# The Design and Implementation of Material Requirement Planning: A Case Study of the Plastic Company

**Ploypailin Phrikthim[1], Paitoon Siri-O-Ran[2], Panisuan Jamnarnwej[3]**
[1,2,3]Faculty of Engineering and Technology, Panyapiwat Institute of Management, Nonthaburi, Thailand.
E-mail: ploypailinphr@pim.ac.th, paitoonsir@pim.ac.th, panisuanj@gmail.com

Received: April 12, 2023/ Revised: July 17, 2023/ Accepted: August 21, 2023

***Abstract*— The Company has a problem with inventory shortages caused by insufficient materials to meet customer needs and a lack of spare components for constructing finished goods due to the shared use of spare parts. To improve inventory management, this research employs engineering principles to create a new Material Requirement Planning (MRP). It also offers planners an option that would provide an inventory that is more efficient than the current approach. The problem was analyzed with Cause and Effect (Fishbone Diagram), presented the structure of the Bill of Material (BOM), and used a spreadsheet program on the cloud (real-time) for material management Order Notification Program can be compatible with Microsoft Excel. This research uses ABC analysis of the high-order Type A products of four departments.**

**The reduction in raw material shortages from November to December 2022 resulted in a 100% reduction in delivery delays across all departments and a 66.67% reduction in the cost of warehouse management compared to the average ratio in the year 2022, leading to a cost savings of 64,180 baht per year for warehouse management.**

***Index Terms*—Material Requirement Planning (MRP), Inventory Control, Bill of Materials (BOM)**

## I. Introduction

Material Requirement Planning management involves inventory in many companies. Operations managers have to consider this because inventory is one of the most expensive assets. It has also a high value in current assets so good inventory management is a crucial part of any company. They may have some types of inventory planning and control systems. A bank has methods to control its inventory of cash. The manufacturing company has methods used to control inventories: raw materials, work in process, and finished goods. Retailers and wholesalers are also concerned with inventory planning and control.

### *A. Statement of the Problems*

The case study is a plastic company, the manufacturing was initially bathroom accessories and glass, showers, and seat cover equipment. The distributor sells several different sanitary ware materials products and has earned the trust of the nation's top modern trade department stores and shops.

The plastic company has Make-to-Order management by receiving orders from customers and production operations Assembling the finished product and delivery of orders. For inventory control, the staff checks the available stock level of items every day and orders by using past experiences. Sometimes does not have enough materials to meet customer needs or spare components to construct finished goods because spare parts are used together. There is a shortage of inventories. There is a shortage of inventories. The Warehouse at Plastic Company is shown in Fig. 1 to Fig. 2.

Fig. 1. Raw Materials


Fig. 2. Work in Process (WIP) Materials

In the warehouse, Staff controls the inventory of many materials based on the experience of observing. Regardless of customer order quantity.

When the staff checks stock and prepares orders for each: a product that is composed of several types and sizes, it does not operate on suitable what items should be stocked, when stock should be replenished, and how large orders should be. Sometimes out of stocks products be occurred leading to shortage costs. Customers have to wait for backorders and customers receive the product late. The number of shipping delays is shown in Fig. 3.

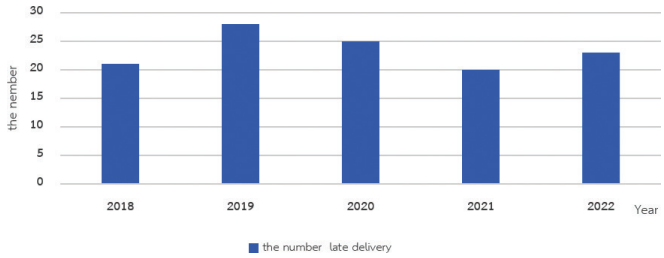



Fig. 3. The number of shipping delays

If there are insufficient spare components, the planning department will notify the manufacturing department. However, producing spare parts takes varying amounts of time depending on the specific production processes involved. As a result, shipping may be delayed, and if the delay exceeds the allotted time, the factory may incur penalties.

The shortage of goods comes from using spare parts together. Fig. 4 illustrates a comparison between the maximum order count and the average inventory each time during production. The staff places orders based on their experience, regardless of the quantity specified in customer orders.

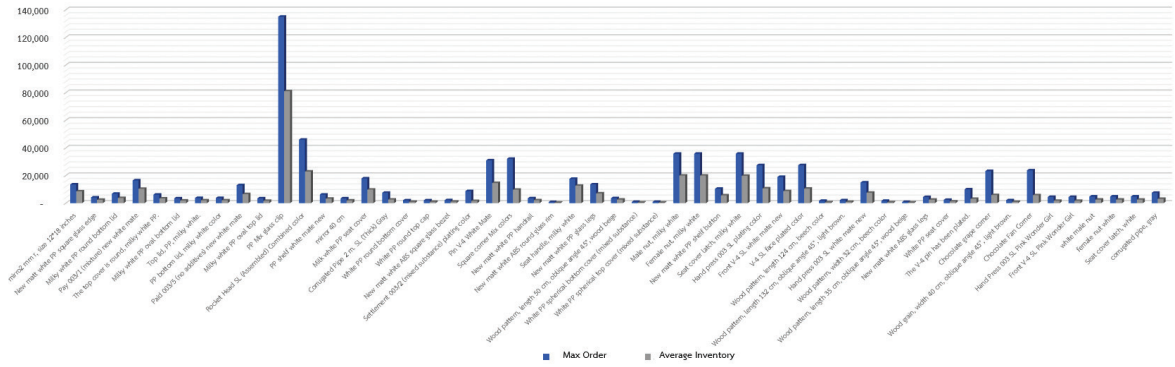



Fig. 4. Compare count maximum order with an average inventory

The researcher has an idea to assist in the creation of the production planning database system by using the spreadsheet program order notification 2022 on Google cloud to create and edit files online while collaborating with other users in real time to help decrease stock management issues and delivery delays.

## *B. Scope of Study*

• This research examined the high-order type A products of four departments.

The data used in this research aims to assist material planning for the plastic company through the utilization of the order notification program.

• Microsoft Excel, specifically the order notification software, is employed for material management, and the associated files are uploaded onto Google sheets.

## *C. Objectives*

• To study the causes of problems to reduce delayed delivery and the spare parts that aren't enough for production.

• To study and summarize the current practices of companies.

• To develop a new Material Requirement Planning (MRP) to remedy inventory management.

• To propose an alternative for planners who want to generate an effective inventory that is better than the existing method.

## II. Literature Review

### *A. The Material Requirement Planning System (MRP)*

MRP system attempts to determine material needs. The main purpose of the MRP is to facilitate organizational calculations to determine the required quantity of parts needed in production [1]. MRP helps to ensure that required materials like components, parts, or subcontracted items arrive at the set time for fulfilling the demand requirements of finished goods. To calculate and define the right order time and shipping time for the required parts or components needed for the production of a new product, it combines data from production schedules with data from inventory as well as the bill of materials [2].

The data were analyzed to examine the status quo and to adopt the MRP by spreadsheet on the cloud. After the MRP adoption, the company was able to determine the quantity requirement, leading to the MRP prototype creation for production as follows: inventory quantity, materials that are in the process of ordering, production schedule, and component requirement lists [3].

### *B. Inventory Control*

Inventory is their largest asset that may cover more than 40% of the total assets, it should be properly managed and controlled. However, the managing and controlling of the inventory should have some objectives as follows:

• To raise company profitability

• To evaluate the effect of company policies on inventory levels

• To minimize the total cost of logistics activities

Nowadays, many inventory management techniques can be applied in many businesses such as Inventory carrying cost, Economic order Quantity (EOQ), ABC analysis, and the Bill of Materials (BOM) [4].

