AN APPROACH TO IMPROVE LAYOUT STORE AND PRODUCT PLACEMENT USING COMBINATION OF APRIORI ALGORITHM AND PROFITED SEQUENTIAL PATTERN (STUDY CASE: CV.XYZ)

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Authored by:

Balya Ibnu Mulkan (14522068)

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AUTHENTICITY STAETEMENT

In the name Allah the most gracious and the most merciful, I hereby certify that this research of mine was conducted by my own work except the citations and summaries which those are already mentioned on references list as the source of this research. If someday this statement is proved is nor right and violates the legal regulation of papers and intellectual property right, I agree Universitas Islam Indonesia to revoke my bachelor certificate.

Yogyakarta, October 2018

Balya Ibnu Mulkan

THESIS APPROVAL OF SUPERVISOR

AN APPROACH TO IMPROVE LAYOUT STORE AND PRODUCT PLACEMENT USING COMBINATION OF APRIORI ALGORITHM AND PROFITED SEQUENTIAL PATTERN (STUDY CASE: CV.XYZ)

THESIS

Arranged by:

Name : **Balya Ibnu Mulkan**

Student Number : **14522068**

Yogyakarta, October 2018

Supervisor

(Muhammad Ridwan Andi Purnomo, ST., M.Sc., PhD.)

EXAMINER APPROVAL OF EXAMINATION COMMITTEE

AN APPROACH TO IMPROVE LAYOUT STORE AND PRODUCT PLACEMENT USING COMBINATION OF APRIORI ALGORITHM AND PROFITED SEQUENTIAL PATTERN
(STUDY CASE: CV.XYZ)

By:

Name : Balya Ibnu Mulkan
Student Number : 14522068

Was defended before Examination Committee in Partial Fulfillment of the requirement for the bachelor degree of Industrial Engineering Department
Universitas Islam Indonesia
Examiner Committee

Sri Indrawati, S.T., M.Eng.
Examination Committee Chair

Muhammad Ridwan Andi Purnomo, ST., M.Sc., PhD.
Member I

Agus Mansur, S.T., M.Eng.Sc.
Member II

Acknowledge by,
Head of Undergraduate Program Department Industrial Engineering
Faculty of Industrial Technology
Universitas Islam Indonesia

(Dr. Taufiq Immawan, ST., M.M)

DEDICATION

This research is dedicated to give the benefits for my family retail. Hopefully this research of mine could be one of my parents' ridho.

آمِيْن يَا رَبَّ العَالَمِيْنَ

MOTTO

خَيْرُ الناسِ أَنْفَعُهُمْ لِلناسِ

"The best of people are those that bring most benefit to the rest of mankind."
(HR. Ahmad, Thabrani, Daruqutni. Disahihkan Al Albani dalam As-Silsilah As-Shahihah)

"And say, "Do [as you will], for Allah will see your deeds, and [so, will] His Messenger and the believers. And you will be returned to the Knower of the unseen and the witnessed, and He will inform you of what you used to do".
(Q.S At-Taubah: 105)

"Allah - there is no deity except Him, the Ever-Living, the Sustainer of [all] existence. Neither drowsiness overtakes Him nor sleep. To Him belongs whatever is in the heavens and whatever is on the earth. Who is it that can intercede with Him except by His permission? He knows what is [presently] before them and what will be after them, and they encompass not a thing of His knowledge except for what He wills. His Kursi extends over the heavens and the earth, and their preservation tires Him not. And He is the Most High, the Most Great"
(Q.S Al Baqarah: 255)

PREFACE

Assalamu'alaikum Warahmatullahi Wabarakatuhu

All praise to Allah the Almighty who has bestowed His mercy and grace. Shalawat and greetings always poured to the Great Prophet Muhammad and all of his companions who always istiqomah to practice their religion. Thanks to the help and mercy of Allah so that the author is able to complete the thesis entitled "An Approach to Improve Layout Store and Product Placement using Combination of Apriori Algorithm and Profited Sequential Pattern (Study Case: CY.XYZ)".

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ABSTRACT

Two of the parameters of success in retail business are by seeing how the store facilitates the service response and attracts the customers to buy more products in the store. Market Basket Analysis is widely used to discover customers behavior by analyzing the co-occurring products items in customers shopping basket. Understanding customers behavior could be great knowledge to discover corresponding with help of Market Basket Analysis by using Apriori Algorithm. The minimum support and confidence of Apriori Algorithm applied in this research is 1% and 60% respectively has generated 15 rules. In this research, the result will be used to determine the efficient proposed layout to reduce the total people walking distance. After comparing the total people walking distance of the Initial Layout and Proposed Layout by using 7 data transactions as a sample, there is reduced length of people walking distance from 179.38 meters for initial layout to 64.38 for proposed layout. As a result, the improvement in percentage is about 64.97%. It means that the proposed layout consumes less walking distance if compared to the previous layout. Displaying products in certain level of shelf also has significant influence on customers' buying behavior. Thus, another calculation applied into this research to determine the proper product display is Profited Sequential Pattern (PSP). There are 54 products generated, clustered as high PSP value by considering the support, gross margin and facing of product. Those products will be arranged into certain level of shelf based on its category. Tools used to discover the frequent items set is R studio with the help of Microsoft Excel. As the data used in this research as sample size for the analysis is 1061 transactions with 2836 observations.

Keywords: *Data Mining, Market Basket Analysis, Apriori Algorithm, Product Placement, Profited Sequential Pattern, Retailing, Lumberyard.*

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CHAPTER I

INTRODUCTION

1.1 Background

The growth of population in Indonesia is increasing over years, especially in Cirebon. The increase of the population in Cirebon from 2010 – 2015 gradually increased (Pusat Data dan Analisa Pembangunan Jawa Barat, 2015). At this rate, people living in Cirebon will need more places to stay. Establishing new housings is one of the common solutions to overcome this case and also people tend to build their own house for their living. Therefore, plenty of Lumberyards are emerging to gain the margin by providing customers' needs.

This research was conducted in specific types of store which is lumberyard or a builiding store. There are numerous products sold in this sort of store are considered asheavy products in term of weight compared to other stores for instance department store, pharmacies, minimarket and etc. Thus, the author proposed to change the store's layout based on the corresponding product to avoid the people walking distance that is widened by buyers and workers in the store.

CV. XYZ is one of lumberyards located in Cirebon Indonesia. Lumberyard is a store that sells building materials and equipments needed for construction. Although CV. XYZ has been established since 1995, CV. XYZ does not understand that by having good design layout will increase their performance on shopping atmosphere, shopping behavior, and more efficiency in their trading process. (Lewison, 1994)

Layout is one of the most vital concerns for every store. Customers perhaps look around and buy other products while they are doing product selection for their intended product. Although, in fact, they do not plan to buy it, but since it is considered as their preferences, they will buy anyway. (Cil, 2012) stated that a good store layout is a factor which could show the uniqueness of the store and could attract customer's attention.

Arranging proper layout and display for the store should be considered well because it will influence the sales, performance and service of the store. The method that applied for this research is Market Basket Analysis. Market Basket Analysis is one of the techniques in determining which product tends to be bought by the customers in the same transaction in accordance with the association rules (Maheshwari et al., 2016).

Another vital rule is the arrangement of goods or product item on store's shelves. The product placement is also an important part in the retailer's company. Research was conducted by Shahrabi and Nafari (2010) stated that the placement of products in the store rack will affect and encourage the buying process. Therefore, the author tries to find out which products are appropriate to be placed in each rack level.

1.2 Problem Formulation

Based on the description above, the problem that comes up in the research would be:

1. How to redesign the efficient layout for customers self-service?
2. How to arrange proper product placement on shelves?

1.3 Objective Research

This research is proposed to answer several objectives as mentioned below:

1. To redesign the efficient layout for customers self-service.
2. To arrange the proper product placement on the shelves level.

1.4 Research Scope

The author determines the scope of the research in order to be more focus on the problem. Several factors that should be in the scope in this research are:

1. This research applies Market Basket Analysis method
2. This research applies Profited Sequential Pattern (PSP) to product placement on shelves store
3. The research will be conducted in a lumberyard of CV. XYZ
4. No changes in the shape of building store

1.5 Constraint of Item Product on Shelves

The arrangement of products into the proposed shelf are only products that have previously been placed in the initial shelf. The products that are not previously in the initial shelf will be excluded from the proposed layout.

1.6 Benefits of the Research

This research hopefully could give several benefits. The benefits derived from this research are as follows:

1. CV. XYZ is able to set the proposed new layout and rack display
2. Avoid the people walking distance that is widened
3. Proposed the layout supporting self-service by the customers
4. Increase the products sales

1.7 Systematic Writing

This study is composed based on the rules of scientific writing in accordance with the systematics as follows:

CHAPTER I **INTRODUCTION**

This chapter contains a preliminary description of research activities, on the background of the problem, formulation of the problem, the objectives to be achieved, the benefits of research and systematic writing

CHAPTER II **LITERATURE REVIEW**

This chapter will elaborate the theories of reference books and journals as well as the results of previous researches related to the research problem which are used as references for problem solving

CHAPTER III **RESEARCH METHODOLOGY**

Contains the description of the framework and lines of inquiry, the research object to be studied and the methods used in the study

CHAPTER IV **COLLECTION AND PROCESSING DATA**

Contains the data obtained during the research and how to analyze the data. Data processing result is displayed either in the form of tables and graphs. What is meant by processing the data also

includes analysis of the results obtained. In this section is a reference to the discussion of the results to be written in Chapter V.

CHAPTER V DISCUSSION

Contains discussion of the results of data processing that has been performed in research. Compatibility with the objectives of research so as to produce a recommendation

CHAPTER VI CONCLUSIONS AND RECOMMENDATIONS

Contains the conclusion of the analysis made and any recommendations or suggestions on the results achieved in the problems identified during the study, so it needs to be done on assessed in future studies

REFERENCE

CHAPTER II

LITERATURE REVIEW

2.1 Inductive Study

There are some previous literatures discussing Market Basket Analysis. One of the researches was conducted by Bermudez et al. (2016) entitled *Layout Optimization and Promotional Strategies Design in a Retail Store based on a Market Basket Analysis.* The research proposed model for designing the optimal floor and the design the promotional strategies. This kind of research was conducted in a particular store which is located in the Latin America.

A research conducted by Shahrabi and Nafari (2010) entitled *A Temporal Data Mining Approach For Shelf-Space Allocation With Consideration* is explaing the importances product which is allocated in the certain level of rack. The shelf arrangement will influnce and induce the buyer to buy cross seling products. This will be good to the retailer in maximazing the profit through an increasing sales. The variable taken to determine which level of the product will be placed is by the product price consideration.

The Study Conducted by Kavitha (2016) *Entitled Market Basket Analysis Using FP Growth and Apriori Algorithm: A Case Study of Mumbai Retail Store* was discussing about the implementation of association rule to find how different products in a grocery store assortment related and how to exploit these relations by marketing activities. The data

collected as many 300 data and then being processed and analyzed using R software and Rapid miner.

Mirajkar et al. (2016) studied about *Data Mining Based Store Layout Architecture for Supermarket.* This paper was discussing the association rule using Apriori algorithm, the data obtained from data base of supermarket and then being processed using Apriori algrotim to allow the supermarket clustering their products around meaningful purchase opportunities related to use association. Thus, the output of this research is to set the layout based on the products clustering.

The journal entitled *Market Basket Analysis for a Supermarket based on Frequent Itemset Mining* authored by Annie and Kumar (2012) applied Market basket analysis as an important component of analytical system in retail organizations to determine the placement of goods, designing sales promotions for different segments of customers to improve customer satisfaction and hence the profit of the supermarket.

A journal entitled *An approach to products placement in supermarkets using PrefixSpan algorithm PrefixSpan algorithm* authored by Aloysius & Binu (2013) was a jurnal discussing the layout and the product placement in supermarket. The authores utilized the buyer pattern and product profit to propose layout and display product on the shelves in the supermarket using PrefixSpan algorithm.

The journal entitled *A data mining approach to product assortment and shelf space allocation* conducted by Chen & Lin (2007) applied the data mining knowledge that was association rule. The association rule is aimed to explore the relationships among products as well as among product categories using the multi-level association rule. The aim of this research is to define which proper product to be displayed in retailer's rack.

The previous research concerning the layout display was conducted by (Hariga et al., 2007) entitled *A Joint Optimization Model for Inventory Replenishment, Product Assortment, Shelf Space and Display Area Allocation Decisions.* This research was aimed to optimize model to determine the product placement, inventory replenishment, display area and shelf space allocation decisions that jointly maximize the retailer's profit.

The study conducted by Hwang, Choi and Lee (2009) related the shelf display was done entitled *Genetic Algorithm Approach to An Integrated Problem of Shelf Space Design and Item Allocation.* This research is to overcome the problems in retailers regarding how to display the product on shelf space. The main objective of this research is to maximize the retailer's profit using model of a genetic algorithm.

C.Murray et al. (2010) studied about *Joint Optimization of Product Price, Display Orientation and Shelf-Space Allocation in Retail Category Management.* This journal is discussing on optimization development in the business of retailers. The uniqueness of this study is not only considering the width of shelves available in store but also considering on the height of shelves. The algorithm applied on this study is MINLP algorithm.

The Journal Entitled Consumption Universes Based Supermarket Layout Through Association Rule Mining and Multidimensional Scaling conducted by Cil (2012), discussed about the layout improvitation using association rule and multidimensional scalling teqnique. This proposed a proper layout to overcome the time search spending by the customers. Thus, the customers feel comfort while doing transaction and do not waste extra time for that.

2.2 Deductive Study

2.2.1 Retail

Retail is one ways of product marketing including all activities that involve the sale of goods directly to the end consumer for personal and non-business use in relation to the concept of retail management, the word "retail" is defined as the sale of goods and services to the ultimate consumer for their personal, family, or household use. (Cox and Paul, 2000)

In the retail business there are several variables in an effort to get attention from the buyer perspective. Most buyers see merchandise contained in the retail with consideration of several variables, among them are variable of Product, Price, Promotion, Service and Physical Facilities. Below is an explanation of each variable:

A. Product

Product is the item offered for sale. The product could be an item or a service. The product is the entire offer made normally by the company to customers in providing services, store locations, and product name. Customers will give a good impression on a store if the store can provide the required and desired products by the customer. Therefore, retailers should be responsive to needs and customer desires. The vital factor that should be considered by the managers or the owners of the retailer is the variety if the product, sort of product brand, the quality of the product and also the determining of market segment they offer.

B. Price

Prices are variable which is quite important in running any businesses, including retail business. Price is a factor that influences buyers in buying and selling activities. The retail price is determined based on the cost of the product item plus a percentage to gain profit from the product. According to (Cox and Paul, 2000) stated there are some factors how to have the fix price :

1. Market Segmentation

Pricing should be adjusted to the demands of target market. If the target market wants exclusivity against goods and services, the prices are high. Otherwise if target market needs goods and services, then price offered should be low.

2. Competition

Competition is also part to determine the product price, by consideration on the competition existence, the managers should adjust the product price as the strategy to gain more customers.

3. Company Objective

Pricing must be in accordance with the company's objectives as whole. If the company wants to pursue its share market aggressively then the cheap price should be chosen. Conversely, if the company requires funds to recovery of investment, the high price should be chosen.

4. The Role of Price

The role of prices in retail should be considered. If the price be a key element that influences customer decisions in buying, then then price will be used to establish a differentiating role. If prices are not an important element for decisions customers in buying, then other elements should be more focused.

5. Other Factors

Another factor in determining the fix price is kind of intermediaries. The institution who may take the interest from the company could affect to how the company or retailers put the fix price on their product item.

