Cashier Perf%

	Sales Period			
Cashier Name	Week 1	Week 2	Week 3	Week 4
ANNA			57.1%	-62.3%
DELLA TASYA		52.2%	-92.0%	-100.0%
EGA		382.4%	-28.0%	-57.6%
SALSA		185.7%	-100.0%	
YOKO				-100.0%

Figure 5. 19. Cashier Performance Scorecard

Since the market basket analysis dashboard used different data warehouse, the weekly performance of the cashier person can be identified. The percentage indicate the differences of cashier performance within the week before. The performance calculated from the total quantity of product

in all transaction that handled by the cashier. For example based on Figure 5.19, Yoko has the least performance because he working on the third week only.

4. Cashier Sales

Figure 5. 20. Cashier Sales Graph

The graph of cashier sales analyzes the total gross income from the transaction generated by each cashier person. To determine the sales period, a single filter was applied to the graph. The graph can help the company in analyzing the target sales for each cashier person and supported the cashier person's performance scorecard. Cashier Della has the greatest sales in the form of the gross income of 35,850,000 rupiahs, as seen in Figure 5.20.

5. Brand Sales

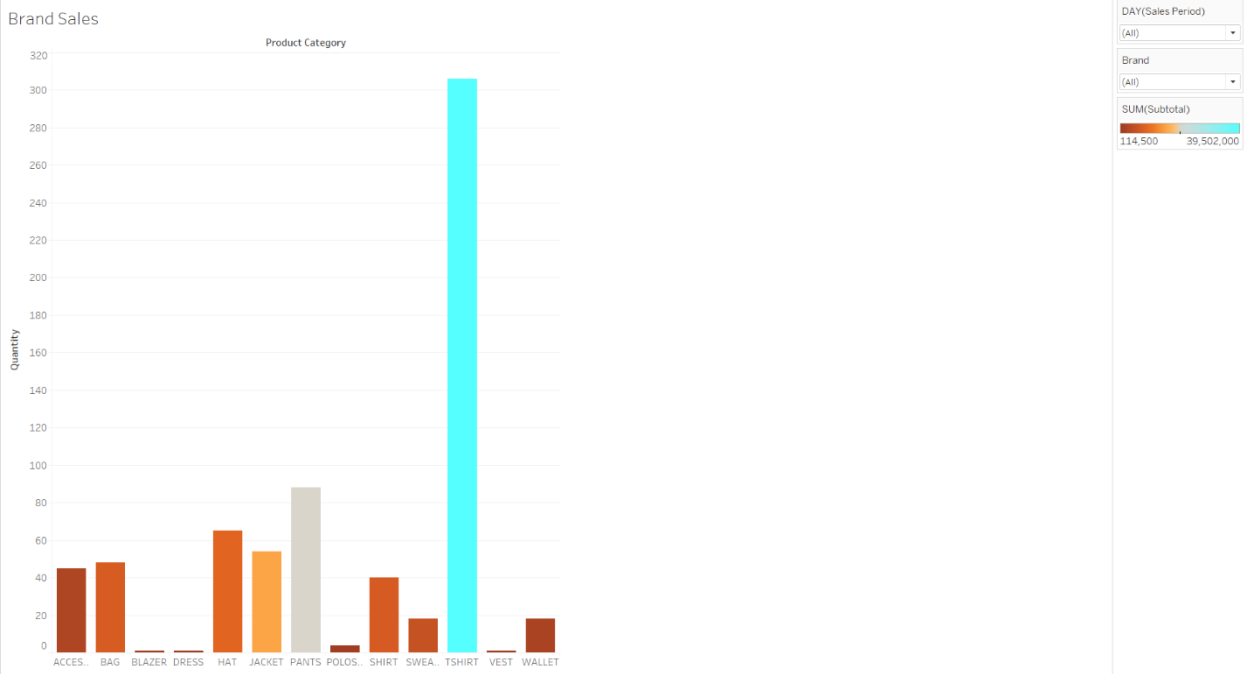


Figure 5. 21. Brand Sales Graph

The brand sales graph takes the form of a bar chart to identify the total sales by quantity of each product category. The graph employed two filters namely sales period and brand. Users have the option of determining the range of sales period through the sales period filter. A brand filter in the form of a multiple values dropdown allows users to select a preferred product brand. Figure 5.21 represents within 1st – 20th January sales period of all brands, the t-shirt is best selling products. T-shirts sold by more than 300 pieces with the subtotal or gross income of 39,502,000 rupiahs.

5.3 Limitations and Implications for Future Research

The outputs and findings of this study, like any other research, must be interpreted with caution. First, the data extraction, transformation, and load are mainly done in Microsoft Excel. Consequently, the ETL process will take much time needed. Second, the data source is solely depends on the company's internal data. Third, the process of the dashboard development used Tableau desktop software. Because of the the dashboard development on the other software may experience different steps or methods explained in the current study. Fourth, the supporting methods for sales performance improvement are based on the forecasting and market basket

analysis. The other methods besides sales performance improvement should be applied such as automatic procurement order and et cetera.

CHAPTER 6
CONCLUSION AND RECOMMENDATION

6.1 Conclusion

In accordance with the objective stated in the first chapter, the following conclusion is obtained from this research. The design of five dashboards namely sales performance analysis, monthly forecasting (custom), quarterly forecasting (custom), built-in Tableau forecasting, and market basket analysis are proposed and put together in a Tableau story. The dashboard created serves as a tool for sales improvement through the approach of Self-Service Business Intelligence. The dashboards are web-based, allowing access from any computer with an internet connection. The company can transform raw data from the Revota software results into information that can be evaluated for improving its sales.