### *C. ABC Analysis*

ABC analysis can basically be used in all areas of materials management.

It enables:

• To distinguish the essential from the inessential

• To focus on activities of high economic importance, while reducing the burden on the remaining areas by simplification measures

• to increase the efficiency of measures (e.g. cost reduction) by the possibility of targeted use

ABC analysis can be carried out weekly, monthly, quarterly, or annually as required. The more often the analysis is performed, the better the overview of the stock situation, and the faster the response to changes in stocks can be implemented [5].

### *D. Bill of Materials (BOM)*

BOM is a detailed account used for defining, recording, and saving the final product and its makeup, contents, quantities, and structure. The BOM can be presented in many different ways, such as Explosion and Implosion [6]. This study briefly describes the different BOM structures as follows:

- Single-Level Explosion
- Indented Explosion
- Summarized Explosion
- Single-level Implosion
- Indented Implosion
- Summarized Implosion

Furthermore, BOM can also be called a Product Structure or Material List. The Furthermore, BOM is usually presented in a Level-by-Level way: Level 0 represents the finished products, Level 1 as structural components, Level 2 as the composition of the structure in Level 1, and so on as Level 3 until the list reaches the most basic components/raw materials. The tree structure of BOM is illustrated in Fig. 5 [7].

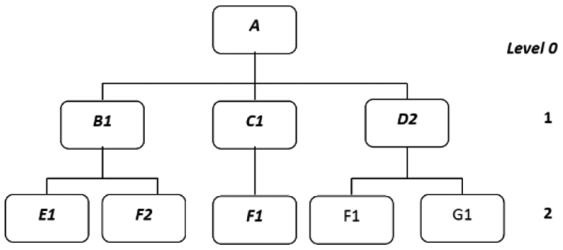



Fig. 5. Tree structure (BOM) of product A

## II. Research Methodology

The steps that will be taken for research completion are as follows:

1) Study the background of the plastic company.
2) Process Analysis
   - ABC Analysis
   - Cause and effect analysis
   - The structure of the BOM
   - Calculate safety stock and re-order point
3) Design the experiments and apply them to the program.

### *A. Information about the Plastic Company*

This research is on the design and implementation of a material requirement planning system in a plastic company. Based on requests from customers (Make-to-Order). Customers can choose from a variety of shapes and sizes for the items they want. The product can be categorized into 4 categories shown in Fig. 6.

- Nozzle
- Seat Cover
- Glass
- Wood Glass

Fig. 6. The product of the plastic company

## B. Process Analysis

The first step in the process is to prepare data about statistics on transportation from the previous year to gather data on delivery delays of a plastic company. From the statistics from Table I, the amount of delay from delivery in 2022 shows a total of 22 delivery delays. Each department has similar delivery averages.

TABLE I
THE AMOUNT OF DELAY FROM DELIVERY IN 2022

| Department | Number of Delays | Average |
|---|---|---|
| Nozzle | 8 | 2 |
| Seat cover | 5 | 3.63 |
| Glass assembly | 5 | 2.80 |
| Wood grain assembly | 4 | 4 |
| **Total (Day)** | **22** | **3.11** |

In the second step, the researcher uses ABC analysis to select the products of each department in the Type a group and found that there were 27 types of products in the type a group as shown in Fig. 7 to Fig. 10.

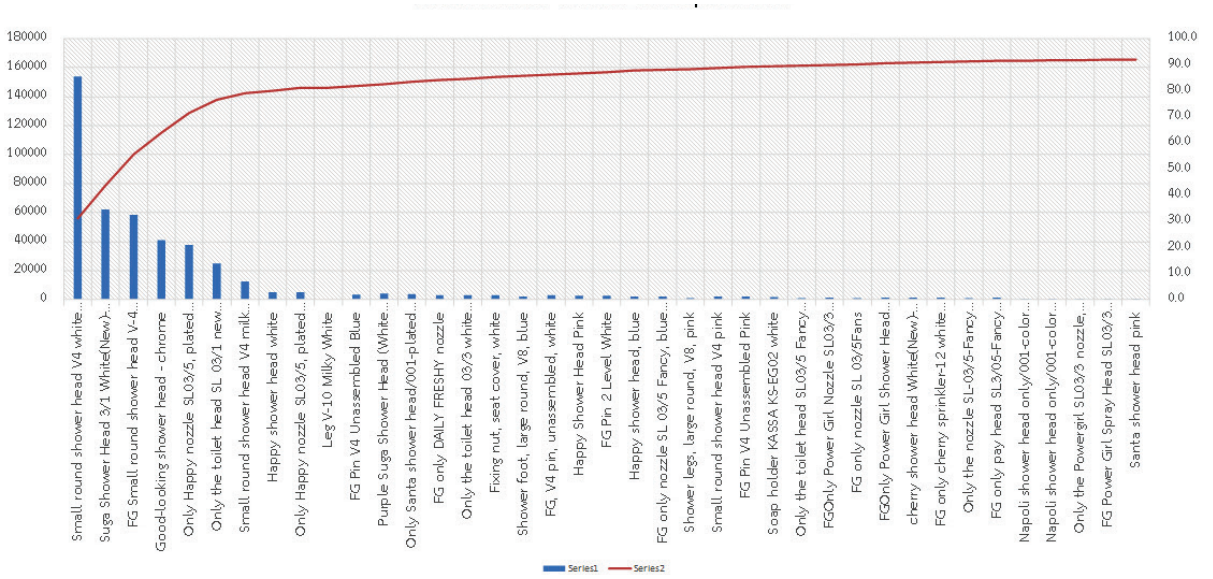



Fig. 7. Volume sales of the nozzle department (December, 2021- October, 2022)

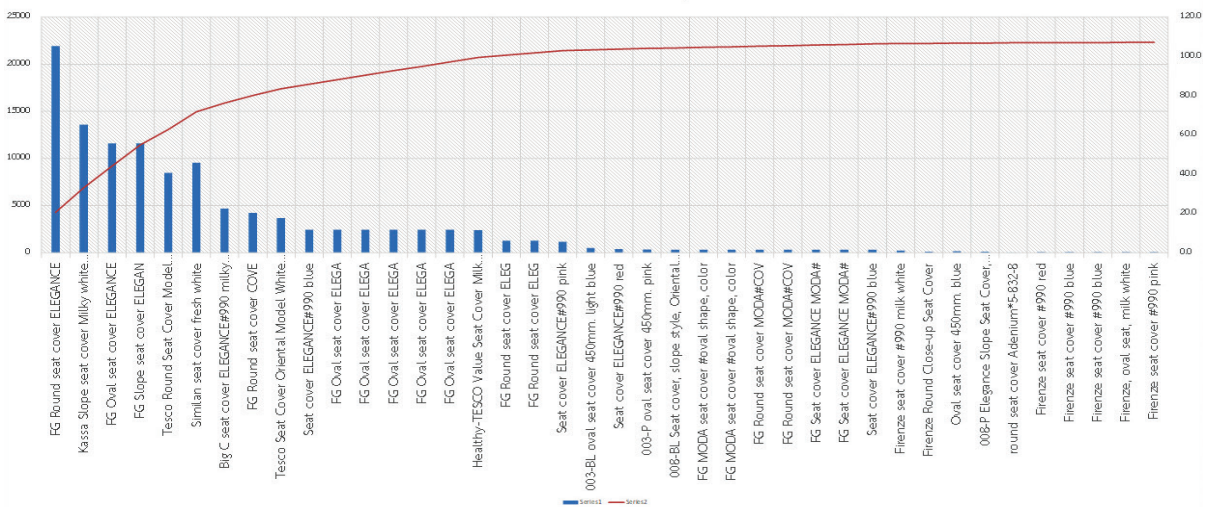



Fig. 8. Volume sales of the seat cover department (December, 2021- October, 2022)