C. Promotion

Promotion is an activity affecting perceptions, attitudes, and behaviors of customers to a retail store with all offers. Promotion is a communication tool to connect between retailers and consumers to tell, persuade, and remind customers to buy products in the store with the benefits the customers will gain. There are three kinds of tools promotions commonly used by retailers, namely:

1. Advertisement

   This sort of tool is the common tool to get the attention from the customers. the media used in this tool are television, newspaper and etc.

2. Direct Selling

   This tool is executed in the form of an oral presentation in one conversation with one or several
   prospective buyers with the goal of reaching a purchase agreement

3. Promotion Selling

   Form of activity that can stimulate customers to buy, which includes exhibitions, shows and demonstrations. Usually this kind of tool conducted in the crowd of people or customers.

D. Service

Service is an activity, benefit, satisfaction from something offered in sales. Retailers must be able to customize the service type which are offered with other elements in the retail business. As an example, the store that sets the selling price above the market price must provide service which really matches the price paid by the customer. As for types services in the retail mix include:

1. Store service time.
2. Shipping of goods.
3. Handling of complaints from customers.
4. Receiving orders by telephone and post.
5. Providing of parking facilities

The more complete and satisfying service that is provided then the more likely customers will be interested in choosing to shop at the shop concerned.

E. Physical Facilities

Physical facilities are a determining factor in dominating market share that preferred by the retailer. Market control can be achieved if retail gets a good position to create a company's image for its customers. Physical facilities have an important role to position retail stores in the minds of customers. Physical facilities are divided into three parts, namely:

1. Store location

Determining store location is the most important task since the right location will be the key to the success of a business.

2. Store Layout

Store arrangement is designed and created after the shop location is selected. All of this aim is designated to facilitate and provide comfort for customers in shopping.

3. Shop Design (exterior and interior)

The exterior design is an exterior appearance of a shop that can attract customers to make purchases. Interior design is the appearance of a part in a store that is to attract the customers.

2.2.2 Retail Type Based on Product Selling

a. *Specialty Store* is a retail business that only sells one type of category of goods or the range of categories of goods sold relatively little. Examples of this retail business include pharmacies, optics, jewelry stores, lumberyard and bookstores.

b. *Grocery Store* is a retail business that provides a category of goods that almost most of them are daily necessities, fresh-food, perishable, dry-food, beverages, cosmetics, and home appliances. Examples of this retail business include Carrefour, Lotte-Mart, Giant, and Hypermart.

c. D*epartment Store* is a retail business with a category of goods that are sold not for basic needs such as clothing (branded items).

d. *Hyperstore* is a retail business that has a wide range of categories of goods, selling almost all types of goods required by every consumer's segment with the concept of one stop shopping. Generally, the area required for this retail business is at least 10,000 m.

2.2.3 Layout

Layout is the mapping that designed as a place to set the goods. The purpose of layout is to make activities become easier for both buyer and seller as well as to achieve the efficiency and effectivity. nowadays, the retailers and the store are growing rapidly anywhere, hence the customers want to get proper service from the retailer. The faster service provided by the retailer, the more satisfied the customers. Hence, many retailers need to have better layout for their development.

According to Juel-Jacobsen (2015) that well-established principles of urban retail designs are very vital for the owner of the retails, in particular for supermarkets and larger retail stores. Big retailer must have good layout because the customers do not want to wait longer for delayed services.

2.2.4 Shelf

Shelf is a must-have property for a store. in the retailers the function of shelf is to set or put product in a store in order to display the product to the customers. another usage of shelf is to keep the wares of goods in inventory to minimize the storehouse. Shelf space is one of the most essential resources in logistic decisions and shelf space management (Yang and Chen, 1999) and the proper space allocation that could influence the customers in buying.

2.2.5 Management Product Display

Implementation of display rack space management is needed to optimize the allocation of product diversity on limited display shelf space. space management is usually referred to as a planogram is defined as a concept or plan of displaying products based on consumer spending habits in order to maximize profits and improve service to consumers.

According to Silva et al. (2009) Shelf-space allocation and product display are the problems of efficiently arranging retail products on shelves in order to maximize profit, improve stock control, improve customer satisfaction, etc.

Some considerations in the application of space management are as follows:

a. Match the customer demand by providing the right range and stock units available for customer purchases.
b. Provide an appropriate range of products into limited shelf space and product categories on outlets.
c. Formalize approaches to analyze product categories and performance in outlets.

Benefits that can be generated from the application of space management for retailers are as follows:

a. Reduce expenses.
b. Reduce the occurrence of out of stock.

c. Improve customer service.

d. Increase sales and profits.

2.2.6 Product Placement

The collection of goods in the store provided by the company's manager to the customers. Commonly, it has some main characteristics for instances the products are provided under the group, its length or number of product and this product placement is intended to be seen easily by the customers in the display.

2.2.7 Customers' Behavior on Shelf Level

The allocation of product items on store's shelves plays the important role especially in a retail business. The efficient allocation product item on store's store could maximize the empty space on store's racks and also could provide customers satisfaction to the store (Fancher, 1991). The study conducted by (Raghubir, et., al. 2008), the vertical product items on store's store is more attractive if compared to the horizontal products placement. The products placement on shelves mostly divided into three level, those are eye-level, waist to shoulder-level, knee-level. the upper level shelves will be allocated for the product or department, which has high profited value by considering the support of each product or each department. This might be the case due to the upper level or eye-level shelf take less effort than other shelves level (Sigurdsson, et. al., 2009)

The research conducted by et al. (2005) stated that each product will have different sales if the products are allocated in different level. Urban (1998) stated that the product placement is very vital for a retailers in how they allocate the product on their shelves, because the arrangement of goods on the shelves will attract a buyer in his transaction in a retailer.

2.2.8 Techniques of Data Mining

There are several familiar data mining techniques and algorithms available to obtain the useful pattern and rules. The study conducted by Saurkar et al. (2014) discovered that there are many different techniques as follow:

1. Association

   Association rule is one of technique in data mining to discover the relationship between the product existing in the store or market (Kaur, 2014) This technique could be run by using Weka tools, R software and Rapid miner.

2. Classification

   This technique is as machine learning proposed to predict data that has similarity one to another (Chauhan et al., 2010) the output of this technique is to make a group of data.

3. Clustering

   Clustering is proposed to organize the data into meaningful sub-groups, in order to have the similarity in that group and as different as possible from the points in the other groups (Sheenu and Sakshi, 2014)

2.2.9 Association Rule

According to Rakesh and Pinki (2011), Association rule is the technique to discover a correlation relationship between the occurrence of products in a market through database based on certain attributes and characteristics. Association rule is quite useful as the information for the store. Thus, the managers or the owner of the store could utilize some benefits gained from this method. The benefits for the store are (Kavitha, 2016):

1. To find products with affinity to be sold together.
2. To improve in-store settings and optimize product placement
3. To improve layout of the catalogue of e-commerce site.
4. To control inventory based on product demand.

The problem of finding association rules was first introduced by Agrawal et al. (1993). It provides the results in the form of "if-then" statements. These rules are generated from the input datasets. The rules are derived from the support and confidence value given as input from the user. An association rule is, in general, an expression of the form X Y, where X is an antecedent and Y is a consequent. Association rule shows how many times Y has occurred if X has already occurred depending on the support and confidence value. Many algorithms for generating association rules were presented over time. Some well-known algorithms are Apriori and FP-Growth (Meera and Shafaqu, 2015).

2.2.10 Apriori Algorithm

Apriori algorithm is one of the most widely used and famous techniques to find association rules (Mirajkar et al., 2016). The first phase of this algorithm produces the items that often appear systematically and the second phase produces a strong rule of the itemset.

An association rule can be explained as follows: O is the set of items where O = $\{o_1, o_2, ..., o_n\}$. T_i is the i-th transaction that contains the set of items. D is the set of all transactions so that D = $\{T_1, T_2, ..., T_m\}$. The association rule that will be generated will be in the following implications:

"If A, then B" or "A $\Rightarrow$ B"

A is the antecedent of the implication, whereas B is consequent (follower) of the implication. A and B are the pure subset of I so that A, B $\subset$ I. A and B are two sets of interconnected so A $\cap$ B = $\emptyset$.

There are two sizes in determining whether a pair of items can be expressed as an association rule. This measure is expressed as support and confidence. Support is a requirement of how often a / series of items should be appears to be expressed as a rule. Support denoted by s.

$$\textbf{support } \{A \Rightarrow B)\} = \frac{f(A \cup B)}{Number\ of\ Tm\ in\ D}$$

Confidence shows the level of confidence of predecessor items (antecedents) and the follower item (consequently) will appear in the same transaction. Confidence is denoted by p.

$$\textbf{confidence } \{A \Rightarrow B)\} = \frac{f(A \cup B)}{f(A)}$$

Itemset is a partial or whole set items that are members of I. An itemset consisting of k items
called k-itemset. A frequent itemset is a an itemset that has a frequency of φ numbers. Items often have k member pieces are called frequent k-itemset (frequent k-itemset).

In addition to the size of the support and confidence of a frequent itemset, the third measure that can be considered is the value of Lift. The size of the lift is determined as follows:

$$l = \text{lift}\{A \Rightarrow B\} = \frac{f(A \cup B)}{f(A)f(B)}$$

The value of Lift is describing as follows:

a. If the value of Lift <1, then A and B have the frequency of occurrence at the same time low on the data as expected based independent assumptions. In other words, A and B have dependencies negative and substitution effect between A and B.
b. If the value of Lift = 1, then A and B frequency of occurrence simultaneously which is often on the data as expected based on assumptions independent. It can be said that A and B are independent of one with others.
c. If the value of elevator> 1, then A and B frequency of occurrence simultaneously on the data more often as expected based on assumptions independent. In other

words, A and B are interdependent positive and there is a complementary influence between A and B.

Lifts are calculated for only 2-itemsets as the value of the lift tends to increase high for many itemset compared to a few itemset. Therefore, the unsuitable lift is used to determine the effect of the itemset with different sizes.

2.2.11 The Profited Sequential Pattern (PSP)

The Profited Sequential Pattern (PSP) is a calculation to determine the allocation of products in the display rack with the variables that have been set. The product items those grouped as higher PSP value will be placed to the upper level of rack and the lower PSP of the product items then will be placed to the lower rack level. Here is the formula to get the Profited Sequential Pattern (PSP) value (Aloysius and Binu, 2013):

$$\textbf{PSP (X)} = \frac{\textbf{supp (X)} * \boldsymbol{profit}\ (\boldsymbol{X})}{\boldsymbol{l}\ (\boldsymbol{X})}$$

Where:

Supp (X) = Support value of pattern X in database DT
profit(X) = Profit value of pattern
X l(X) = Length of pattern X

2.2.12 R Software

R software is a programming language and environment for statistical computing and graphics. The R language is being used widely by statistician and data miners. This software is also providing library of statistical, such as linear and nonlinear modeling, classic statistical tests, time-series analysis, classification, clustering and etc.

CHAPTER III

RESEARCH METHODOLOGY

This chapter is discussing the research object and the data required to complete the research. The farther explanation regarding the method of data collection, tools of data analysis and framework will be explained.

3.1 Research Approach

This study uses a quantitative approach with the type of survey research into the field to obtain data in the form of transaction for each purchase, the initial layout, the length of each item categorized high support and the gross profit of each product.

3.2 Research Objective

This research is aiming to redesign the store's layout and allocate the proper product placement of Lumberyard CV. XYZ in order to optimize the time efficiency on their service and increase the sales.

3.3 Collecting Data Method

In this research, the researcher uses several methods to get the data. The methods used are observation, collecting the bills, reviewing several journals and literatures. CV. XYZ does not keep the previous receipts in their computer database, but only keep the recap of each transaction in the form of copy. The data was obtained by performing

research at CV. XYZ for more less 1 month. In this period of time, the researcher collected the receipts recap from the store.

The second data were taken after the first data had been processed by using software R to discover which products should have high support of highly purchased by customers, the second data were the front length or facing of product and the gross margin of each product by observing the second tie and doing the interview to the managers of the store.

3.4 Data Processing

The first processing data, the researcher uses the data from collecting the receipts in 1 month from the store. All those receipts will be processed by using method of Market Basket Analysis to discover the products which correspond with other products.

The second data processing applied the Profited Sequential Pattern (PSP) calculation with the help of Microsoft Excel. The aim of this calculation is to determine which product will be arranged on the store's store by considering the variables of Length of Product item, Gross margin of each product item and the support value of product.

3.5 Analysis Tools

In this research, the analysis tool used by the researcher is R Studio software. The additional software such as Microsoft Word and Microsoft Excel will be required to process the data. While in in the end of the research, the researcher uses the assistance of Microsoft Visio to measure the distance of people's steps as a proof that the proposed store's layout store applicable to the store and more efficient if it is compared with the previous layout store.