Sales performance analysis dashboard provides a broad and general view of company product sales within its details. Two strategies are employed in hopes for engaging sales improvement namely forecasting and market basket analysis. Furthermore, the company can evaluate directly the five different forecast technique results by refers to tracking signal graph, mean absolute deviation, and an average of tracking signal. For built-in forecasting evaluation, Tableau provides the categorization of forecast result quality refers to the MASE. In order to improve forecast result quality, the company can change the forecasting option setting. The market basket analysis determining the others product who bought together within the specified product. As input for marketing strategy, the dashboard of market basket analysis is able to provide the proposed product bundling and store product arrangement.

6.2 Recommendation

Based on the assessment of the results of research, the researcher intends to provide recommendations that hopefully can be useful for the company, the future research, and to the public:

1. For the company (PT. Lintas Bintang Mulia Nusantara)
    a. In order to incorporate the report and the dashboard design that has been proposed, the organization would need to employ a data engineer and data analyst position
    b. The other position of data storyteller needs to be employed by the company for translating the dashboard nor data provided into a comprehended narrative in making future business strategies.
2. For the Future Research
    a. Future researchers can develop a dashboard through the use of more complex BI systems by integrating Tableau with SQL database, Python, Azure Machine Learning, and R, which makes BI findings more complex and data in large numbers easier to handle.
    b. The future study can use external data besides internal data.
    c. The next researcher can compare the development of the dashboard within the same approach of Self-Service BI on other applications, such as Microsoft Power BI besides Tableau.
    d. Other methods, such as Economic Order Quantity, may be added by the next researcher to improve the analysis decision-making methods, resulting in a more detailed coverage in decision-making.
3. For the Public
    a. This research is expected to become reference material for other students who want to carry out practical work and undergraduate thesis.
    b. Current research in hopes can aid the others company who have the same business process and same problem in developing their dashboard through the approach of SSBI for sales performance improvement.

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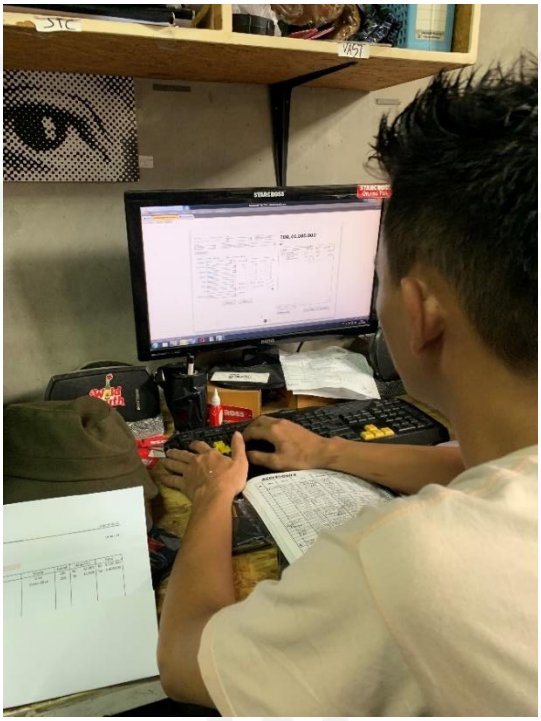
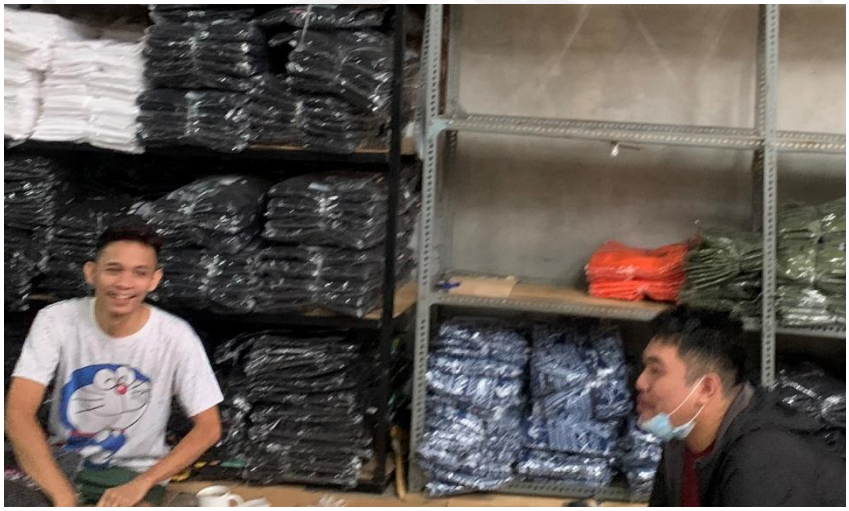
APPENDICES

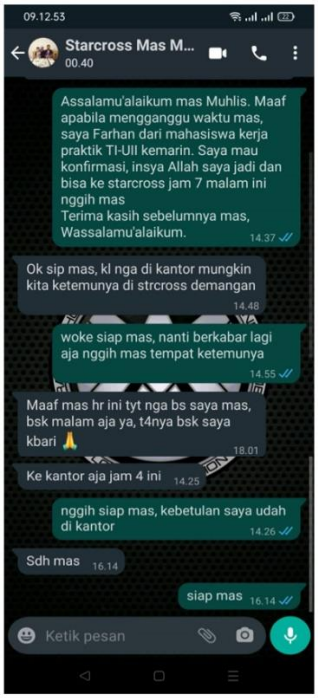
Discussion About Revota Software with Head of Production and Design Department



Interview with the Head of Production and Design Department



Proposing Meeting Appointment to Group Discussion through General Store Manager



Waiting for Meeting Appointment of Group Discussion