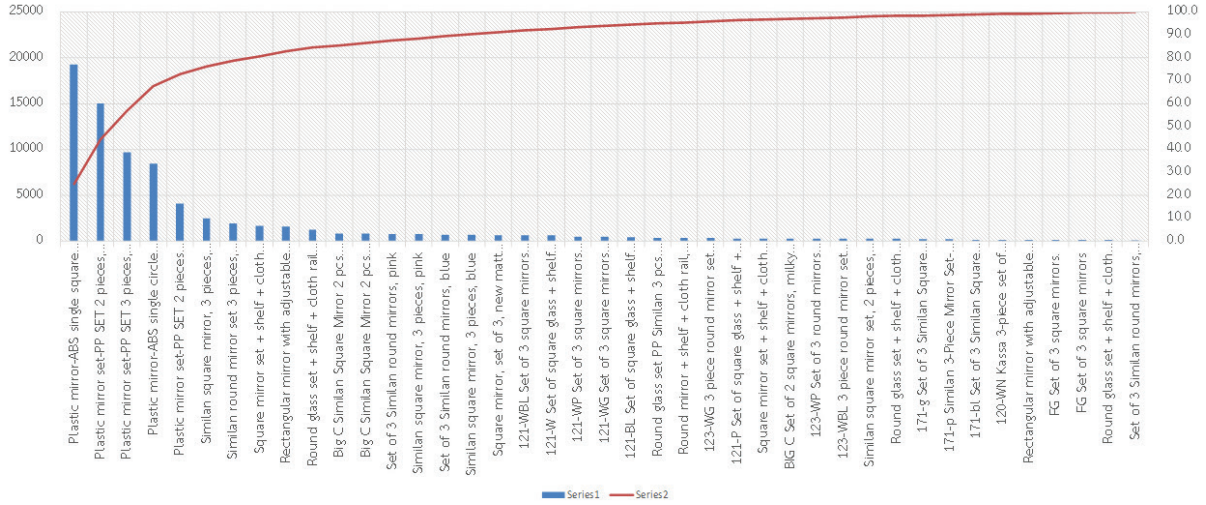



Fig. 9. Volume sales of the glass assembly department (December, 2021- October, 2022)

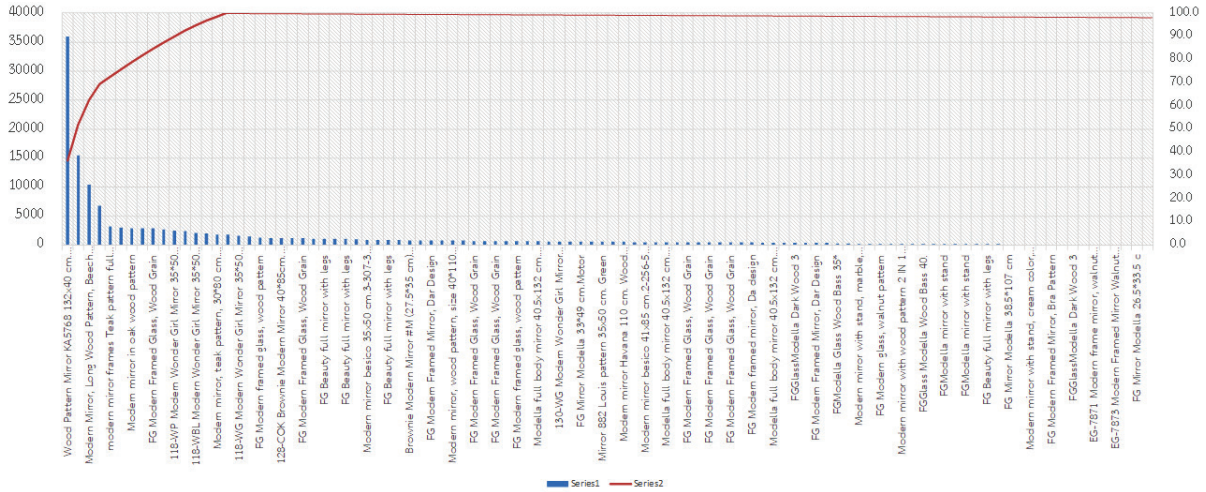



Fig. 10. Volume sales of wood glass assembly department (December, 2021- October, 2022)

According to the ABC analysis, there are 27 Type a products divided into 4 departments, as shown in Table II below.

• The nozzle department has product type 7 items and uses characters instead of N1- N7.

• The seat cover department has product type 8 items and uses characters instead of S1-S8.

• The glass assembly department has a product type 7 items and uses characters instead of G1- G7.

• The wood glass assembly department has product type 5 items and uses characters instead of W1- W5.

TABLE II
THE PRODUCTS IN TYPE A GROUP

| No. | Department | Code | Character |
|---|---|---|---|
| 1 | Nozzle | 11113050071 | N1 |
| 2 | Nozzle | 11113030136 | N2 |
| 3 | Nozzle | 11113060004 | N3 |
| 4 | Nozzle | 11113040044 | N4 |
| 5 | Nozzle | 11113030143 | N5 |
| 6 | Nozzle | 11113030138 | N6 |
| 7 | Nozzle | 11113050061 | N7 |
| 8 | Seat Cover | 11115010002 | S1 |
| 9 | Seat Cover | 11115010051 | S2 |
| 10 | Seat Cover | 11115020001 | S3 |
| 11 | Seat Cover | 11115010068 | S4 |
| 12 | Seat Cover | 11115010026 | S5 |
| 13 | Seat Cover | 11115010050 | S6 |
| 14 | Seat Cover | 11115010061 | S7 |
| 15 | Seat Cover | 11115010067 | S8 |
| 16 | Glass | 11114010136 | G1 |
| 17 | Glass | 11114010137 | G2 |
| 18 | Glass | 11114020068 | G3 |
| 19 | Glass | 11114020069 | G4 |
| 20 | Glass | 11114020071 | G5 |
| 21 | Glass | 11114010142 | G6 |
| 22 | Glass | 11114010122 | G7 |
| 23 | Wood Glass | 11114030063 | W1 |
| 24 | Wood Glass | 11114030112 | W2 |
| 25 | Wood Glass | 11114030003 | W3 |
| 26 | Wood Glass | 11114030047 | W4 |
| 27 | Wood Glass | 11114030057 | W5 |
| **Total** | | **27** | |

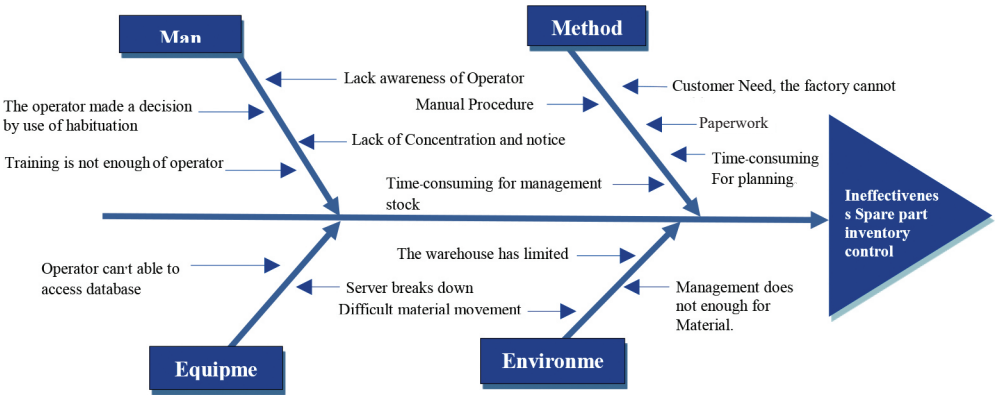



Fig. 11. Cause and effect for the ineffectiveness of the current system.