3.6 Flowchart

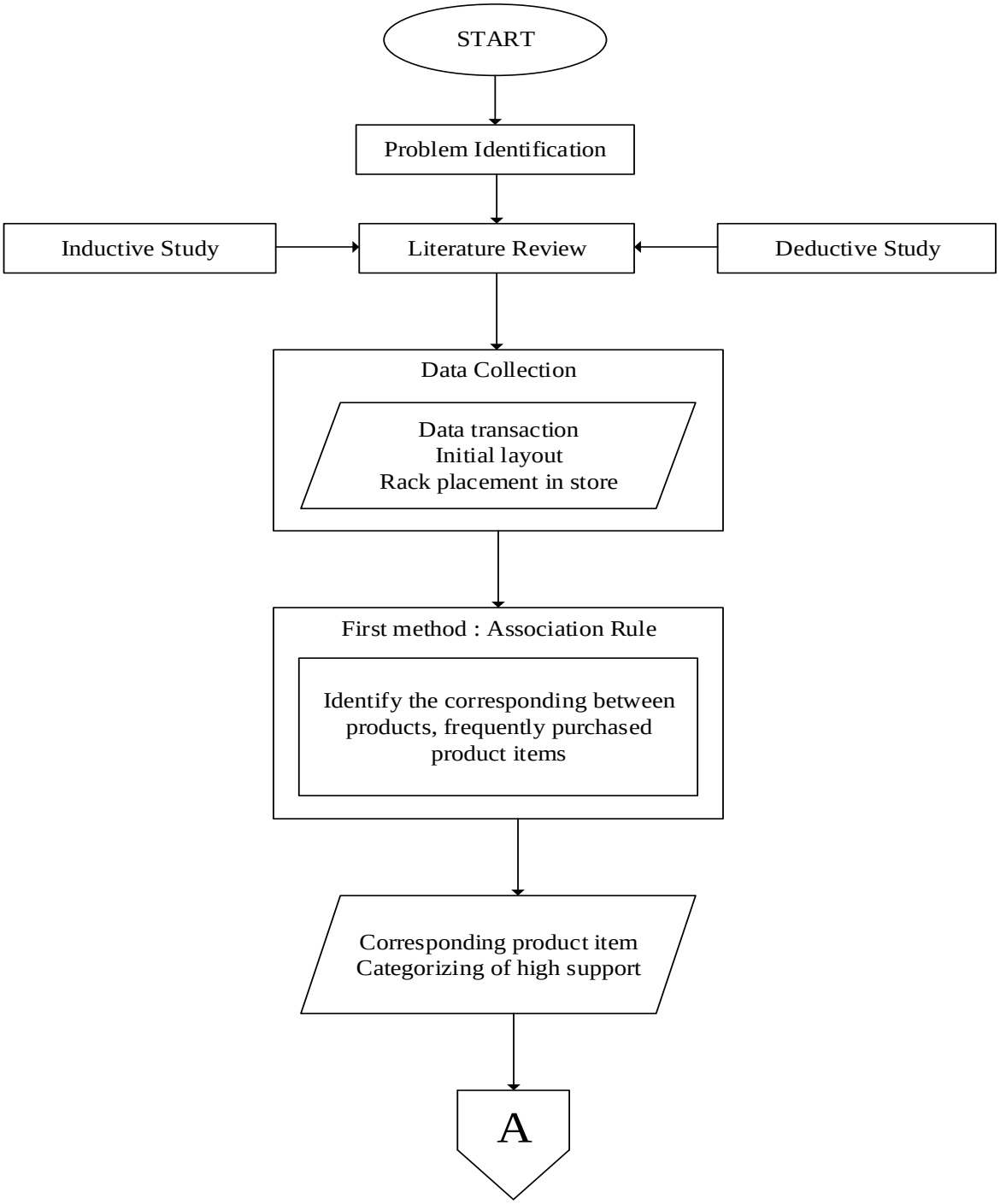

Figure 3. 1 Research Flow Diagram

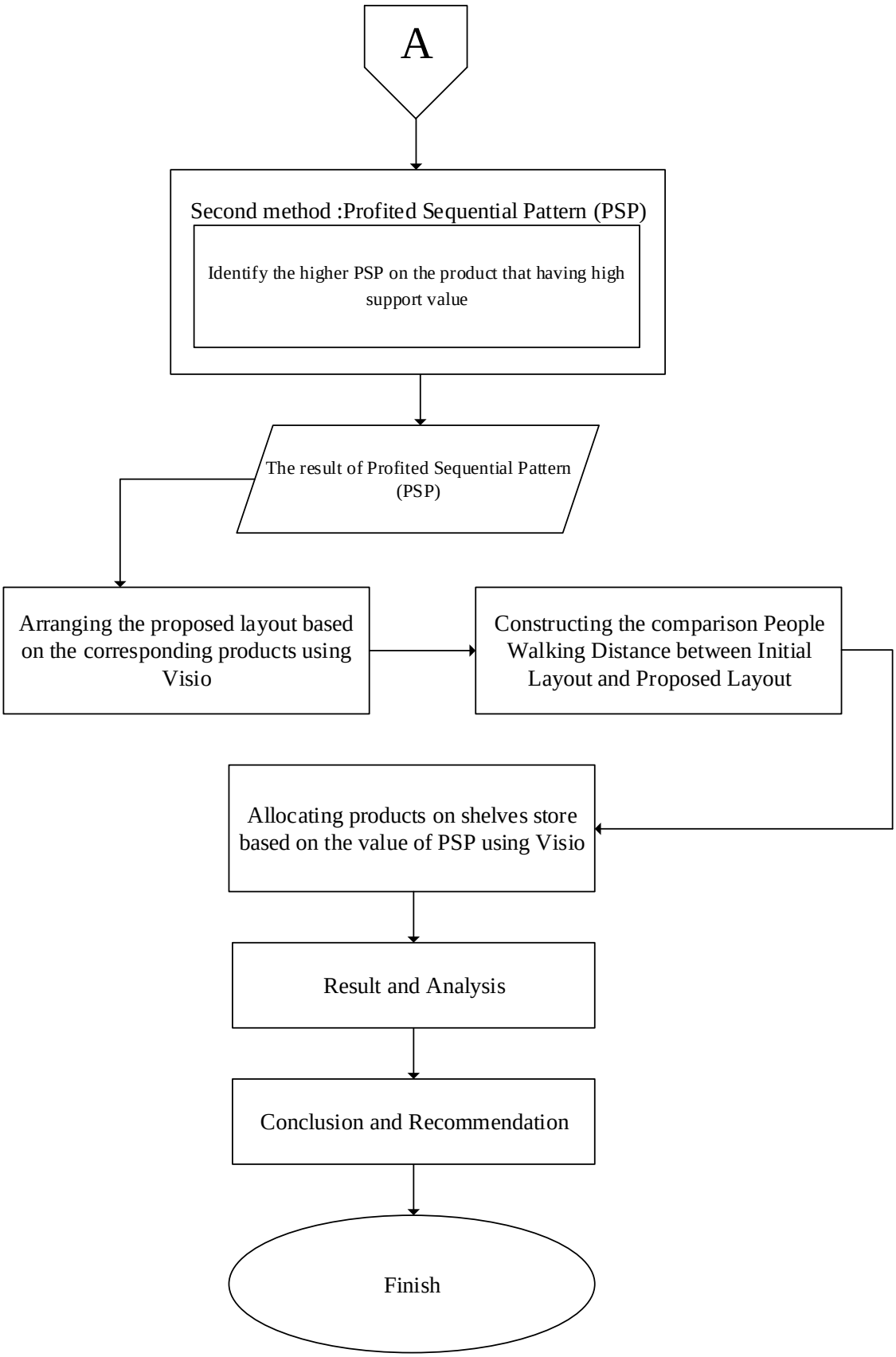

Figure 3.1 Research Flow Diagram (continues)

CHAPTER IV

DATA COLLECTION AND PROCESSING

4.1 Data Collection

This research is taken place in a lumberyard namely CV. Pelita Mas located in Desa Panggang Sari Kab. Cirebon West Java.

4.1.1 Product Categories

The products that are sold by this store is varied, each product is categorized in a certain category based on the similarity. Categorization of all products are determined by the store and completed by the author for the accuracy. The total categories in the store are 21 categories in total. The details of the categories are presented in the following Table 4.1.

Table 4. 1 The details of the Category

No	Category
1	Nails / Bolts
2	Wall Paint
3	Wood / iron paint
4	Paint / coating materials
5	Oil / catalyst materials
6	Paint tool
7	Piping
8	Pipe connection
9	Sanitary
10	Ceiling / roof covering

No	Category
11	Iron
12	Smoothing tool
13	Wood
14	Base Material
15	Floor materials / wallcoverings
16	Electrical materials
17	Hangers / keys
18	Artisan Goods
19	Basic adhesive material
20	Mixing material
21	Rope / Adhesive

4.1.2 Data Transaction

The data was derived from the store in a period of approximately 1 month divided by 2 period of time. The first period, the data were taken from 6 June 2018 - 17 June 2018 and on the second period, the data were taken from 20 September 2018. The transaction data were in the form of costumers' payment proof, which are being kept by the store. Within 1 month, it was collected 1061 buyers and 2836 rows in total to be used in this research. Below is the example of the data transaction that already transformed to Microsoft Excel as shown in Table 4.2.

Table 4. 2 Data Transaction

Tid	Date	Product
A1	June 6, 2018	Dulux V-Gloss
A1	June 6, 2018	Thinner Botol
A1	June 6, 2018	Kuas 2"
A2	June 6, 2018	Kran Sanho 3/4
A2	June 6, 2018	Sok Drat Dalam
A2	June 6, 2018	Knee 1/2"
A2	June 6, 2018	Sok 1/2"
A2	June 6, 2018	Siltip
A2	June 6, 2018	Ppc Wavin 1/2"
A2	June 6, 2018	Stopkran 1/2"
A3	June 6, 2018	Roll Ace Besar
A3	June 6, 2018	Bak Cat
A3	June 6, 2018	Amplas Lembar

Tid	Date	Product
A4	June 6, 2018	Kran Sanho 3/4
A4	June 6, 2018	Siltip
A4	June 6, 2018	Lem Isarplas
A5	June 6, 2018	Cat Catylac Galon
A5	June 6, 2018	Semen Putih (Kg)
A5	June 6, 2018	Roll Ace Kecil
A5	June 6, 2018	Sekrap Kecil
A6	June 6, 2018	Lem Fox
A6	June 6, 2018	Semen Hitam (Kg)
A7	June 6, 2018	Cat Catylac Galon
A7	June 6, 2018	Cat Altex 1 Kg
A7	June 6, 2018	Semen Hitam (Kg)
A8	June 6, 2018	Thinner Botol
A8	June 6, 2018	Kuas 3"
A8	June 6, 2018	Dulux V-Gloss
A9	June 6, 2018	Kawat Tali Putih
A9	June 6, 2018	Paku Beton 5cm (Satuan)
A9	June 6, 2018	Paku
A10	June 6, 2018	Risplang 20
A10	June 6, 2018	Cat Catylac Galon
A10	June 6, 2018	Kaso Lokal
A10	June 6, 2018	Roll Ace Besar

The receipt includes transaction ID, date of purchasing, product name. Those variables will be proceeded to determine the pattern of customers behaviors using association rule and to determine the product placement on shelves based the value of PSP.

4.1.3 Layout Store

The store is located on the area of 1485 square meters, with a width of 27 meters and 55 meters long backward. This shop applies self-service and non-self-service system for customer. This system is employed due to variety of goods that existed in store. Therefore, the shop layout will be divided into 2 parts, the first part for goods will be served by the employees, while the second part will be designed to accommodate the self-service although sometimes there are several goods that must be assisted by the employee, specifically for the goods purchased in large quantities or the huge in size.

In displaying products at the store, it only displays large products in the self-service product category. While products that are categorized as non-self-service are placed in location that cannot be accessed directly by the buyer and will be served directly by the store's employees, just like a traditional store in general.

The placement of goods on the shelves are also limited. The items that being arranged on the store's shelves are the products commonly small and light in order to fit the shelves. While Self-service items do not use shelves. self-service items are placed on paving only that have been designed with a base matched to each product category. More details can be seen in Figure 4.1 Layout Store below:

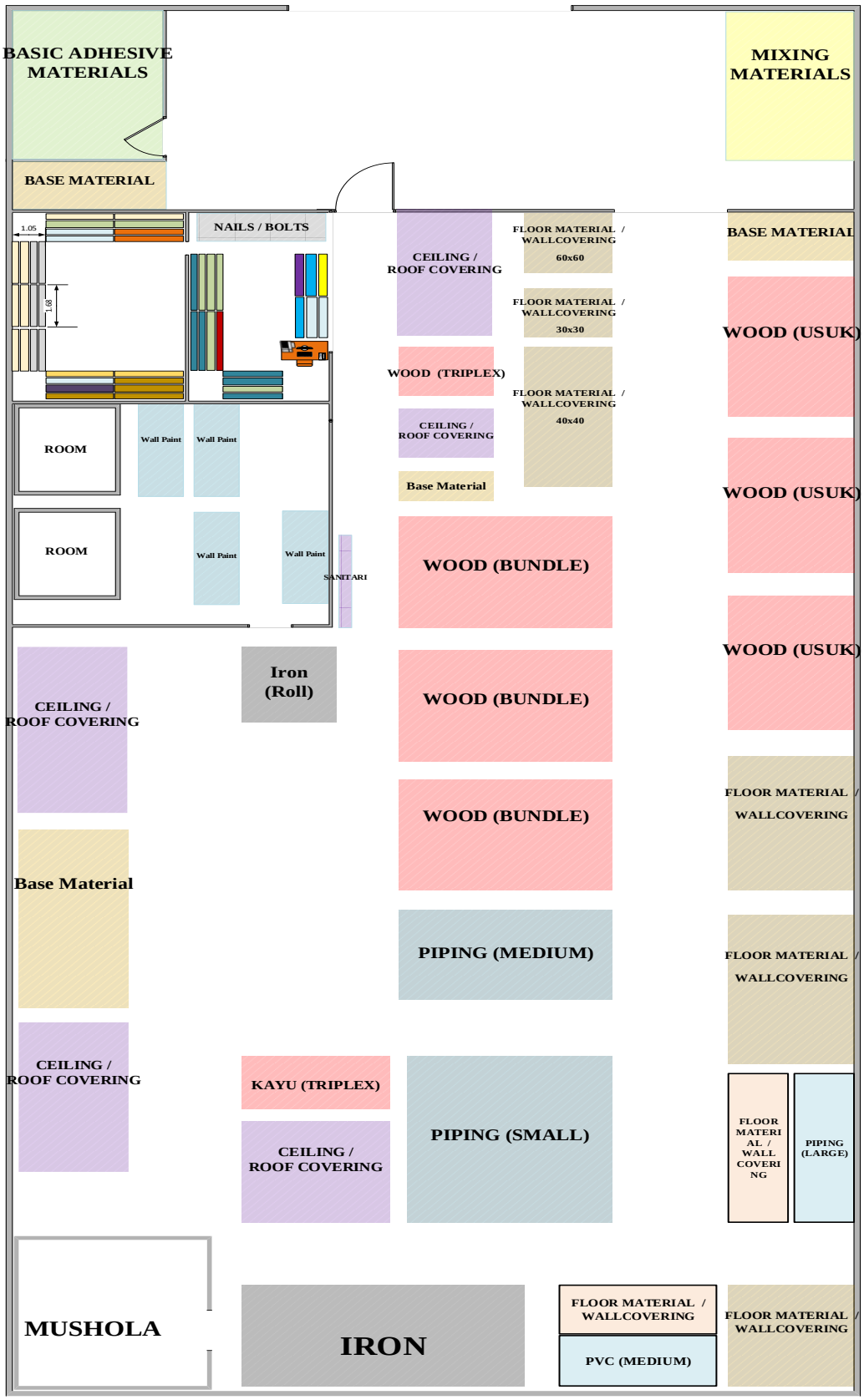

Figure 4. 1 Layout Store

Each department is grouped based on the shelves' color in order to ease the reader to distinguish each department placed in the store's layout. while rack dimension size is mostly in the same size which is 1.68 in length and 1.05 in width.

Details of each Departments available on shelves:

- Smoothing tool
- Artisan Goods
- Floor materials / wallcoverings
- Wood / iron paint
- Paint tool
- Oil / catalyst materials
- Rope / Tape
- Paint / coating materials
- Pipe connection
- Sanitary
- Electrical materials
- Hangers / Keys

The dimension of each category has variety of size. The category that is not using rack could be adjusted because there is no wall or partition between category.

4.1.4 Rack Placement in the Store

Placement of products in this building store employs several alternatives such as Rack aluminum multilevel, wood rack terraced, hanger and wooden plinth. The dimensions are different depending on the needs of the goods in the storage tool. Because there are 2 parts of the store (self-service and non-self-service). As mentioned before, the area of services is divided into two types, which are the self-service and non-self-service. The non-self-service section is defined as a section that is limited to the wall of the top left down a bit from the above maps, while the remaining area is classified as self-service area. Then, to facilitate the explanation of each rack and its allocation, the author divides it into 2 parts. The first for the shelf rack that is provided on the side of non-self-service as follows:

1. Standard wooden shelf

This shelf is used for goods that are being categorized as Wall Paint or Wood Paint. It is medium size, Pipe connection category, Artisan Goods, etc. As for the shelves rack, available with different lengths of different sizes to adjust the available space in the store. This kind of rack consisted of 4 levels.

2. Transparent aluminums rack

This shelf is specifically used for Electrical materials because this sort of rack included in the rack lining placed on the front so that buyers can choose the goods directly. The dimensions of this shelf is 1.5 meters length and 1 meter high and consisted of 3 levels.

3. Hanger

This type of rack is not widely used in store outlets. It only used for list of gypsum, wooden list and some products from category of Pipe connection with large size that should be placed on this hanging rack.

4. Wooden rack with the front transparent

Wooden rack with a transparent front part has similar function as transparent aluminum rack, this rack is placed in front of non-self-service side outlets. Even so, buyers can see the product first before conducted the purchasing because the front side of this shelf applies transparent glass. The dimensions for this shelf are 1.5 meters wide and 1 meter high with 3 rack levels available.

While the shelf rack or media product placement for the self-service is explained as follows:

1. Wooden pads

These wooden pads are used for products that are susceptible to water or humidity, they are used for categorical purposes such as Iron with the objective of not subject to rusting, categorized as Basic Adhesive material with the purpose of hardening of harsh materials when exposed to high humidity and for goods that use package in the form of cardboard.