Moreover, the cause-effect diagram Ishikawa diagram fishbone diagram is an effective tool for the problem-solving process. It is used to investigate for sub-causes [8]. This step shows the analysis of cause and effect for the ineffectiveness of the current system. Fig. 11 shows a fishbone.

In the man-related cause, to investigate the spare parts required, the material planners and purchasing personnel should have high experience in doing their job. They have to know every part in detail. And they must concentrate on their work because their work involves numerical tasks. Lost concentration would make an error and result in overstock and shortage.

In the method-related cause, most of the work is paperwork. Staff use a parts list printed on paper to investigate the quantity needed for each product that is composed of several types, and sizes and use spare parts together. The Investigation task then is time-consuming since the staff has to deal with many spare parts lists and sheets of schedule. Besides time wasted on paperwork while investigating the required quantity for each part.

The equipment-related cause involves the use of printers, servers, and computers for material planning. As the spare part requirements are updated daily, any server breakdown can restrict staff members' access to the database, impeding their ability to perform their tasks effectively.

The environment-related cause relates to the limited space in the warehouse, which hampers the movement of products and pallets, leading to decreased storage efficiency.

In conclusion, the proposed system should address these identified causes that hinder the efficiency of the material planning and control system. The new system should adopt a proactive approach, focusing on appropriate methods, ease of use, minimizing human error, and facilitating the

In the next step, study the structure of the Bill of management of raw materials.

BOM can be presented as a relationship between the assembling work and the components necessary to manufacture items. The researcher has analyzed the composition of various types of products. After that, the data for 67 different materials and components were divided using code A-Z to show the data by Table III, The semi-product of 27 product types A.

TABLE III
THE SEMI-PRODUCT OF 27 PRODUCT TYPES A

| Character Product | Code Semi | Character Semi Product | Amount of Used |
|---|---|---|---|
| N1 | 020902040051 | CC | 1 |
| N2 | 020502030051 | P | 1 |
| | 020602010051 | T | 1 |
| | 020701020051 | W | 1 |
| | 029902020028 | KKK | 1 |
| N3 | 020902040026 | BB | 1 |
| N4 | 020502040026 | Q | 1 |
| | 020602010026 | S | 1 |
| | 020701020026 | V | 1 |
| | 029902020028 | KKK | 1 |
| N5 | 020501070051 | O | 1 |
| | 020602010026 | S | 1 |
| | 020701020026 | V | 1 |
| | 029902020028 | KKK | 1 |
| N6 | 020502030051 | P | 1 |
| | 020602010024 | R | 1 |
| | 020701020024 | U | 1 |
| | 029902020028 | KKK | 1 |
| N7 | 020902040002 | AA | 1 |

TABLE III
THE SEMI-PRODUCT OF 27 PRODUCT TYPES A (CON.)

| Character Product | Code Semi | Character Semi Product | Amount of Used |
|---|---|---|---|
| S1 | 021202020002 | FF | 1 |
| | 021201020002 | CC | 1 |
| | 021209020002 | MM | 1 |
| | 021210020002 | OO | 2 |
| | 021211020002 | QQ | 2 |
| | 021217020002 | VV | 2 |
| | 021217020002 | VV | 2 |
| | 021212020002 | RR | 1 |
| S2 | 021207020002 | JJ | 1 |
| | 021208020002 | KK | 1 |
| | 021209020002 | MM | 1 |
| | 021210020002 | OO | 2 |
| | 021211020002 | QQ | 2 |
| | 021217020002 | VV | 2 |
| | 021212020002 | RR | 1 |
| S3 | 021204020002 | HH | 1 |
| | 021205020002 | II | 1 |
| | 021209020002 | MM | 1 |
| | 021210020002 | OO | 2 |
| | 021211020002 | QQ | 2 |
| | 021217020002 | VV | 2 |
| | 021212020002 | RR | 1 |
| S4 | 021202020002 | FF | 1 |
| | 021201020002 | CC | 1 |
| | 021209020002 | MM | 1 |
| | 021210020002 | OO | 2 |
| | 021211020002 | QQ | 2 |
| | 021217020002 | VV | 2 |
| | 021212020002 | RR | 1 |
| S5 | 021202040001 | GG | 1 |
| | 021201040001 | EE | 1 |
| | 021209020001 | LL | 1 |
| | 021210020001 | NN | 2 |
| | 021211020001 | PP | 2 |
| | 021217020001 | UU | 2 |
| | 021212020002 | RR | 1 |
| S6 | 021202020002 | FF | 1 |
| | 021201020002 | CC | 1 |
| | 021209020002 | MM | 1 |
| | 021210020002 | OO | 2 |
| | 021211020002 | QQ | 2 |
| | 021217020002 | VV | 2 |
| | 021212020002 | RR | 1 |
| S7 | 021215020002 | SS | 1 |
| | 021216020002 | TT | 1 |
| | 021209020002 | MM | 1 |
| | 021210020002 | OO | 2 |
| | 021211020002 | QQ | 2 |
| | 021217020002 | VV | 2 |
| | 021212020002 | RR | 1 |

TABLE III
THE SEMI-PRODUCT OF 27 PRODUCT TYPES A (CON.)

| Character Product | Code Semi | Character Semi Product | Amount of Used |
|---|---|---|---|
| S8 | 021207020002 | JJ | 1 |
| | 021208020002 | KK | 1 |
| | 021209020002 | MM | 1 |
| | 021210020002 | OO | 2 |
| | 021217020002 | VV | 2 |
| | 021212020002 | RR | 1 |
| G1 | 020101010051 | E | 1 |
| | 020901010051 | Y | 2 |
| | 020408020028 | N | 8 |
| | 010301010001 | A | 1 |
| | 029903050028 | MMM | 1 |
| | 021212020002 | RR | 1 |
| | 020901010051 | Y | 2 |
| | 020408020028 | N | 8 |
| G2 | 020901010051 | Y | 2 |
| | 020408020028 | N | 8 |
| | 010301010001 | A | 1 |
| | 029903050028 | MMM | 1 |
| | 021212020002 | RR | 1 |
| | 020901010051 | Y | 2 |
| | 020408020028 | N | 8 |
| | 010301010001 | A | 1 |
| | 029903050028 | MMM | 1 |
| | 021212020002 | RR | 1 |
| | 020901010051 | Y | 2 |
| W1 | 021601120030 | BBB | 2 |
| | 021601230030 | FFF | 2 |
| | 021701040028 | III | 4 |
| | 021702050028 | JJJ | 3 |
| | 029903040028 | LLL | 1 |
| | 010301010004 | B | 1 |
| W2 | 021601041150 | WW | 2 |
| | 021601041350 | XX | 2 |
| | 021701040028 | III | 4 |
| | 029903040028 | LLL | 1 |
| | 010301010001 | A | 1 |
| W3 | 021601080020 | YY | 2 |
| | 021601210020 | DDD | 2 |
| | 021701010021 | GGG | 2 |
| | 021701020021 | HHH | 2 |
| | 021702050028 | JJJ | 1 |
| | 010301010004 | B | 1 |
| | 029903040028 | LLL | 1 |
| W4 | 021601100021 | ZZ | 2 |
| | 021601150021 | CCC | 2 |
| | 021701040028 | III | 4 |
| | 029903040028 | LLL | 1 |
| | 010301010001 | A | 1 |
| W5 | 021601120019 | AAA | 2 |
| | 021601230019 | FF | 2 |
| | 021701040028 | III | 4 |
| | 021702050028 | JJJ | 3 |
| | 010301010004 | B | 1 |
| | 029903040028 | LLL | 1 |

In addition, the researcher provides an example of the BOM structure diagram N4-N6, which can be simulated as shown in Fig. 12 to Fig. 14.

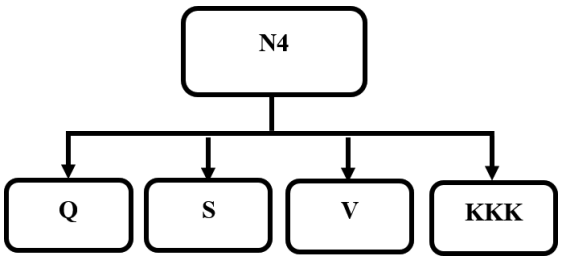


Fig 12.The structure diagram of N4

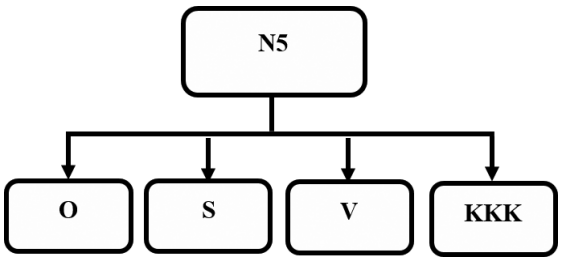


Fig. 13. The structure diagram of N5

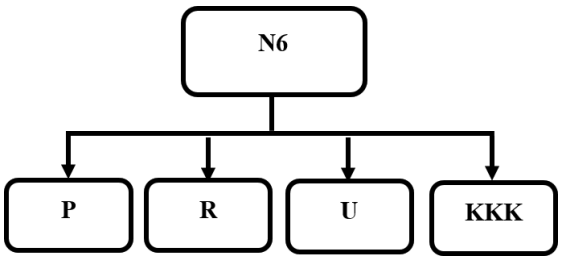


Fig 14.The structure diagram of N6

From Fig. 12 to Fig. 14, BOM diagram N4-N6 shows the use of shared parts in production, for example:

• N4 and N5 have semi-product parts S: code 020602010026, and V: code 020701020026 that share spare parts.

• N4, N5, and N6 have semi-product parts KKK: code 029902020028 shares spare parts.

Calculate safety stock and re-order point

Finally, find the safety stock and reorder point of the semi-product of 67 items. Calculated using Microsoft execs applied software using mean and maximum value methods. To feed the database into the order notifications program as shown in Fig. 15.

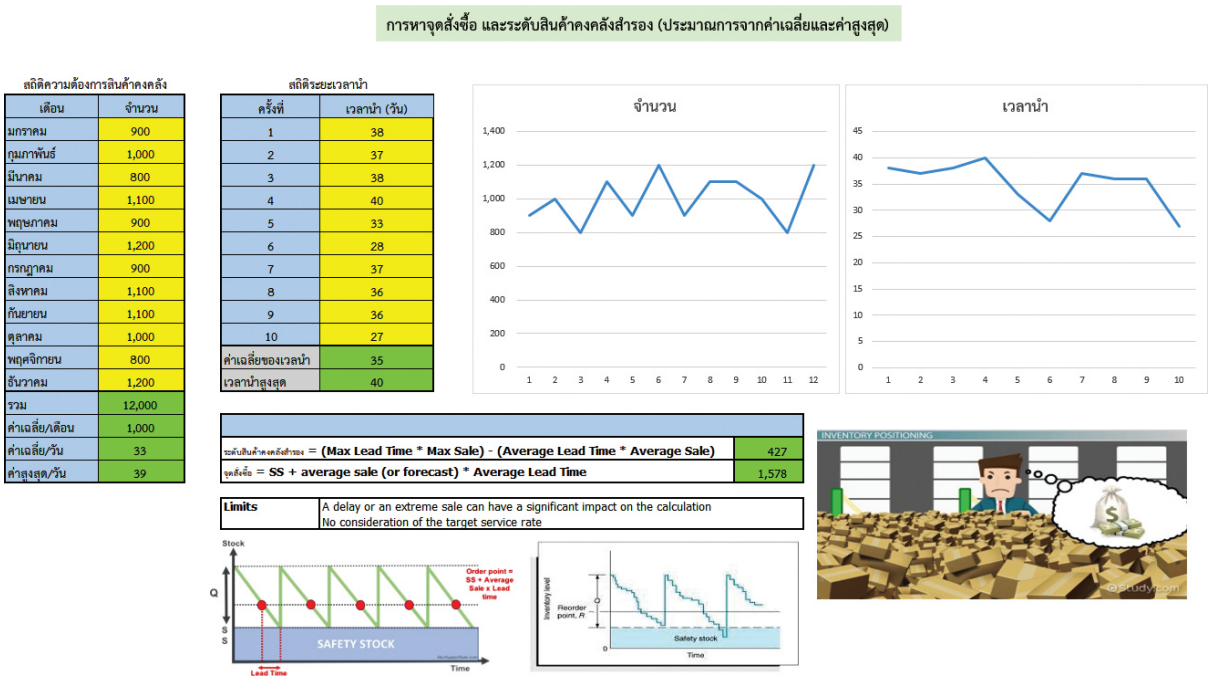



Fig. 15. Finding safety stock and reorder point

## *B. Design the Experiments and Apply to the Program*

The order notification program can be used to determine the number of raw materials in inventory. How much can be utilized to create various commodities or products?

The order notifications program will tell you right away to make purchases to top off the stored inventory level if the raw materials are not enough to utilize in accordance with the production schedule. The software was created using the practical spreadsheet program on the cloud, which can be used conveniently and edited files online in real-time. In addition, is compatible with Microsoft Excel files the basic office program available on most computers. It consists of several worksheets.

5 Worksheets are as follows:

1) Home screen
2) Products
3) Raw materials used to assemble products
4) Bill of Materials
5) Orders

as shown in Fig. 16.

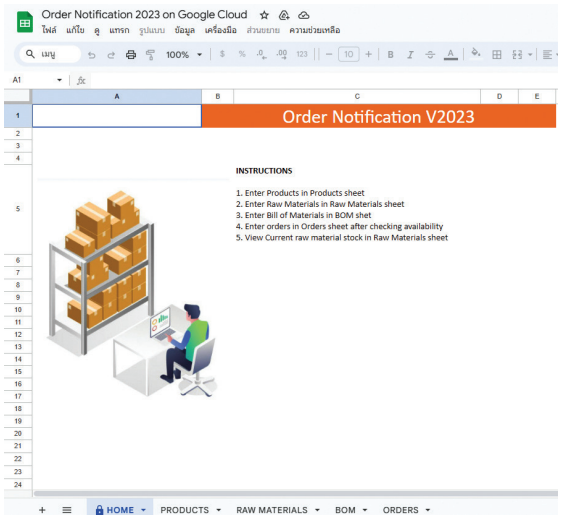



Fig. 16. Main page (Home screen)

Using the order notifications program

Open the order notifications program. Developed from google spreadsheet by entering class a product data 27 items on the product or product sheet (products) and shown in Fig. 17.