2. Plaster

This type of display is quite widely used for goods in the building store, since there are a lot of hard-resistant goods such as Wood category, Wall Paint with a large enough item, category Mixing material etc. The plaster is also available partly on the non-self-customers of the product.

4.1.5 Workers in the Store

Currently, the total of workers in CV. XYZ is 5. They are 1 manager, 1 cashier and 3 labors. That number excludes the drivers who have specific task to deliver the product ordered by customers. The workers who are usually being replaced or resign are in the position of cashier and labors. According to the expert, the workers tend to resign from the store in second up to 4 years. According to the experts' opinion, there is a possibility that heavy workload in term of product weight, a salary that is considered insufficient or boring feelings due to monotony activities, are the reasons of resigning.

4.2 Data Processing

4.2.1 Categorizing the Product Name to Product Categories

The first step in data processing is to categorize the product consisted in the data transaction data (receipt), so those categories can be processed by using R software with the purpose of which categories that have a close corresponding with other categories.

This process of data assembling is assisted by using Microsoft Excel software with CSV format (Comma Delimited). The following is the Table 4.3 for categorizing the product as shown below:

Table 4. 3 Categorizing Product

TID	PRODUCT	CATEGORIES
A1	DULUX V-GLOSS	WOOD / IRON PAINT
A1	THINNER BOTOL	OIL / CATALYST MATERIALS
A1	KUAS 2"	PAINT TOOL
A2	KRAN SANHO ¾	SANITARY
A2	SDL 1/2"	PIPE CONNECTION
A2	KNEE 1/2"	PIPE CONNECTION
A2	SOK 1/2"	PIPE CONNECTION
A2	SILTIP	ROPE / TAPE
A2	PPC WAVIN 1/2"	PIPING
A2	STOPKRAN 1/2"	SANITARY
A3	ROLL ACE BESAR	PAINT TOOL
A3	BAK CAT	PAINT TOOL
A3	AMPLAS LEMBAR	SMOOTHING TOOL
A4	KRAN SANHO 3/4	SANITARY
A4	SILTIP	ROPE / TAPE
A4	LEM ISARPLAS	ROPE / TAPE
A5	CAT CATYLAC GALON	WALL PAINT
A5	SEMEN PUTIH (KG)	BASIC ADHESIVE MATERIAL
A5	ROLL ACE KECIL	PAINT TOOL
A5	SEKRAP KECIL	SMOOTHING TOOL
A6	LEM FOX	ROPE / TAPE
A6	SEMEN HITAM (KG)	BASIC ADHESIVE MATERIAL
A7	CAT CATYLAC GALON	WALL PAINT
A7	CAT ALTEX 1 KG	WOOD / IRON PAINT
A7	SEMEN HITAM (KG)	BASIC ADHESIVE MATERIAL
A8	THINNER BOTOL	OIL / CATALYST MATERIALS
A8	KUAS 3"	PAINT TOOL
A8	DULUX V-GLOSS	WOOD / IRON PAINT
A9	KAWAT TALI PUTIH	IRON
A9	PAKU BETON 5CM (SATUAN)	NAILS AND BOLTS
A9	PAKU	NAILS / BOLTS
A10	RISPLANG 20	CEILING / ROOF COVERING
A10	CAT CATYLAC GALON	WALL PAINT
A10	KASO LOKAL	WOOD
A10	ROLL ACE BESAR	PAINT TOOL

In the above table, 3 variables are shown, those are Transaction ID (TID), Product and Categories. Whereas, the variables that will be only processed by using R software are variable of Transaction ID and Categories.

4.2.2 The Number of each Category Purchased per Day

Table 4. 4 Category Purchased per Day

Category	DAY																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Artisan Goods	2	2	1	4	2	1	1	0	0	0	1	1	1	1	1	2	0	1	0	2	4	2	0	2	5	1	2	0	2	0	0
Base Material	3	4	4	0	2	3	2	1	4	2	0	0	7	5	4	1	1	2	2	5	3	4	4	3	2	5	3	9	3	4	8
Basic adhesive material	10	14	9	16	6	7	10	15	12	14	2	6	15	14	18	12	14	18	9	17	17	18	21	17	12	12	16	9	18	15	14
Ceiling / roof covering	2	1	3	4	0	1	3	0	1	1	0	0	3	1	0	5	1	2	2	0	6	1	1	3	5	2	11	3	6	6	3
Electrical materials	0	1	5	4	1	3	0	2	5	7	9	0	1	7	0	0	2	3	5	3	1	1	6	2	0	8	4	5	0	6	3
Floor materials / wallcoverings	1	2	5	2	5	4	4	6	1	3	3	4	3	4	3	0	6	3	2	1	7	2	6	6	0	8	5	4	3	2	9
Hangers / keys	1	0	0	1	2	3	7	0	2	2	6	2	2	0	1	3	0	1	1	0	1	3	0	8	3	1	6	1	2	3	3
Iron	3	3	7	6	1	2	8	8	1	3	3	4	13	6	8	6	12	6	10	11	3	4	6	6	8	9	3	7	9	18	12
Mixing material	0	2	2	4	0	0	4	2	1	2	0	0	4	2	5	3	1	3	0	0	2	1	7	1	3	1	1	3	3	2	5
Nails / Bolts	3	6	8	4	3	11	8	2	3	1	1	4	8	12	7	9	7	9	2	15	8	11	14	14	8	11	19	13	14	21	15
Oil / catalyst materials	6	3	4	6	6	4	4	8	3	5	6	5	2	0	1	0	1	1	1	0	1	1	2	0	3	3	0	0	1	0	1
Paint / coating materials	5	1	1	1	4	1	5	4	2	1	2	3	2	0	1	0	3	0	0	1	0	0	1	0	1	2	2	1	0	0	0
Paint tool	19	12	6	10	19	13	6	14	9	8	13	2	4	0	8	0	9	4	0	5	0	1	6	1	2	2	2	1	2	2	0
Pipe connection	3	5	8	0	2	3	2	4	6	11	10	20	5	13	15	18	17	9	18	6	13	9	8	5	4	5	5	3	0	11	4
Piping	1	0	2	3	1	1	0	2	2	2	2	4	4	5	3	5	3	3	5	2	4	4	3	2	1	3	2	5	4	4	1
Rope / Tape	4	8	9	7	6	4	5	6	5	9	3	15	5	6	9	13	10	7	13	4	12	14	7	5	4	4	11	3	4	8	8
Sanitary	3	4	4	0	3	0	0	2	4	2	3	4	6	2	0	4	1	1	3	6	7	0	0	3	0	4	1	1	1	4	1
Smoothing tool	4	7	1	7	4	1	8	1	4	1	6	3	2	2	3	4	4	6	6	5	4	6	4	4	3	1	4	1	0	2	2
Wall Paint	10	3	5	11	15	9	4	15	12	7	8	2	4	2	4	0	3	0	6	2	1	2	2	2	1	3	0	0	2	0	1
Wood	2	4	2	1	5	3	5	2	2	0	1	2	5	5	5	4	7	4	1	4	2	2	7	2	6	1	5	8	8	3	4
Wood / iron paint	9	1	4	8	6	4	4	4	7	4	3	6	4	1	1	1	4	6	0	0	1	1	2	1	2	7	1	1	1	0	0

The Table above describes the purchases carried out by customers per Day, the total data collected are 31 days. The table is proposed to figure out the variance sampling and standard deviation. Both variance sampling and standard deviation could be used as the parameter to discover the diversity or variance of the data. Below is Table 4.5 that presents the result of variance and standard deviation:

Table 4. 5 The result of Variance and Standard Deviation

Category	Average	Variance	Standard Deviation
Artisan Goods	1.32	1.6	1.28
Base Material	3.23	4.6	2.16
Basic adhesive material	13.13	19.0	4.36
Ceiling / roof covering	2.48	6.1	2.46
Electrical materials	3.03	7.2	2.68
Floor materials / wallcoverings	3.68	5.0	2.24
Hangers / keys	2.10	4.5	2.12
Iron	6.65	15.2	3.90
Mixing material	2.06	3.1	1.77
Nails / Bolts	8.74	27.7	5.27
Oil / catalyst materials	2.52	5.4	2.32
Paint / coating materials	1.42	2.3	1.50
Paint tool	5.81	31.2	5.59
Pipe connection	7.81	30.8	5.55
Piping	2.68	2.2	1.47
Rope / Tape	7.35	11.7	3.42
Sanitary	2.39	4.0	1.99
Smoothing tool	3.55	4.5	2.11
Wall Paint	4.39	19.3	4.39
Wood	3.61	4.7	2.17
Wood / iron paint	3.03	6.8	2.61

It could be seen in the Table 4. 6 about the result of Variance and Standard Deviation , the value of variance and standard deviation is quite variative to each category and the author realizes that the value of standard deviation is pretty high if it is compared with the average value of each category. The researcher assumes this as common case due to the research object. The research object of this case is specific store, called Lumberyard. Since Lumberyard sells products with long expired products or long term-use products.

4.2.3 Identification of Product Categories Association

The data processed by the author uses the R Studio software as many as 1061 Transactions with rows of 2836 for the total amount of data. The packages used in this R studio software include Arules, ArulViz, Matrix and Grid. Summary of the results on the transaction data are presented in Figure 4.2:

```
set of 15 rules
> summary(rules)
set of 15 rules

rule length distribution (lhs + rhs):sizes
 2  3
 2 13

   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  2.000   3.000   3.000   2.867   3.000   3.000

summary of quality measures:
    support         confidence          lift            count
 Min.   :0.01048   Min.   :0.6038   Min.   :1.882   Min.   :11.00
 1st Qu.:0.01238   1st Qu.:0.6583   1st Qu.:4.350   1st Qu.:13.00
 Median :0.01619   Median :0.7059   Median :5.746   Median :17.00
 Mean   :0.02165   Mean   :0.7118   Mean   :5.777   Mean   :22.73
 3rd Qu.:0.02810   3rd Qu.:0.7279   3rd Qu.:7.195   3rd Qu.:29.50
 Max.   :0.05048   Max.   :0.9167   Max.   :9.823   Max.   :53.00

mining info:
    data ntransactions support confidence
 ftrans1          1050    0.01        0.6
```

Figure 4. 2 Summary of Categories

The results of 1050 data transactions processing that have been categorized for each product by using the rules association with the assistance of R studio software are shown in Figure 4.2 below:

```
> inspect(rules_conf)
     lhs                                rhs                              support confidence     lift count
[1]  {Piping,
      Sanitary}                      => {Pipe connection}          0.01047619  0.9166667 7.403846    11
[2]  {Piping,
      Rope / Tape}                   => {Pipe connection}          0.03047619  0.8648649 6.985447    32
[3]  {Oil / catalyst materials,
      Paint tool}                    => {Wood / iron paint}        0.02571429  0.7297297 9.231521    27
[4]  {Paint tool,
      Wood / iron paint}             => {Oil / catalyst materials} 0.02571429  0.7297297 9.823285    27
[5]  {Piping}                        => {Pipe connection}          0.05047619  0.7260274 5.864067    53
[6]  {Basic adhesive material,
      Piping}                        => {Pipe connection}          0.01428571  0.7142857 5.769231    15
[7]  {Basic adhesive material,
      Ceiling / roof covering}       => {Nails / Bolts}            0.01142857  0.7058824 3.615495    12
[8]  {Oil / catalyst materials,
      Wall Paint}                    => {Paint tool}               0.01142857  0.7058824 5.745554    12
[9]  {Mixing material}               => {Basic adhesive material}  0.04095238  0.7049180 2.056011    43
[10] {Rope / Tape,
      Wood / iron paint}             => {Oil / catalyst materials} 0.01238095  0.6842105 9.210526    13
[11] {Wall Paint,
      Wood / iron paint}             => {Paint tool}               0.01333333  0.6666667 5.426357    14
[12] {Smoothing tool,
      Wall Paint}                    => {Paint tool}               0.01238095  0.6500000 5.290698    13
[13] {Rope / Tape,
      Smoothing tool}                => {Basic adhesive material}  0.01904762  0.6451613 1.881720    20
[14] {Rope / Tape,
      Sanitary}                      => {Pipe connection}          0.01619048  0.6296296 5.085470    17
[15] {Pipe connection,
      Piping}                        => {Rope / Tape}              0.03047619  0.6037736 3.267847    32
> rules_conf <- sort(rules, by="confidence", decreasing = TRUE)
```

Figure 4. 3 Categories Association

Based on the result of category's combinations shown in the figure above, the conclusion could be withdrawn from several associations formed based on the size of the support, confidence and lift ratio in each combination of categories made. In the figure above can be seen there are 15 rules that are formed with minimum support and confidence of 0.01 and 0.6 respectively. Below is an explanation of each rule:

1. Association between {Piping, Sanitary} and {Pipe connection}

   The first association is the category between {Piping, Rope / Tape} with {Pipe connection}. The association has support and confidence of 0.01 and 0.91 respectively.

2. Association between {Piping, Rope/Tape} and {Pipe connection}

   The association with the second largest confidence value is the category association between {{Piping, Rope/Tape} and {Pipe connection}. The association has support and confidence values of 0.030 and 0.86 respectively.

3. Association between {Oil/Catalyst material, Paint tool} and {Wood/Iron paint}

   The third association involves 3 categories simultaneously is category {Oil/Catalyst material, Paint tool} and {Wood/Iron paint}. The association between that categories has support and confidence of 0.025 and 0.72 respectively.

4. Association between {Paint tool, Wood/Iron paint} and {Oil/Catalyst material}

   The fourth association also involves 3 categories simultaneously namely category {Paint tool, Wood/Iron paint} and {Oil/Catalyst material} categories. The association between those categories has support value of 0.025 and confidence value of 0.72.

5. Association between {Piping, Basic adhesive material} and {Pipe connection}

   The next association is the association involving 3 categories namely category {Piping, Basic adhesive material} and {Pipe connection}. This association has a considerable support value with a support value of 0.05 and a confidence value of 0.72.

6. Association between {Basic adhesive material, Piping} and {Pipe connection}

   The association with the sixth largest confidence value is the association between category {Basic adhesive material, Piping} and {Pipe connection}. The associatio n has support and confidence values of 0.01 and 0.71 respectively.

7. Association between {Basic adhesive material, Ceiling/ Roof covering} and {Nails/Bolts}

   The seventh association involves 3 categories simultaneously namely category {Basic adhesive material, Ceiling/ Roof covering} and {Nails/Bolts}. The association among those categories have support and confidence of 0.01 and 0.70 respectively with 12 transactions.

8. Association between {Oil / catalyst materials, Wall paint} and {Paint tool}

   The association with the 8th largest confidence value is the category association between {Oil / catalyst materials, Wall paint} and {Paint tool}. The association has support and confidence values of 0.01 and 0.70 respectively.

9. Association between {Mixing materials} and {Basic adhesive material}

   The next association is an association formed Category {Mixing materials} and {Basic adhesive material. The association has support and confidence values of 0.04 and 0.70 respectively.

10. Association between {Rope/Tape, Wood/Iron paint} and {Oil / catalyst materials}

    The next association is an association involving 3 categories: category between {Rope/Tape, Wood/Iron paint} and {Oil / catalyst materials}. This association has support and confidence value of 0.01 and 0.68 respectively.

11. Association between {Wall paint, Wood/Iron paint} and {Paint tool}

    The 11th Association involves 3 categories simultaneously namely category {Wall paint, Wood/Iron paint} and {Paint tool}. The association between those categories has support and confidence of 0.01 and 0.66 respectively.

12. Association between {Smoothing tool, Wall paint} and {Paint tool}

    The 12th association involves 3 categories simultaneously namely categories {Smoothing tool, Wall paint} and {Paint tool} categories. The association between those categories has support and confidence of 0.01 and 0.65 respectively.

13. Association between {Rope/Tape, Smoothing tool} and {Basic adhesive material}

    The 13th association involves 3 categories simultaneously namely {Rope/Tape, Smoothing tool} and {Basic adhesive material} categories. The association among those categories have support and confidence of 0.01 and 0.64 respectively.

14. Association between {Rope/Tape, Sanitary} and {Pipe connection}

    The 14th association involves 3 categories simultaneously namely category {Rope/Tape, Sanitary} and {Pipe connection}. The association among those categories have support and confidence of 0.01 and 0.62 respectively.

15. Association between {Pipe connection, Piping} and {Rope/Tape}

    The last association involves 3 categories simultaneously namely category {Pipe connection, Piping} and {Rope/Tape}. This association rule is the same as the 2nd association rule.

4.2.4 Identification of the most frequent product categories

The most frequent product categories also be another alternative to arrange the proper layout in the store. The author generated 10 most frequent product categories in order to discover which category should be considered to be placed in the front line of store. By placing the most frequent product category in the front line of store or near the cashier table to do transaction between the customers and cashier, the people walking distance

will be reduced as well. Thus, this table below could be another reference to arrange the proper layout. Below is Figure 4.4 on The most frequent categories:

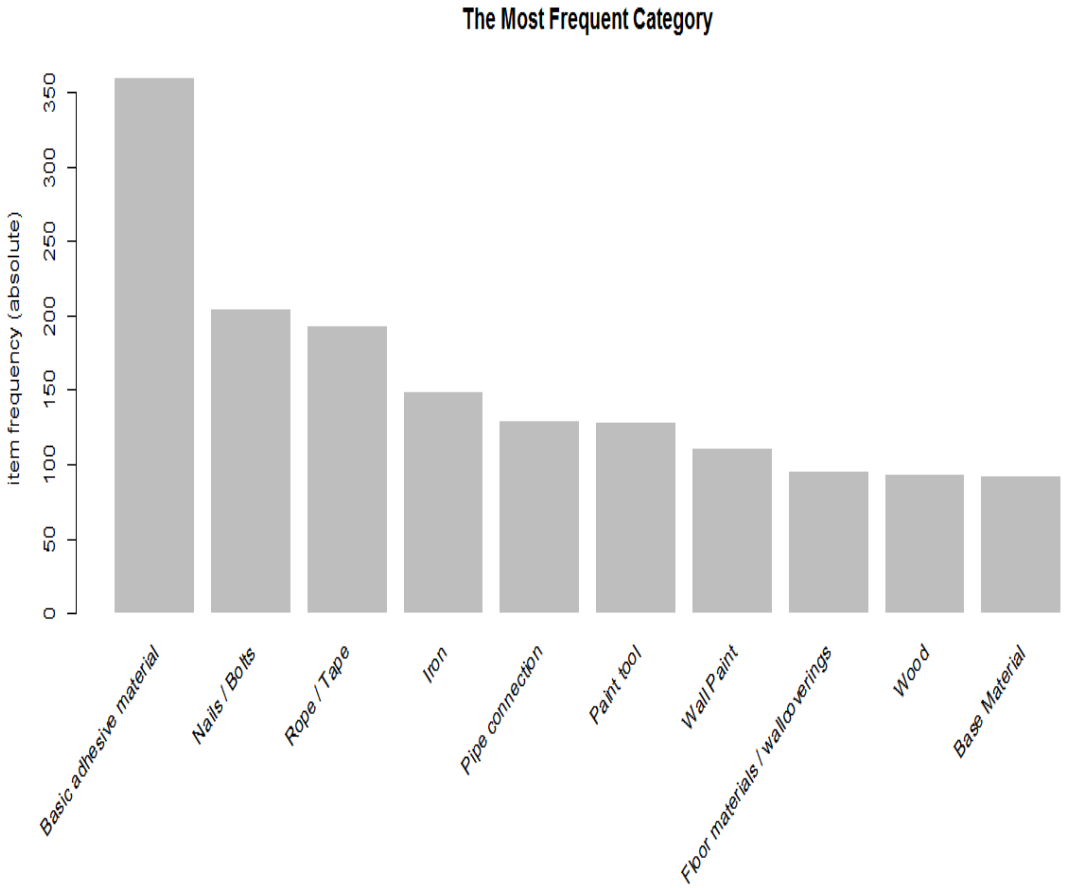

Figure 4. 4 The most frequent categories:

4.2.5 Identification of Product Items

Right after finishing association on categories that have good corresponding with one category with other categories, with the aim of bringing the categorical category product into the retailer layout. The next stage is to find out what product items should be placed on the upper rack, middle rack and lower rack with the aim of maximizing sales and also to facilitate the process of taking products in the store

At first, the author identifies which products are most commonly sold among other products in the store. The author tries to find the high support value, with the minimum

support value is 0.005 to get the most selling product. That support generated 107 product items. By looking for products with a high support value, it means that the products are included in the most purchased products by the customer. Software used by the author to find the data is R studio software with the help of Microsoft Excel. The following that is shown in Figure 4.3 is 107 The most purchased product:

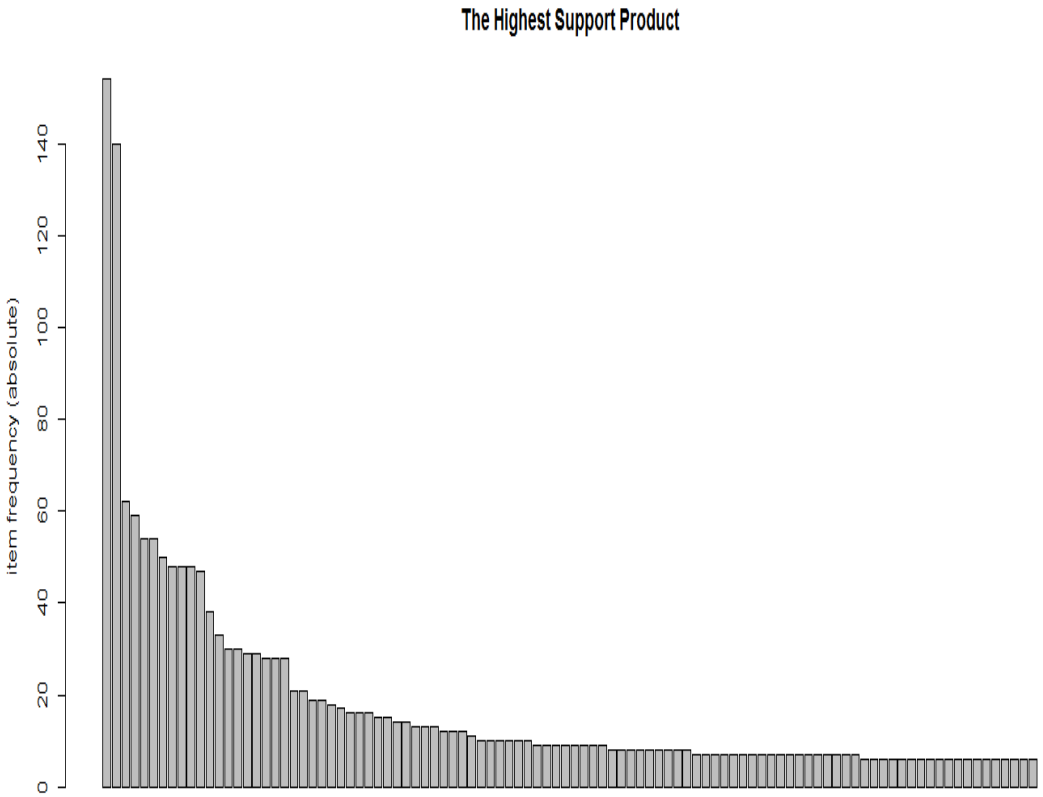

Figure 4. 5 107 The most purchased product

The above figure shows the 107 most frequently purchased products within a period of one month of research. The data have a minimum support of 0.005 and the highest support value of 0.146 for product name Pasir (ember) and Semen Tiga Roda (zak) respectively.

4.2.6 Item product associated with Profit

After obtaining the products with the high support value in the previous step. The next step is to find out the value of the profited sequential pattern (PSP) by calculating the support of product item, Profit of product item and Length of product item with the purpose of which product item will be arranged on the shelves level. The products that are not placed on shelf will not be researched deeper as the products that located on shelf. The symbol of (-) indicates products, which are not available on shelf.

Below is the data from the second data collection in the form of each Gross margin of product (X) and the length of item product (X) of each product belonging to have a relatively large support. The method used to obtain the gross margin and length of item product is direct interview to the owner of the store. While, to find out the length of product's items, the researcher interviewed the store's employees and also did some observation at the store. The numerous variations of items make difficult to discover all product items in the store. Thus, the author tries to limit the number of products by considering the high support value only. the support limit emphasized from the lowest to the highest by the author of the range of 0.005 - 0.146. Below is the table 4.4 on Calculation of profited sequential pattern (PSP):

Table 4. 7 Calculation of profited sequential pattern (PSP)

No	Items	Support	Count	Gross Profit	Length	PSP
1	Semen Tiga Roda (Zak)	0.147	154	-	-	-
2	Paku (Kg)	0.133	140	-	-	-
3	Semen Bima (Zak)	0.059	62	-	-	-
4	Semen Hitam (Kg)	0.056	59	-	-	-
5	Lem Isarplas	0.051	54	2000	5	20.57
6	Lem Fox	0.051	54	2000	15	6.86
7	Thinner Botol	0.048	50	3000	5	28.57
8	Semen Putih (Kg)	0.046	48	-	-	-
9	Cat Catylac Galon	0.046	48	9000	25	16.46
10	Kawat Tali (Kg)	0.046	48	-	-	-
11	Dulux V-Gloss	0.045	47	6000	12	22.38

No	Items	Support	Count	Gross Profit	Length	PSP
12	Ceramic 40x40	0.036	38	-	-	-
13	Knee 3/4"	0.031	33	700	6	3.67
14	Amplas (Meteran)	0.029	30	-	-	-
15	Kuas 2"	0.029	30	1000	6	4.76
16	Knee 1/2"	0.028	29	600	6	2.76
17	Pasir (Becak)	0.028	29	-	-	-
18	Siltip	0.027	28	1000	6	4.44
19	Kuas 2.5"	0.027	28	2000	7	7.62
20	Kuas 4"	0.027	28	3000	10	8.00

4.2.7 Product Placement on Shelves Store

After identifying the PSP value of each product categorized as a product with a relatively high support value, the next step is to allocate product items into shelves that are available in stores based on the value of the PSP of each product. Product items that have relatively high PSP values for each will be placed in upper shelf, middle shelf and lower shelf respectively based on the shelf available in the supermarket layout (Aloysius and Binu, 2013).

Since only 107 products are categorized as the best-selling products in the store and it turned out that after being sorted in depth, there are only 54 product items that will be placed into shelves store due to the constrains that have been made in chapter 1. Thus, in order to facilitate or simplify the product allocation process on the shelf based on PSP value of each product in category, the author divides it by grouping it into several tables for each category. There are 11 categories made by using the shelves at CVXYZ, here are some examples of each category, namely Table 4. 4 PSP value of Artisan good category, Table 4. 5 PSP value of Electrical materials category, Table 4. 6 PSP value of Oil/Catalyst materials category and Table 4. 7 PSP value of Paint/Coating materials category:

Table 4. 8 PSP value of Artisan good category

No	Items	Category	PSP
1	Gerinda Potong	Artisan Goods	1.68

Table 4. 9 PSP value of Electrical materials category

No	Items	Category	PSP
2	Kabel Isi 1 (Meter)	Electrical Materials	0.38
3	Klem Kabel (Pack)	Electrical Materials	1.33
4	Stop Kontak Broco	Electrical Materials	3.43
5	Kawat Las Kecil (Kg)	Electrical Materials	6.00

Table 4. 10 PSP value of Oil/Catalyst materials category

No	Items	Category	PSP
6	Thinner Impala	Oil / catalyst materials	4.44
7	Thinner Botol	Oil / catalyst materials	28.57

Table 4. 11 PSP value of Paint/Coating materials category

No	Items	Category	PSP
8	Ultran Vernis	Paint / coating materials	3.17
9	Dempul Impra	Paint / coating materials	4.29

Above tables show that there are several product items in a category with different PSP values. PSP value is the parameter for determining product placement into shelves store. The author has also divided for each product item into their categories, because each product item with the same category will be placed in the same rows on the shelf level so that each product item is more easily seen by the customer (Aloysius and Binu, 2013). The rest of complete tables above could be seen in the Attachment.

CHAPTER V

DISCUSSION

5.1 Association Product Category

Based on the results obtained in section 4.2.3 Identification of Category Association, there are 15 rules that are formed from a minimum and maximal support of 0.01 and 0.05 respectively and minimum confidence is 0.6 or 60%. The number above is quite high enough because the data collected is around 1061 Transactions with rows of 2836 in total.

5.2 The New Proposed Layout

The new layout is proposed based on the association rules formed among product categories which were discussed in the previous chapter. The rules are obtained by using Apriori algorithm with the assistance of R Studio software to indicate rules that have a good corresponding between one product category to another. This approach aims to place the corresponding product category get closer to another product category with the aim of shortening people walking distance both for buyers and workers. Thus, both buyers and workers are able to reduce the time while picking the product items in the store. Here is the Figure 5.1 Proposed Layout as following below:

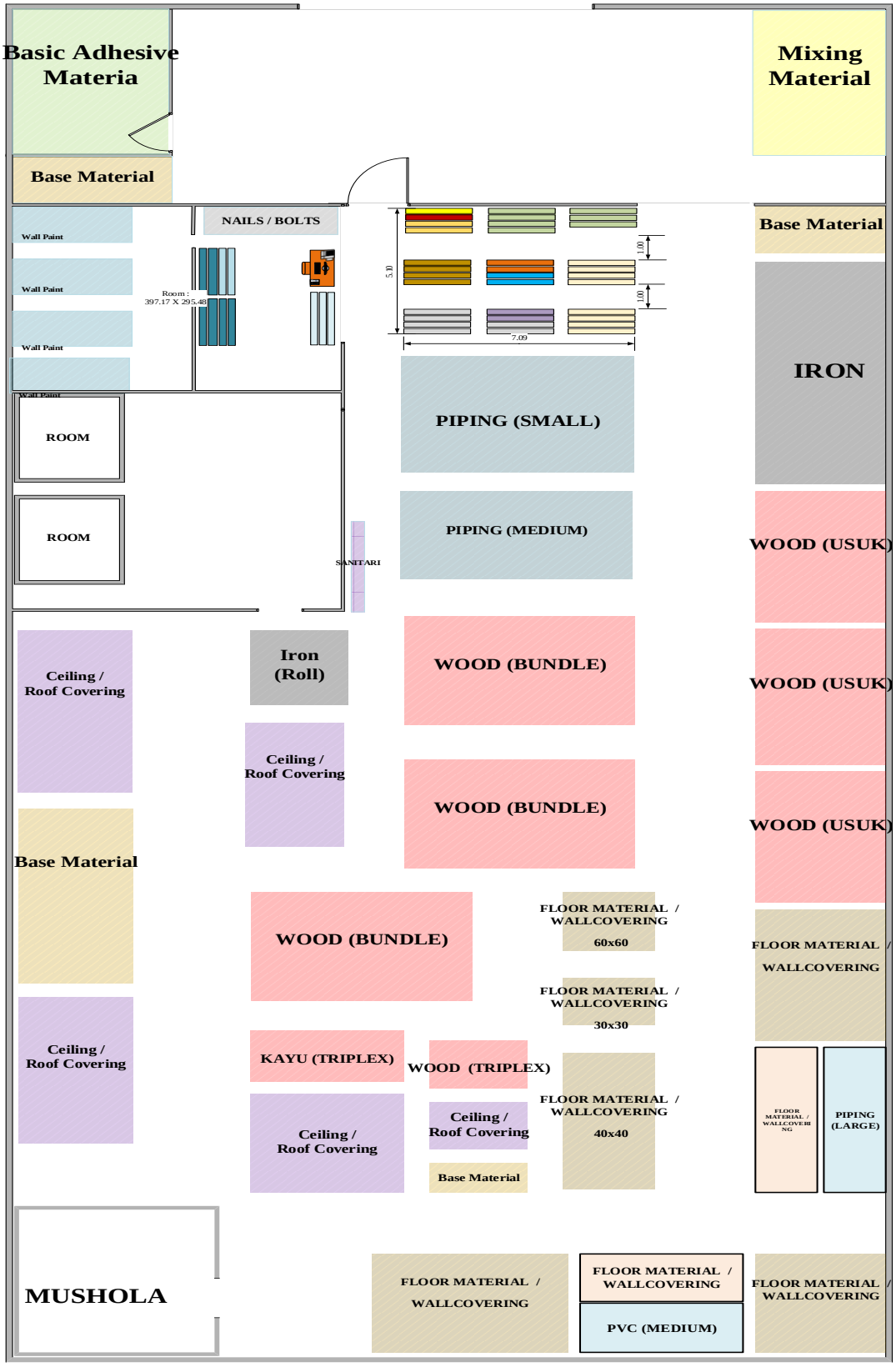

Figure 5. 1 Proposed Layout

Overall, if it is compared with the previous layout, the proposed layout has significant change especially in the position of racks. The previous layout of the rack is located inside to the room in the upper left, it was when the certain product still being served by the employee of CV. XYZ. While the proposed layout indicted that most racks of product are located in the outside of the upper left room, this layout is subjected to the self-service by customers. Nevertheless, because rack dimension is fixed size, the author should consider the space if the author tries to allocate the racks into different certain area.