**RAW MATERIALS**

*Enter each Raw Material in a separate row (Start from row 7)*

| *Unique Raw Material Name* | *Inventory you have when you first start using this template* | *Inventory level below which you should replenish stock* | Calculated: *Units purchased till now* | Calculated: *Units available in stock now* | Calculated: *Should we order now?* |
|---|---|---|---|---|---|
| RAW MATERIAL NAME | STARTING INVENTORY | RE-ORDER POINT | PURCHASES | AVAILABLE NOW | TO ORDER |
| A | 488 | 1428 | 500 | 738 | YES |
| B | 344 | 770 | 0 | 344 | YES |
| C | 138 | 263 | 0 | 138 | YES |
| D | 86 | 126 | 0 | 86 | YES |
| E | 268 | 537 | 0 | 18 | YES |
| F | 110 | 234 | 0 | 110 | YES |
| G | 103 | 191 | 0 | 103 | YES |
| H | 86 | 174 | 0 | 86 | YES |
| I | 175 | 387 | 0 | 175 | YES |
| J | 43 | 95 | 0 | -207 | YES |
| K | 43 | 95 | 0 | -207 | YES |
| L | 37 | 79 | 0 | 37 | YES |
| M | 212 | 466 | 1000 | 1212 | NO |
| N | 3909 | 8774 | 1000 | 2909 | YES |

HOME | PRODUCTS | RAW MATERIALS | BOM | ORDERS

Fig. 17. Raw materials worksheets

For the system to calculate these quantities automatically when delivering order notifications, the researcher implements the software using the number of raw materials and points of purchase. Fill out the BOM sheet as shown in Fig. 18 to Fig. 19 with the list of materials used to manufacture each product.

**BILL OF MATERIALS**

*Enter recipe for each product (Start from row 10)*

See Sample below: To create Banana Berry Shake (L), we need 1 Banana, 5 Strawberries and 10 Blueberries.

**BILL OF MATERIALS**

*Enter recipe for each product (Start from row 10)*

***These three calculations are needed to calculate inventory. Please do not edit.***

*You can ignore this data.*

| PRODUCT | RAW MATERIAL | UNITS | UNIT OF MEASURE | RAW MATERIAL UNITS USED TILL NOW (*Total raw material units used till now*) | AVAILABLE RAW MATERIALS NOW (*Available raw materials now*) | HOW MANY PRODUCTS CAN BE MADE? (*Units of Products that can be made*) |
|---|---|---|---|---|---|---|
| N1 | CC | 1.00 | Count | 1000.00 | 1596 | 1596 |
| N2 | P | 1.00 | Count | 500.00 | 366 | 366 |
| N2 | T | 1.00 | Count | 500.00 | 334 | 334 |
| N2 | W | 1.00 | Count | 500.00 | 334 | 334 |
| N2 | KKK | 1.00 | Count | 500.00 | -1005 | 0 |
| N3 | BB | 1.00 | Count | 1000.00 | 173 | 173 |
| N4 | Q | 1.00 | Count | 1000.00 | 516 | 516 |
| N4 | S | 1.00 | Count | 1000.00 | 944 | 944 |
| N4 | V | 1.00 | Count | 1000.00 | 944 | 944 |
| N4 | KKK | 1.00 | Count | 1000.00 | -1005 | 0 |
| N5 | O | 1.00 | Count | 500.00 | 1086 | 1086 |
| N5 | S | 1.00 | Count | 500.00 | 944 | 944 |
| N5 | V | 1.00 | Count | 500.00 | 944 | 944 |
| N5 | KKK | 1.00 | Count | 500.00 | -1005 | 0 |
| N6 | P | 1.00 | Count | 800.00 | 366 | 366 |
| N6 | R | 1.00 | Count | 800.00 | 295 | 295 |
| N6 | U | 1.00 | Count | 800.00 | 295 | 295 |
| N6 | KKK | 1.00 | Count | 800.00 | -1005 | 0 |

Fig. 18. List of spare parts used in the production of goods

**ORDERS**

*Enter purchase and sale orders in the below table.*

*If an order has multiple product items, enter them in separate rows.*

*Supports up to 1000 entries below.*

16-Nov-2022

CHECK TODAY'S AVAILABILITY

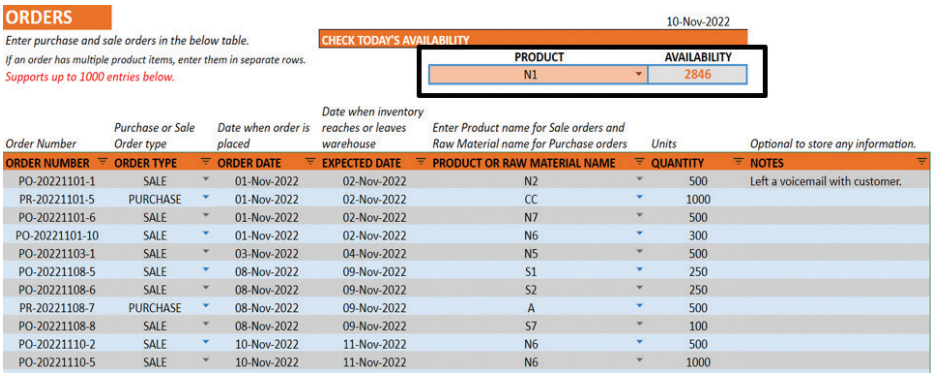
| PRODUCT | AVAILABILITY |
|---|---|
| N3 | 173 |

| *Order Number* | *Purchase or Sale Order type* | *Date when order is placed* | *Date when inventory reaches or leaves warehouse* | *Enter Product name for Sale orders and Raw Material name for Purchase orders* | *Units* | *Optional to store any information.* |
|---|---|---|---|---|---|---|
| ORDER NUMBER | ORDER TYPE | ORDER DATE | EXPECTED DATE | PRODUCT OR RAW MATERIAL NAME | QUANTITY | NOTES |

Fig 19. The number of products that can be manufactured.

Assume that there are now 2,846 pieces of raw materials for product N1 that can be used to make items, as shown in Fig. 20.

When an order comes in 1,000 units of product N1 Fig 21. Depicts the remaining quantity of item N1 as 1,596 pieces.



ORDERS

*Enter purchase and sale orders in the below table.*
*If an order has multiple product items, enter them in separate rows.*
*Supports up to 1000 entries below.*