The certain area that should be allocated for racks product has length and width more less 4.30 meters and 7.09 meters. With this size, there will be enough space for entire racks because the dimension of each rack more less 1.05 meters in length and 1.68 meters in width. The rest of space will be allocated as the route between racks product.

5.3 Total People Walking Distance

To prove that this research can be applied to business retailers of building stores CV. XYZ, the author made a comparison on the total calculation of people walking distance of initial layout and the proposed layout by selecting 7 buyers' walking distance as random sampling taken from transaction data using Microsoft Excel. The random sampling criteria that can be used by the author in this calculation is the people with a minimum purchase equal or more than 3 product categories, in order to get more valid data. The smaller value of People walking distance in a layout indicates the faster the process of selecting products in store outlets conducted by customers and store workers.

The random samplings formed using Microsoft Excel are Transaction ID A60, E179, A119, A75, A121, A700 and A807. The following tables below presented 3 Transaction ID as the examples out of 7, the rest of the tables could be seen in Attachment 4.

TID	Product	Category
A60	Dulux V-Gloss	Wood / Iron Paint
A60	Lem Fox	Rope / Tape

A60	Thinner Botol	Oil / Catalyst Materials
A60	Semen Putih (Kg)	Basic Adhesive Material

Table 5. 1 Transaction ID A60

Table 5. 2 Transaction ID A179

TID	Product	Category
A179	Cat Catylac Galon	Wall Paint
A179	Dulux V-Gloss	Wood / Iron Paint
A179	Thinner Cepot	Oil / Catalyst Materials
A179	Kuas 3"	Paint Tool

Table 5. 3 Transaction ID A119

TID	Product	Category
A119	Cat Catylac Galon	Wall Paint
A119	Cat Nodrop (1kg)	Wall Paint
A119	Cat Altex 1 Kg	Wood / iron paint
A119	Kuas 2"	Paint tool

Those transactions will be used as the sampling and later will be simulated using Microsoft Visio to measure how big the differences of total people walking distance between the initial layout and proposed layout. The measurement tool applies Visio 2013 and then the calculation will be proceeded in excel. the parameter is the shorter people walking distance, the better layout will be. Figure 5.2 presents Total People Walking Distance of Initial Layout:

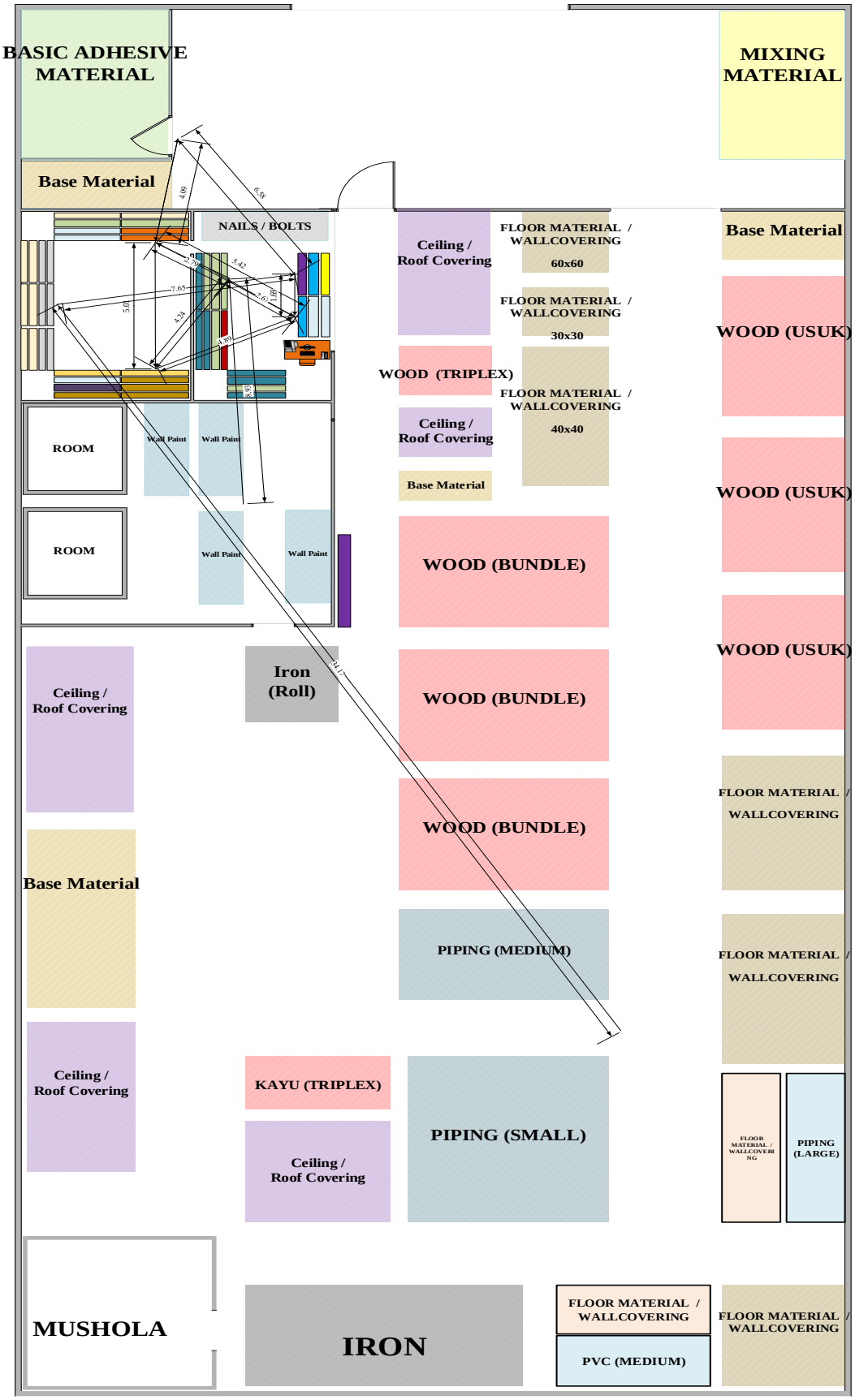

Figure 5. 2 Total People Walking Distance of Initial Layout

The result of total people walking distance of initial layout with the number of 7 transactions was obtained from the random sampling results indicated 179.38 meters in total. The detail calculation of figure above on total people walking distance of Initial Layout using Microsoft excel could be seen in **Attachment 5: The calculation of total people walking distance of Initial Layout**

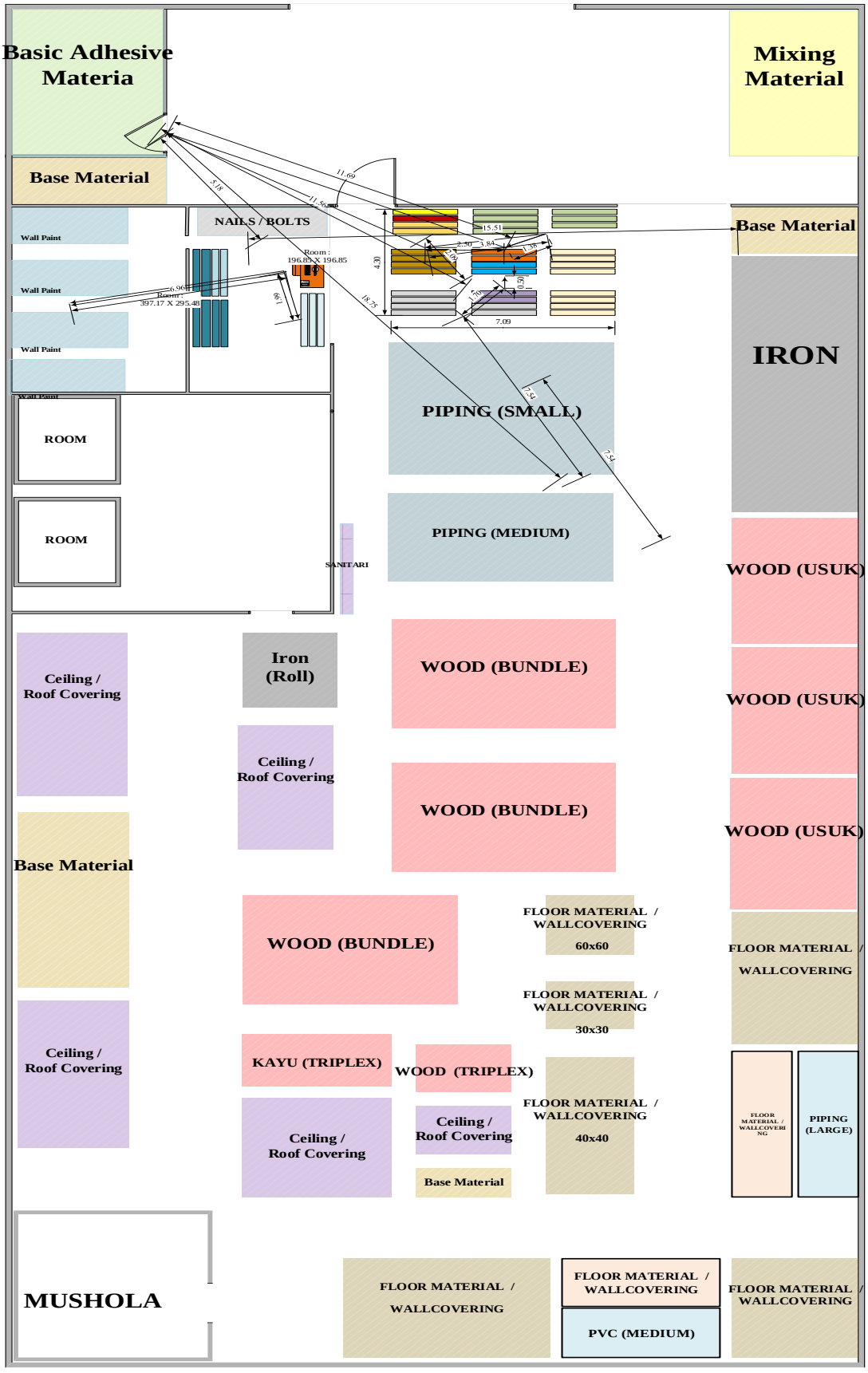

Figure 5. 3 Total People Walking Distance of Proposed Layout

While The result of total people walking distance of proposed layout above with the number of 7 transactions that have been obtained from the random sampling results in the previous step is 116.56 meters in total. The detail calculation of figure above total people walking distance of Proposed Layout using Microsoft excel could be seen in **Attachment 5: The calculation of total people walking distance of Initial Layout**

It means the comparison result of both initial layout and proposed layout made by the author could be concluded. The initial layout has total people walking distance of 179.38 meters. while the proposed layout has the smaller total distance, which is only 116.56 meters. The improvement of this proposed layout with the previous layout based on the 7 transactions sampling could be presented in percentage, which is 64.97%. Thus, the proposed new layout is better than initial layout in term of reducing people walking distance and reducing the traveling time while the customers or the store workers picking up the product in the CV. XYZ Store.

5.4 Productivity of Workers based on Reduction of Distance

The reduction people walking distance based on 7 transactions– reaches 64.94%. It indicates that the process of buying time will reduced also. The faster service conducted by the workers the less workers will be needed in the store. in this case, CV.XYZ has 5 workers in total, 1 manager, 1 cashier and 3 labors. Because there is only 1 manager and 1 cashier in this retail, then it is impossible to reduce the number of workers for that position. The possibility only to reduce labors.

Total workhours per labor = 1 (labor) × 8 (hours) × 30(days)
= 240 workhours / month

Every worker is allocated with 8 hours in a day. Thus, in a month, the workers spend more less 240 hours. This working hour is not including with the holiday time that may occur any time.

Total workhours per 3 labors = 3 × 8 × 30
= 720 workhours / month

Because CV.XYZ has 3 labors in total. Then in a month, CV.XYZ employs more less 720 workhours in a month.

$$\text{Reduction Labor} = 720 \text{ hours} \times 240 \text{ workhours (per labor)}$$
$$= 1.9491 \rightarrow 2 \text{ labors}$$

The labor reduction is based on the time efficiency which shows positive reduction. It means that, there are significant reduction for labors. The initial labors are 3 in total, but after the reduction, the labors in the ZV.XYZ could be proposed as 2 labors only considering the time efficiency and total people walking distance. Thus, CV. XYZ could reduce cost Rp 1.723.578 in a month as the minimum work wage of Cirebon West Java. This proposed reduction could be applied to the CV. XYZ if the system applied in the store is 100% non-self-customers service. It means, all the serving is all conducted by the retail workers.

5.5 Allocation of Product Items into each Shelf

The approach applied in this case to propose the new allocating product into shelves levels based on the Profited Sequential Pattern (PSP) which is already mentioned in the sub chapter 4.2.6 about Product Placement on Shelves Store. The product item with the higher PSP value of each category will be arranged in the higher-level shelf. The level of shelves is variant, but mostly the level of shelf contains 4 levels, those are eye-level, shoulder-level, knee level and lowest level.

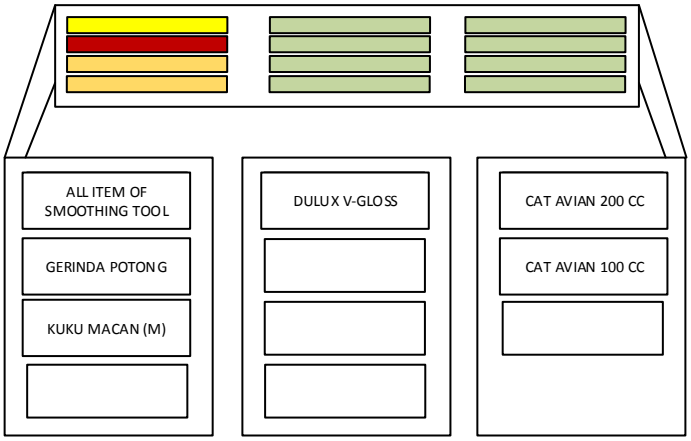

Figure 5. 4 Group of Upper-line Shelves

The figure above describes the product items of each category that allocated into shelves. There are 4 categories in figure above, those are Category of Smoothing tools, Artisan Goods, Floor materials / wallcoverings, Wood / Iron paint. The product items have high PSP that will be allocated in the highest level of shelves.