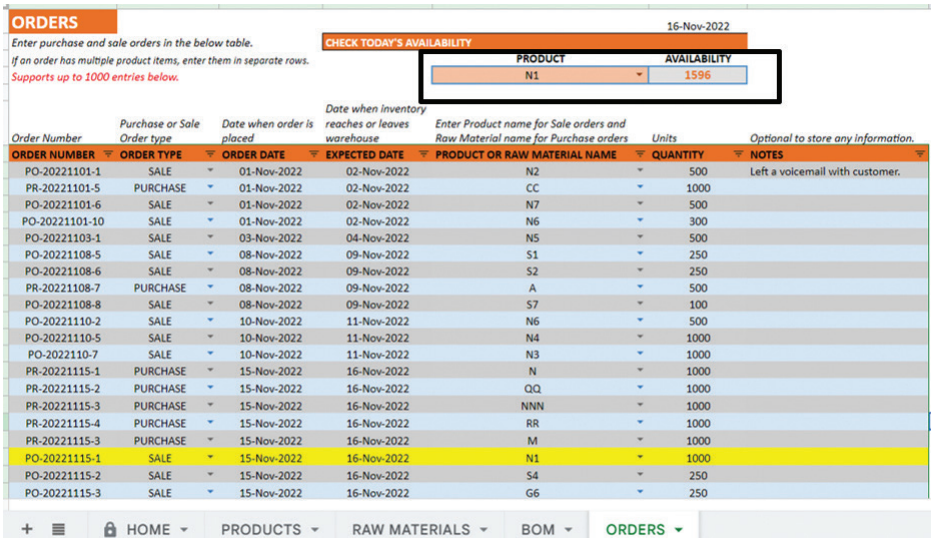
10-Nov-2022

CHECK TODAY'S AVAILABILITY

| PRODUCT | AVAILABILITY |
|---|---|
| N1 | 2846 |

| *Order Number* | *Purchase or Sale Order type* | *Date when order is placed* | *Date when inventory reaches or leaves warehouse* | *Enter Product name for Sale orders and Raw Material name for Purchase orders* | *Units* | *Optional to store any information.* |
|---|---|---|---|---|---|---|
| ORDER NUMBER | ORDER TYPE | ORDER DATE | EXPECTED DATE | PRODUCT OR RAW MATERIAL NAME | QUANTITY | NOTES |
| PO-20221101-1 | SALE | 01-Nov-2022 | 02-Nov-2022 | N2 | 500 | Left a voicemail with customer. |
| PR-20221101-5 | PURCHASE | 01-Nov-2022 | 02-Nov-2022 | CC | 1000 | |
| PO-20221101-6 | SALE | 01-Nov-2022 | 02-Nov-2022 | N7 | 500 | |
| PO-20221101-10 | SALE | 01-Nov-2022 | 02-Nov-2022 | N6 | 300 | |
| PO-20221103-1 | SALE | 03-Nov-2022 | 04-Nov-2022 | N5 | 500 | |
| PO-20221108-5 | SALE | 08-Nov-2022 | 09-Nov-2022 | S1 | 250 | |
| PO-20221108-6 | SALE | 08-Nov-2022 | 09-Nov-2022 | S2 | 250 | |
| PR-20221108-7 | PURCHASE | 08-Nov-2022 | 09-Nov-2022 | A | 500 | |
| PO-20221108-8 | SALE | 08-Nov-2022 | 09-Nov-2022 | S7 | 100 | |
| PO-20221110-2 | SALE | 10-Nov-2022 | 11-Nov-2022 | N6 | 500 | |
| PO-20221110-5 | SALE | 10-Nov-2022 | 11-Nov-2022 | N6 | 1000 | |

Fig. 20. Checking the maximum amount of finished goods that can be produced.



ORDERS

*Enter purchase and sale orders in the below table.*
*If an order has multiple product items, enter them in separate rows.*
*Supports up to 1000 entries below.*

16-Nov-2022

CHECK TODAY'S AVAILABILITY

| PRODUCT | AVAILABILITY |
|---|---|
| N1 | 1596 |

| *Order Number* | *Purchase or Sale Order type* | *Date when order is placed* | *Date when inventory reaches or leaves warehouse* | *Enter Product name for Sale orders and Raw Material name for Purchase orders* | *Units* | *Optional to store any information.* |
|---|---|---|---|---|---|---|
| ORDER NUMBER | ORDER TYPE | ORDER DATE | EXPECTED DATE | PRODUCT OR RAW MATERIAL NAME | QUANTITY | NOTES |
| PO-20221101-1 | SALE | 01-Nov-2022 | 02-Nov-2022 | N2 | 500 | Left a voicemail with customer. |
| PR-20221101-5 | PURCHASE | 01-Nov-2022 | 02-Nov-2022 | CC | 1000 | |
| PO-20221101-6 | SALE | 01-Nov-2022 | 02-Nov-2022 | N7 | 500 | |
| PO-20221101-10 | SALE | 01-Nov-2022 | 02-Nov-2022 | N6 | 300 | |
| PO-20221103-1 | SALE | 03-Nov-2022 | 04-Nov-2022 | N5 | 500 | |
| PO-20221108-5 | SALE | 08-Nov-2022 | 09-Nov-2022 | S1 | 250 | |
| PO-20221108-6 | SALE | 08-Nov-2022 | 09-Nov-2022 | S2 | 250 | |
| PR-20221108-7 | PURCHASE | 08-Nov-2022 | 09-Nov-2022 | A | 500 | |
| PO-20221108-8 | SALE | 08-Nov-2022 | 09-Nov-2022 | S7 | 100 | |
| PO-20221110-2 | SALE | 10-Nov-2022 | 11-Nov-2022 | N6 | 500 | |
| PO-20221110-5 | SALE | 10-Nov-2022 | 11-Nov-2022 | N4 | 1000 | |
| PO-2022110-7 | SALE | 10-Nov-2022 | 11-Nov-2022 | N3 | 1000 | |
| PR-20221115-1 | PURCHASE | 15-Nov-2022 | 16-Nov-2022 | N | 1000 | |
| PR-20221115-2 | PURCHASE | 15-Nov-2022 | 16-Nov-2022 | QQ | 1000 | |
| PR-20221115-3 | PURCHASE | 15-Nov-2022 | 16-Nov-2022 | NNN | 1000 | |
| PR-20221115-4 | PURCHASE | 15-Nov-2022 | 16-Nov-2022 | RR | 1000 | |
| PR-20221115-3 | PURCHASE | 15-Nov-2022 | 16-Nov-2022 | M | 1000 | |
| PO-20221115-1 | SALE | 15-Nov-2022 | 16-Nov-2022 | N1 | 1000 | |
| PO-20221115-2 | SALE | 15-Nov-2022 | 16-Nov-2022 | S4 | 250 | |
| PO-20221115-3 | SALE | 15-Nov-2022 | 16-Nov-2022 | G6 | 250 | |

HOME | PRODUCTS | RAW MATERIALS | BOM | ORDERS

Fig. 21. The number of finished goods

## III. Result and Discussions

Apply the inventory management method, and follow the established corrective guidelines in the process. The cause-and-effect diagram in Fig. 10 is an analysis by the researchers to identify the true origin of each problem. The processing results are focused on action planning, as stated separately in each topic. These solutions will be implemented step by step, as also shown in Fig. 22.

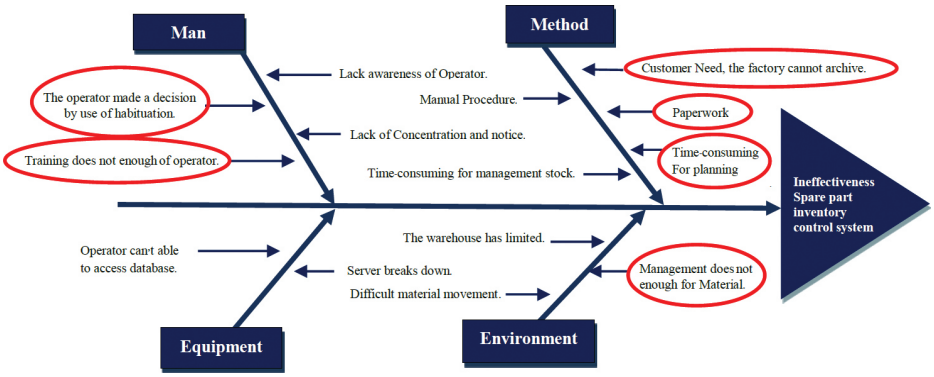



Fig. 22. Fishbone diagram

The summary of what actions to be taken in each solution topic is shown in the diagrams below. The diagrams also link those actions to the root causes they eliminate from Fig. 23.

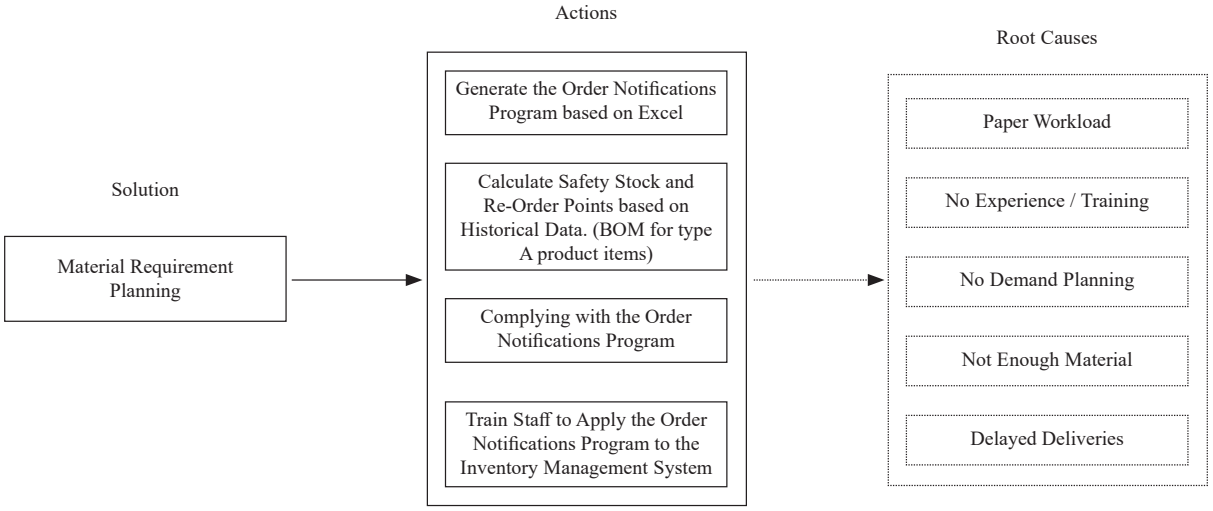



Fig. 23. Actions and eliminated root causes by material requirement planning.

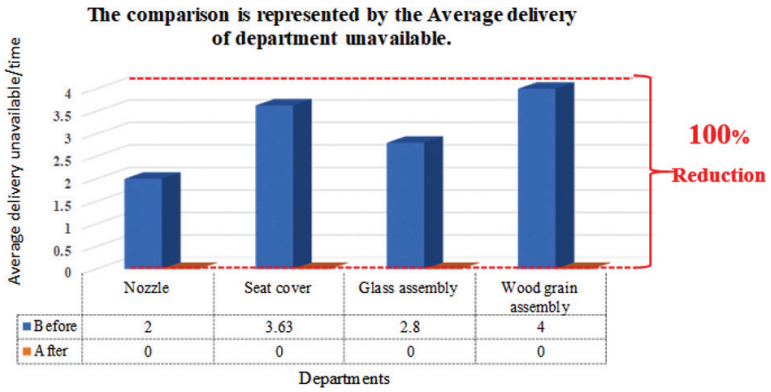



Fig. 24. Bar chart showing reduction of average unavailable delivery per time.

The implementation, results from two months (November-December 2022) reflect the success of improvement activities from the researcher. The company can use the program. The direct and indirect benefits from improvement caused a reduction in the total cost and reduced delayed delivery of the plastic company. The comparison is represented by a bar chart about delivery in Fig. 24 below.

Inventory control is an important problem for business operations in the current economy. The effectiveness of logistics can be increased with good order management. The delivery of goods to customers will be impacted if raw materials are not purchased on time or in adequate quantities. It also has an impact on the organization's brand image and reputation. Material Requirement Planning, in the opinion of the researcher, is an important and effective strategy for handling the demand for the materials required for each product and it is also useful for estimating item sales in the company based on historical sales data to help decrease delayed delivery and Increase the customers' satisfaction. It has main supporting tools such as (1) A Master Plan, giving the number of every product to be made in each period (2) A Bill of Materials, which gives structured lists of the materials needed for each product and (3) Inventory Records, show the current state of stocks, lead times, costs, etc.

Plastic company is used as a case study to be analyzed and improve its process to gain more success. This medium-sized company is located in Bangkok, It has been operating for 31 years, the problem is the ineffectiveness of the inventory control system and there aren't enough spare parts to produce finished goods. There is a shortage of inventories. It needs immediate action to edit the problem and avoid paying a penalty for delivery delays.

## V. Conclusion and Suggestion

The objective of the research is the design and implementation of MRP in The Plastic Company. Researchers study the causes of problems to reduce delayed delivery and the spare parts that are not enough for production. Using the design program is the tool for planning the raw material.

It can improve save costs and increase logistics efficiency to implement the order notifications program to be applied in planning the purchase of raw materials so that inventory is available to serve customer demands in the appropriate quantity and at the right time, can be summarized as follows :

1) Reduce problems from raw material shortage

After generating the order notifications program based on Excel. The improvement caused reduced delayed delivery of the plastic company. There has been a 100% reduction in delivery delays in all departments. Higher accuracy in demand planning can prevent a shortage of raw materials. Staff can prepare adequate raw materials without overstocking them based on reasonable raw material planning.

2) Reduce the cost of warehouse management

Overall improvement after the 2 months of implementation is shown in more effectiveness. The cost of warehouse management (planning), the result has decreased by 66.67%, when compared to the average ratio in the year 2022.

3) Reduction in error

Since in the proposed system most of the work will be done by a basic program computer is user-friendly, the human error, for example, forgettable order, forgettable part, a mistake in calculation, etc. will be improved. In the current system, one material planner is responsible for a lot of spare parts, and there are thousands of parts in the list of low inventory and shortage of spare parts. They may look over some parts. Although they recognize it later, it may be too late to order. Mistakes in the calculation are unavoidable because material planning and control is a numerical task.

This research also addresses the suggestion of monitoring and control continuous improvement needs continuous monitoring and control from supervisors of all departments. The researcher suggests monthly follow-up meetings to ensure the implemented actions are effective without internal errors.

## REFERENCES

[1] N. Slack, S. Chambers, and R. Johnston, *Operation Management.* London, UK: Pearson Education Limited, 2001, pp. 371-377.

[2] P. Gopalakrishnan and H. Abid, *Handbook of Materials*. Dehli, IN: PHI Learning Pvt. Ltd., 2015, p. 164.

[3] S. Khantiprasert and P. Ruangchoengchum, "Material Requirements Planning for Chiangda Vegetable Tea Production: Case Study in the Plant Genetic Conservation Center of Khlongpai, Nakhon Ratchasima Province," M.S. thesis, College of Graduate Study in Management, Khon Kaen Univ., Khon Kaen, Thailand, 2019.

[4] J. R. Stock and D. M. Lambert, *Strategic Logistic Management.* New York: McGraw-Hill Companies, Inc, 1993, pp. 1-896.

[5] J. Moritz Pramono, "Improving Material Control Processes and MRP Planning Parameters in a Motorcycle Manufacturing Company," M.S. thesis, Dept. Logistics Engineering and Supply Chain Management, Chiang Mai Univ., Chiang Mai, Thailand, 2016.

[6] H. C. Chen, M. J. Lu, C. C. Liu et al., "A Study of the Performance Improvement of Bill of Material Document Sign Flow System," *International Journal of Academic Research in Accounting Finance and Management Sciences*, vol. 2, no. 1, pp. 79-96, Mar. 2012.

[7] L. E. Kinney, "Material Planning," *AT&T Technical Journal*, vol. 6, pp. 19-32, Aug. 1990.

[8] S. Ruangdis, "Aircraft Spare Parts Planning And Control," M.S. thesis, Dept. Engineering Program. Eng., Chulalongkorn Univ., Bangkok, Thailand, 2005.

**Ploypailin Phrikthim** received industrial engineering from Panyapiwat Institute of Management, Thailand, in August 2017 and currently studying for a master's degree in the Faculty of Engineering and Technology. Used to work in production engineering at Charoen Pokphand Foods, in 2017-2018. Currently job as a Senior Officer in the Strategic and Innovation Management Department at Panyapiwat Institute of Management, Nonthaburi, Thailand.

**Paitoon Siri-O-Ran** received a doctorate of engineering in industrial engineering from Kasetsart University, Thailand, in 1994. Used to be a professor in industrial engineering, from 2004 to 2011 at Southeast Asia University, Thailand, and The current job as Head of industrial engineering at Faculty of Engineering and Technology at Panyapiwat Institute of Management, Nonthaburi, Thailand.

**Panisuan Jamnarnwej** received the Doctor of Philosophy in Industrial and Systems Engineering from Georgia Institute of Technology, USA, in 1986. The current job is as a lecturer in the industrial engineering department, faculty of engineering and technology at Panyapiwat Institute of Management, Nonthaburi, Thailand.