Since the category of Smoothing tools Artisan goods only has 1 level then all the product items of smoothing tools and Artisan goods category will be arranged in the same level. Another category that allocates the same shelf by vertical is subjected for Floor materials / wallcoverings, this category consists of 2 shelves. The product item that will be allocated is only Kuku macan (m), even though only one product item, Kuku macan (m) will take more space due to its variants.

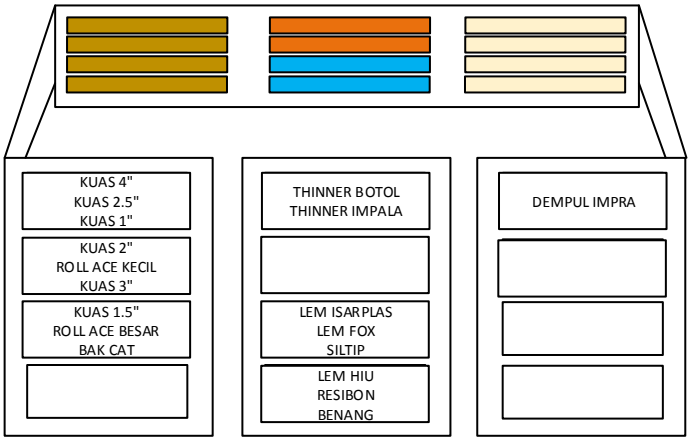

Figure 5. 5 Group of Mid-Line Shelves

The Figure above consist of 3 shelves with 4 categories in total. Those categories from the left are Paint tools, Oil / catalyst materials, Rope / Tape and Paint / coating materials. The black level space indicates that it could be possible to be filled by the product items that haven't been mentioned due to the lower PSP value.

Paint tool category consist of 3 level filled and 1 level unfilled. The next to this Paint category is Oil / catalyst materials and Rope / Tape. The highest-level shelf is filled by Thinner bottles and Thinner impala and included in the category Oil / catalyst materials. Still in the same shelf, the knee-level and lowest level is set for product items of Rope / Tape. The right shelf of figure above is allocated for category of Paint / coating materials, the highest level of this shelf is allocated for product of Dempul impra. Dempul will dominate all the spaces because this product has numbers of color variant.

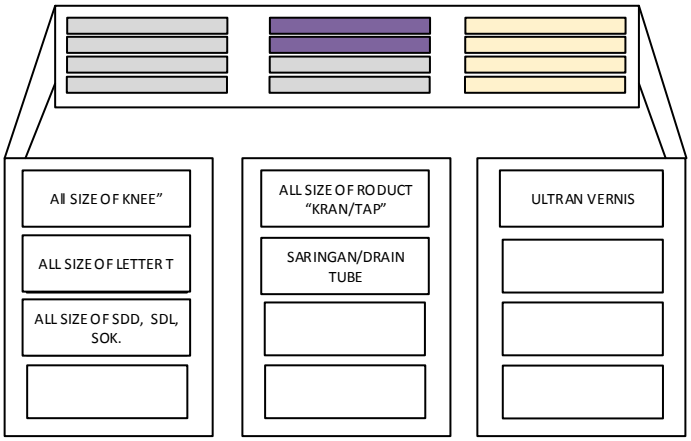

Figure 5. 6 Group of Lower-line Shelf

The structure of Group of Lower-line Shelf consists of 3 categories. Those are category of Pipe connection, sanitary and Paint / coating materials.

The product in the category of Pipe connection has higher frequent items if compared the others product in different categories. in order to simplify product selection, the author also considers the products that have large variant of size. The eye-level up to knee level of Pipe connection shelf will be set to allocate the any size products of Knee, Letter T, and SDD, SDL and Sok.

The next shelf is set to allocate category of Sanitary and Pipe connection as well. The highest PSP in category sanitary is product of Kran sanho ¾ and Kran biasa, but in order to make selection process easier, the eye level will be allocated to any size of Kran/Tap products. While the shoulder level will be allocated to Saringan/Drain tube products. The others last 2 lower levels belong to category Pipe connection.

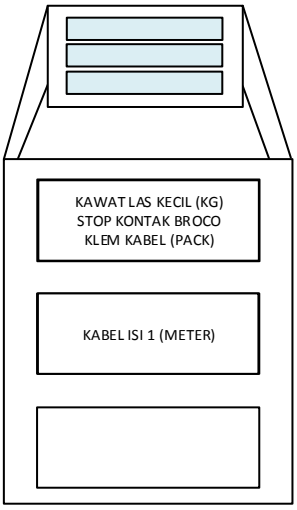

Figure 5. 7 Category of Electrical materials Shelf

The display product on shelf above is category of Electrical materials. This sort of shelf has different size in term of height. The highest level of this shelf is only up to shoulder-level while others shelves is eye-level. Since in the previous initial layout, this shelf is also functioned as the transaction table. See initial layout*.

The product items on shelf is divided into 3 level, 2 levels are filled with the product items that categorized in high PSP value and the rest will be allocated by remaining products. The highest level is allocated to Product of Kawat las kecil (kg), Stop kontak Brocco and Klem Kabel (pack). While the lower level will be allocated to Kabel isi 1 (meter).

5.6 Limitations of This Research

In arranging the products in certain level of rack, there are several products that have numerous varieties of a product, for instance Cat Dulux, Cat Avian and other products especially in Wood / Iron paint category. This research is not designated to observe the detail variety and how many total products in certain category. Thus, this research may require more data to complete this missing link.

Another limitation is the insufficient space for the product to be arranged in the rack. The allocation of products into shelf is based on the value of PSP, the higher value of PSP the upper location will be arranged for the products. The problem is, not every product can be identified for its PSP values due to the limitation data given by the retail manager. Products with no PSP value will be allocated to the lowest level of rack even though the researcher still do not know how many products that will be allocated in the lowest level. So, it is possible if the lowest level of shelf will have insufficient space to cover these unknown products. Thus, the solution for this occurrence is by allocating these unknown PSP products to the available space in the rack as long as it is still in the same product category.

5.7 The Store Atmosphere

When the researcher conducted the research in CV.XYZ, the researcher found several things that probably need to be improved in order to prolong the customers' visit and make them comfortable. Although, there are several kinds of general interior as the factors should be considered to prolong the customers visit in the store such as flooring, color, lighting, scent and sound (Berman & Evans, 2010). In this store the researcher merely suggests 2 factors, both are music and lighting. These 2 things came up when the researcher did the observation to this retail and feel both factors need more improvement among others factors.

The vital factors to make customers feel comfortable during their shopping in a store is by providing a music or an instrument. According to (Milliman, 1982), the tempo of music strongly could influence the behavior of customers in term of their movement

or speed while doing the buying process in the store. Thus, the retailer could be adjusting the tempo of music to prolong the customers visit in order to gain more product bought and shorten the customers' visit.

Another vital factor that must be put into consideration is lighting. Lumberyard is store that sells heavy large products in term of weight and this CV. XYZ is considered as semi-inventory. It means that there are numerous products in the store. The strong reason to be considered regarding to lighting was happening when the researcher took observation in CV. XYZ. This store only relies on the sun light during their work hours. Although the store is just starting to work from morning until afternoon, but the researcher thought that the store is still lack of lights. Thus, the research also suggests more lights settlements in order to gain customers satisfaction.

CHAPTER VI

CONLUSIONS AND RECOMMENDATION

6.1 Conclusion

In this modern era, the database is vital component in any businesses especially in the retail business. two of the many benefits are generated from database, which are constructing new proposed layout and constructing the product display into store's shelf as performed by the author in this research. This research utilizes the database of CV. XYZ by applying the method of Market Basket Analysis (MBA) to discover the pattern of customers behavior and applying and Profited Sequential Pattern (PSP) to discover which product items should be placed in the certain level of shelf.

Based on the research objectives in the first chapter, there are 2 conclusions generated as the research result. Following is the 2 main conclusions:

1. In Market Basket Analysis (MBA) section, the author utilized 1061 transactions and 2836 rows in total. The rules generated by using Apriori algorithm are 15 rules. Those rules will be used to construct new proposed layout based on the corresponding between categories by considering the value of confident of each rule. The higher confidence value of product category, the closer product category will be placed in the layout store. The purpose of this approach is to reduce the total people walking distance while picking up the product item to one product category to others product categories. This research improves the efficiency on reduction total people walking distance from 179.38 meters to 116.56 meters using 7

transactions as sample. Thus, in percentage, the reduction total people walking distance reach by 64.97%.

2. While in Profited Sequential Pattern (PSP) section, the author utilized 54 product items in different product category those should be arranged in the certain level of shelf based on the PSP value of each items. The higher PSP value of an item, the higher level for items to be placed at the shelf of store. By allocating product items into shelf based on the PSP value, it is expected to attract the customers to buy cross selling items, more profited product items and also facilitate the buyers and store workers while doing product selection.

6.2 Recommendation

This research has several limitations such as the limited data transaction and the object research that has not applied computerized database. Thus, the research has taken longer time due to the manual processes.

The suggestions that can be given by this research and further researchers are as follows:

1. In order to conduct easier routine analysis to any aspects in store matters, it is better CV. XYZ to build the system to record the database in their computer. Thus, the continues improvement could be done more effective. The researcher will gladly give all the detail information regarding the data taken in this research to start constructing the computerized database.

2. Encouraging the fellow researchers to choose the retail store with huge number of databases on their computers. Therefore, the time consumed to take the data will be shorter and the data will be more valid.

ATTACHMENT

 # The coding to find out association rule of Product Category

```
library(Matrix)
library(grid)
library(arules)
library(arulesViz)

ftrans <- read.csv('E://INTRODUCTION R/DATA FULL THESIS.csv')
head(ftrans)
tail(ftrans)
dim(ftrans)

ftrans1 <-as(split(ftrans[,4],ftrans[,1]),"transactions")
ftrans1

rules <- apriori (ftrans1, parameter = list(supp = 0.01, conf = 0.6))
rules
summary(rules)
rules_conf <- sort(rules, by="confidence", decreasing = TRUE)
inspect(rules_conf)
inspect(rules_conf)
inspect(sort(rules_conf))
```

 # The coding to find out the most frequent categories

```
ftrans1 <-as(split(ftrans[,4],ftrans[,1]),"transactions")
ftrans1

frequentItems <- eclat (ftrans1, parameter = list(supp = 0.07, maxlen = 12))
inspect(frequentItems)
```

```
itemFrequencyPlot(ftrans1,type="absolute",topN=10,
        main="The Most Frequent Category", col = "grey", border = "white")
```

 # The coding to find out the most frequent product item

```
ftransprod <-as(split(ftrans[,3],ftrans[,1]),"transactions")
ftransprod

frequentItems <- eclat(ftransprod, parameter = list(supp = 0.005, maxlen = 1))
frequentItems
decfreq <- sort(frequentItems, decreasing = TRUE)
inspect(decfreq)
View(inspect(decfreq))
out<-as.data.frame(inspect(decfreq))
out
write.csv(out,file = 'E://decfrecfile.csv')

itemFrequencyPlot(ftransprod,type="absolute",topN=100,
        main="The Highest Support Product", col = "grey")
```

 # The way to export the data to Excel.csv

```
out<-as.data.frame(inspect(decfreq))
out
write.csv(out,file = 'E://decfrecfile.csv')
```

Attachment 1: The result of Association rule between categories

```
> inspect(rules_conf)
     lhs                                rhs                              support confidence     lift count
[1]  {Piping,
      Sanitary}                      => {Pipe connection}              0.01047619  0.9166667 7.403846    11
[2]  {Piping,
      Rope / Tape}                   => {Pipe connection}              0.03047619  0.8648649 6.985447    32
[3]  {Oil / catalyst materials,
      Paint tool}                    => {Wood / iron paint}            0.02571429  0.7297297 9.231521    27
[4]  {Paint tool,
      Wood / iron paint}             => {Oil / catalyst materials}     0.02571429  0.7297297 9.823285    27
[5]  {Piping}                        => {Pipe connection}              0.05047619  0.7260274 5.864067    53
[6]  {Basic adhesive material,
      Piping}                        => {Pipe connection}              0.01428571  0.7142857 5.769231    15
[7]  {Basic adhesive material,
      Ceiling / roof covering}       => {Nails / Bolts}                0.01142857  0.7058824 3.615495    12
[8]  {Oil / catalyst materials,
      Wall Paint}                    => {Paint tool}                   0.01142857  0.7058824 5.745554    12
[9]  {Mixing material}               => {Basic adhesive material}      0.04095238  0.7049180 2.056011    43
[10] {Rope / Tape,
      Wood / iron paint}             => {Oil / catalyst materials}     0.01238095  0.6842105 9.210526    13
[11] {Wall Paint,
      Wood / iron paint}             => {Paint tool}                   0.01333333  0.6666667 5.426357    14
[12] {Smoothing tool,
      Wall Paint}                    => {Paint tool}                   0.01238095  0.6500000 5.290698    13
[13] {Rope / Tape,
      Smoothing tool}                => {Basic adhesive material}      0.01904762  0.6451613 1.881720    20
[14] {Rope / Tape,
      Sanitary}                      => {Pipe connection}              0.01619048  0.6296296 5.085470    17
[15] {Pipe connection,
      Piping}                        => {Rope / Tape}                  0.03047619  0.6037736 3.267847    32
> rules_conf <- sort(rules, by="confidence", decreasing = TRUE)
```

Attachment 2: The result of PSP calculation

No	Items	Support	Count	Gross Profit	Length	PSP
1	Semen Tiga Roda (Zak)	0.147	154			
2	Paku (Kg)	0.133	140			
3	Semen Bima (Zak)	0.059	62			
4	Semen Hitam (Kg)	0.056	59			
5	Lem Isarplas	0.051	54	2000	5	20.57
6	Lem Fox	0.051	54	2000	15	6.86
7	Thinner Botol	0.048	50	3000	5	28.57
8	Semen Putih (Kg)	0.046	48			
9	Cat Catylac Galon	0.046	48	9000	25	16.46
10	Kawat Tali (Kg)	0.046	48			
11	Dulux V-Gloss	0.045	47	6000	12	22.38
12	Ceramic 40x40	0.036	38			
13	Knee 3/4"	0.031	33	700	6	3.67
14	Amplas (Meteran)	0.029	30	0		
15	Kuas 2"	0.029	30	1000	6	4.76
16	Knee 1/2"	0.028	29	600	6	2.76
17	Pasir (Becak)	0.028	29			
18	Siltip	0.027	28	1000	6	4.44

No	Items	Support	Count	Gross Profit	Length	PSP
19	Kuas 2.5"	0.027	28	2000	7	7.62
20	Kuas 4"	0.027	28	3000	10	8.00
21	Besi 10 Full	0.020	21			
22	Cat Nodrop (1kg)	0.020	21	5000	12	8.33
23	Roll Ace Besar	0.018	19	7000	35	3.62
24	Kuku Macan (M)	0.018	19	2000	5	7.24
25	Knee 3"	0.017	18	4000	11	6.23
26	Cat Metrolit Galon	0.016	17	10000	25	6.48
27	Kuas 3"	0.015	16	2500	8	4.76
28	Compound (Kg)	0.015	16			
29	Thinner Impala	0.015	16	3500	12	4.44
30	Amplas Lembar	0.014	15	1000	25	0.57
31	Kuas 1.5"	0.014	15	1500	5	4.29
32	Letter T 3/4"	0.013	14	700	7	1.33
33	Bambu	0.013	14			
34	Paku Asbes (Kg)	0.012	13			
35	Besi 6	0.012	13			
36	Kaso 4/6 3m	0.012	13			
37	Compound (Zak)	0.011	12			
38	Paku Grc (Kg)	0.011	12			
39	Casting (Zak)	0.011	12			
40	Cat Nodrop Galon	0.010	11	9000	25	3.77
41	Roll Ace Kecil	0.010	10	6000	12	4.76
42	Triplex 3mm	0.010	10			
43	Papan Pinus	0.010	10			
44	Ceramic 25x40	0.010	10			
45	Gerinda Potong	0.010	10	2300	13	1.68
46	Nusa Board	0.010	10			
47	Kawat Las Kecil (Kg)	0.009	9	7000	10	6.00
48	Baud Roofing	0.009	9			
49	Dempul Impra	0.009	9	6000	12	4.29
50	Cat Avian 200 Cc	0.009	9	3000	5	5.14
51	Pasir (Colt)	0.009	9			
52	Asbes 180x80	0.009	9			
53	Semen Putih (Zak)	0.009	9			
54	Hebel 10cm	0.009	9			
55	Pvc Vinilon 3/4"	0.008	8			
56	Sdd 1/2"	0.008	8	700	5	1.07
57	Kran Sanho 3/4"	0.008	8	4000	10	3.05
58	Spandek	0.008	8			
59	Kawat Ayak	0.008	8			
60	Ultran Vernis	0.008	8	5000	12	3.17
61	Kuas 1"	0.008	8	2000	3	5.08
62	Cat Avitex Galon	0.008	8	9000	25	2.74
63	Ceramic 25x25	0.008	8			
64	Sdl 1/2"	0.007	7	600	5	0.80

No	Items	Support	Count	Gross Profit	Length	PSP
65	Sok 3/4"	0.007	7	800	6	0.89
66	Bak Cat	0.007	7	4000	30	0.89
67	Sekrap Plastik	0.007	7	2000	10	1.33
68	Triplex 4mm	0.007	7			
69	Siltip	0.007	7	1000	6	1.11
70	Knee 2"	0.007	7	2500	7	2.38
71	Grendel Tower Bolt	0.007	7			
72	Kaso Lokal (Ikat)	0.007	7			
73	Saringan	0.007	7	3000	10	2.00
74	Besi 8 Full	0.007	7			
75	Benang	0.007	7	1000	6	1.11
76	Asbes 240x80	0.007	7			
77	Klem Kabel (Pack)	0.007	7	1000	5	1.33
78	Ceramic 60x60	0.007	7			
79	Semen Holcim (Zak)	0.007	7			
80	Cat Gravi Galon	0.007	7	10000	25	2.67
81	Ceramic 20x40	0.007	7			
82	Pvc Aqualon 3" D	0.006	6			
83	Sok 1/2"	0.006	6	700	4	1.00
84	Sdd 3/4"	0.006	6	700	5	0.80
85	Lem Hiu	0.006	6	2000	5	2.29
86	Amplas Bulat	0.006	6	500	10	0.29
87	Pvc Slg 3/4"	0.006	6			
88	Pvc Wavin 1/2"	0.006	6			
89	Karet Asbes	0.006	6			
90	Sdl 3/4"	0.006	6	700	5	0.80
91	Cat Avian 100cc	0.006	6	2000	5	2.29
92	Stop Kontak Broco	0.006	6	3000	5	3.43
93	Sok 1"	0.006	6	1000	4	1.43
94	Kran Biasa	0.006	6	2000	10	1.14
95	Kabel Isi 1 (Meter)	0.006	6	2000	30	0.38
96	Grc	0.006	6			
97	Sekrap Shigo	0.006	6	2000	6	1.90
98	Grc	0.006	6			
99	Besi 6 Full	0.006	6			
100	Paku Beton (Kg)	0.006	6			
101	Split (Colt)	0.006	6			
102	Knee 1"	0.006	6	1500	4	2.14
103	Resibon	0.006	6	2000	10	1.14
104	Semen Gresik (Zak)	0.006	6			
105	Ceramic 50x50	0.006	6			
106	Bambu	0.006	6			
107	Pasir (Ember)	0.006	6			

Attachment 3: The result product allocation based on each category

No	Items	Category	PSP
1	Gerinda Potong	Artisan Goods	1.68
2	Kabel Isi 1 (Meter)	Electrical Materials	0.38
3	Klem Kabel (Pack)	Electrical Materials	1.33
4	Stop Kontak Broco	Electrical Materials	3.43
6	Thinner Impala	Oil / Catalyst Materials	4.44
7	Thinner Botol	Oil / Catalyst Materials	28.57
8	Ultran Vernis	Paint / Coating Materials	3.17
9	Dempul Impra	Paint / Coating Materials	4.29
10	Bak Cat	Paint Tool	0.89
11	Roll Ace Besar	Paint Tool	3.62
12	Kuas 1.5"	Paint Tool	4.29
13	Kuas 3"	Paint Tool	4.76
14	Roll Ace Kecil	Paint Tool	4.76
15	Kuas 2"	Paint Tool	4.76
16	Kuas 1"	Paint Tool	5.08
17	Kuas 2.5"	Paint Tool	7.62
18	Kuas 4"	Paint Tool	8.00
27	Knee 1"	Pipe Connection	2.14
29	Knee 1/2"	Pipe Connection	2.76
28	Knee 2"	Pipe Connection	2.38
31	Knee 3"	Pipe Connection	6.23
30	Knee 3/4"	Pipe Connection	3.67
25	Letter T 3/4"	Pipe Connection	1.33
24	Sdd 1/2"	Pipe Connection	1.07
19	Sdd 3/4"	Pipe Connection	0.80
21	Sdl 1/2"	Pipe Connection	0.80
20	Sdl 3/4"	Pipe Connection	0.80
26	Sok 1"	Pipe Connection	1.43
23	Sok 1/2"	Pipe Connection	1.00
22	Sok 3/4"	Pipe Connection	0.89
32	Siltip	Rope / Tape	1.11
33	Benang	Rope / Tape	1.11
34	Resibon	Rope / Tape	1.14
35	Lem Hiu	Rope / Tape	2.29
36	Siltip	Rope / Tape	4.44
37	Lem Fox	Rope / Tape	6.86
38	Lem Isarplas	Rope / Tape	20.57
39	Kran Biasa	Sanitary	1.14
40	Saringan	Sanitary	2.00
41	Kran Sanho 3/4"	Sanitary	3.05
42	Amplas Bulat	Smoothing Tool	0.29
43	Amplas Lembar	Smoothing Tool	0.57

No	Items	Category	PSP
44	Sekrap Plastik	Smoothing Tool	1.33
45	Sekrap Shigo	Smoothing Tool	1.90
46	Cat Gravi Galon	Wall Paint	2.67
47	Cat Avitex Galon	Wall Paint	2.74
48	Cat Nodrop Galon	Wall Paint	3.77
49	Cat Metrolit Galon	Wall Paint	6.48
50	Cat Nodrop (1kg)	Wall Paint	8.33
51	Cat Catylac Galon	Wall Paint	16.46
52	Cat Avian 100cc	Wood / Iron Paint	2.29
53	Cat Avian 200 Cc	Wood / Iron Paint	5.14
54	Dulux V-Gloss	Wood / Iron Paint	22.38

Attachment 4: The calculation of total people walking distance of Initial Layout

TID	Product	Category (from)
A60	Dulux V-Gloss	Wood / iron paint
A60	Lem Fox	Rope / Tape
A60	Thinner Botol	Oil / catalyst materials
A60	Semen Putih (Kg)	Basic adhesive material
A179	Cat Catylac Galon	Wall Paint
A179	Dulux V-Gloss	Wood / iron paint
A179	Thinner Cepot	Oil / catalyst materials
A179	Kuas 3"	Paint tool
A119	Cat Catylac Galon	Wall Paint
A119	Cat Nodrop (1kg)	Wall Paint
A119	Cat Altex 1 Kg	Wood / iron paint
A119	Kuas 2"	Paint tool
A75	Pvc Slg 3/4"	Piping
A75	Knee 3/4"	Pipe connection
A75	Ploksok 3/4 X 1/2	Pipe connection
A75	Kran Biasa	Sanitary
A75	Sdd 3/4"	Pipe connection
A75	Lem Isarplas	Rope / Tape
A75	Siltip	Rope / Tape
A75	Kabel Roll + Colokan	Electrical materials
A121	Dulux V-Gloss	Wood / iron paint
A121	Kuas 2.5"	Paint tool
A121	Lem Fox	Rope / Tape
A121	Compound (Kg)	Basic adhesive material
A121	Thinner Botol	Oil / catalyst materials

TID	Product	Category (from)
A700	Semen Bima (Zak)	Basic adhesive material
A700	Semen Putih (Kg)	Basic adhesive material
A700	Paku Ulir	Nails / Bolts
A700	Risplank 10cm	Base Material
A807	Pvc Aqualon 3" D	Piping
A807	Semen Tiga Roda (Zak)	Basic adhesive material
A807	Knee 3"	Pipe connection
A807	Sekrap Shigo	Smoothing tool

Attachment 5: The calculation of total people walking distance of Initial Layout

TID	Items	Category (from)	Category (to)	Distance (m)
A60	Dulux V-Gloss	Wood / iron paint	Rope / Tape	2.67
A60	Lem Fox	Rope / Tape	Oil / catalyst materials	5.42
A60	Thinner Botol	Oil / catalyst materials	Basic adhesive material	4.09
A60	Semen Putih (Kg)	Basic adhesive material		
			Total Each Transaction	**12.18**

TID	Product	Category (from)	Category (to)	Distance (m)
A179	Cat Catylac Galon	Wall Paint	Wood / iron paint	8.93
A179	Dulux V-Gloss	Wood / iron paint	Oil / catalyst materials	2.79
A179	Thinner Cepot	Oil / catalyst materials	Paint tool	5.01
A179	Kuas 3"	Paint tool		
			Total Each Transaction	**16.73**

TID	Product	Category (from)	Category (to)	Distance (m)
A119	Cat Catylac Galon	Wall Paint	Wood / iron paint	8.93
A119	Cat Nodrop (1kg)	Wall Paint		
A119	Cat Altex 1 Kg	Wood / iron paint	Paint tool	4.24
A119	Kuas 2"	Paint tool		
			Total Each Transaction	**13.17**

TID	Product	Category (from)	Category (to)	Distance (m)
A75	Pvc Slg 3/4"	Piping	Pipe connection	34.17
A75	Knee 3/4"	Pipe connection	Sanitary	7.65
A75	Ploksok 3/4 X 1/2	Pipe connection		
A75	Kran Biasa	Sanitary	Rope / Tape	1.69
A75	Sdd 3/4"	Pipe connection		
A75	Lem Isarplas	Rope / Tape	Electrical materials	0
A75	Siltip	Rope / Tape		
A75	Kabel Roll + Colokan	Electrical materials		
			Total Each Transaction	**43.51**

TID	Product	Category (from)	Category (to)	Distance (m)
A121	Dulux V-Gloss	Wood / iron paint	Paint tool	4.24
A121	Kuas 2.5"	Paint tool	Rope / Tape	4.89
A121	Lem Fox	Rope / Tape	Basic adhesive material	6.58

A121	Compound (Kg)	Basic adhesive material	Oil / catalyst materials	4.09
A121	Thinner Botol	Oil / catalyst materials		
			Total Each Transaction	**19.8**

TID	Product	Category (from)	Category (to)	Distance (M)
A700	Semen Bima (Zak)	Basic adhesive material	Nails / Bolts	5.17
A700	Semen Putih (Kg)	Basic adhesive material		
A700	Paku Ulir	Nails / Bolts	Base Material	14.5
A700	Risplank 10cm	Base Material		
			Total Each Transaction	**19.67**

TID	Product	Category (from)	Category (to)	Distance (M)
A807	Pvc Aqualon 3" D	Piping	Basic adhesive material	38.62
A807	Semen Tiga Roda (Zak)	Basic adhesive material	Pipe connection	8.05
A807	Knee 3"	Pipe connection	Smoothing tool	7.65
A807	Sekrap Shigo	Smoothing tool		
			Total Each Transaction	**54.32**
			Total Distance	**179.38**

Attachment 6: The calculation of total people walking distance of Proposed Layout

TID	Product	Category (from)	Category (to)	Distance (M)
A60	Dulux V-Gloss	Wood / iron paint	Rope / Tape	1.38
A60	Lem Fox	Rope / Tape	Oil / catalyst materials	0
A60	Thinner Botol	Oil / catalyst materials	Basic adhesive material	11.69
A60	Semen Putih (Kg)	Basic adhesive material		
			Total Each Transaction	**13.07**

TID	Product	Category (from)	Category (to)	Distance (M)
A179	Cat Catylac Galon	Wall Paint	Wood / iron paint	6.96
A179	Dulux V-Gloss	Wood / iron paint	Oil / catalyst materials	1.38
A179	Thinner Cepot	Oil / catalyst materials	Paint tool	2.5
A179	Kuas 3"	Paint tool		
			Total Each Transaction	**10.84**

TID	Product	Category (from)	Category (to)	Distance (M)
A119	Cat Catylac Galon	Wall Paint	Wood / iron paint	6.96
A119	Cat Nodrop (1kg)	Wall Paint		
A119	Cat Altex 1 Kg	Wood / iron paint	Paint tool	3.84
A119	Kuas 2"	Paint tool		
			Total Each Transaction	**10.8**

TID	Product	Category (from)	Category (to)	Distance (M)
A75	Pvc Slg 3/4"	Piping	Pipe connection	7.55

TID	Product	Category (from)	Category (to)	Distance (M)
A75	Knee 3/4"	Pipe connection	Sanitary	1.7
A75	Ploksok 3/4 X 1/2	Pipe connection		
A75	Kran Biasa	Sanitary	Rope / Tape	0.5
A75	Sdd 3/4"	Pipe connection		
A75	Lem Isarplas	Rope / Tape	Electrical materials	1.99
A75	Siltip	Rope / Tape		
A75	Kabel Roll + Colokan	Electrical materials		
			Total Each Transaction	**11.74**

TID	Product	Category (from)	Category (to)	Distance (M)
A121	Dulux V-Gloss	Wood / iron paint	Paint tool	3.84
A121	Kuas 2.5"	Paint tool	Rope / Tape	2.5
A121	Lem Fox	Rope / Tape	Basic adhesive material	11.69
A121	Compound (Kg)	Basic adhesive material		
A121	Thinner Botol	Oil / catalyst materials		
			Total Each Transaction	**18.03**

TID	Product	Category (from)	Category (to)	Distance (M)
A700	Semen Bima (Zak)	Basic adhesive material	Nails / Bolts	5.18
A700	Semen Putih (Kg)	Basic adhesive material		
A700	Paku Ulir	Nails / Bolts	Base Material	14.5
A700	Risplank 10cm	Base Material		
			Total Each Transaction	**19.68**

TID	Product	Category (from)	Category (to)	Distance (M)
A807	Pvc Aqualon 3" D	Piping	Basic adhesive material	18.75

TID	Product	Category (from)	Category (to)	Distance (M)
A807	Semen Tiga Roda (Zak)	Basic adhesive material	Pipe connection	11.56
A807	Knee 3"	Pipe connection	Smoothing tool	2.09
A807	Sekrap Shigo	Smoothing tool		
			Total Each Transaction	**32.4**

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