*Proceedings of the International Conference on Industrial Engineering and Operations Management*

Publisher: IEOM Society International, USA DOI: 10.46254/AP07.20260195
Published: March 25, 2026

# Implementation of Inventory Management System through Material Requirements Planning (MRP) in a Manufacturing Company of Punched Paper Carrier Tape

**Evelyn D. Valdez**
Former Production Manager, SWID Mfg., Inc.
Calamba, Laguna, Philippines
Logistics Associate, Amazon Erfurt GmbH
Erfurt, Germany
evedvaldez@gmail.com

## Abstract

The rate of economic growth is largely influenced by the expansion of the industrial world, not just in the Philippines but also globally. As we go into the modern day, the economy is growing at a very quick pace, and there is increasing competition among economic players. Material Requirements Planning (MRP) is an inventory management system that involves sequentially applying techniques to develop and identify specific inventory and material requirements for each company's production components. This ensures that product delivery is appropriate and efficient. Implementing MRP as material management helps companies and organizations increase productivity and reduce inventory significantly. SWID Mfg. Inc. has been experiencing a great loss in terms of raw material purchasing cost and spoilage since 2021 due to inconsistent customer forecasts and a poor procurement and inventory management system in the organization. The main objective of this study is to help the management establish material procurement system through the implementation of Material Requirements Planning. The study also aims to determine which forecasting method is best for helping the procurement section in ordering management and material calculation. To ensure that the user only uses one application to record all relevant information, such as the customer's forecast, material ordering, receiving, and manufacturing consumption, the researcher also provided an inventory management system using Visual Basic for Applications, where the calculation was incorporated. Upon implementing the system, the company was able to save by reducing material purchase costs, procurement process fees, and raw material spoilage.

## Keywords

Material Requirements Planning, Forecasting**,** Inventory Management System, Microsoft Macro (VBA)

## 1. Introduction

Inventory, as explained, is a key component of corporate operations and a major source of income for an organization. It is frequently referred to as the transitional phase between manufacturing and order fulfillment. There are many different ways to categorize inventory, and an organization's ability to fulfill orders is directly impacted by how well it is maintained. For instance, companies are gathering vital information that should guide future purchasing and fulfillment processes by monitoring raw materials, safety stock, completed goods, or even packing materials. How frequently businesses need to replenish inventory and which items are prioritized for repurchase are determined by an understanding of purchasing trends and item sales rates. With this data accessible, it can reduce the amount of money lost to shortages, restocking delays, and wasted inventory while simultaneously enhancing liquidity, profitability, and customer relations.

Inventory plays a crucial part in business operations as one of the company's assets. The inventory of finished goods, auxiliary materials, work-in-process (WIP), raw materials, and replacement parts can all be found in a manufacturing factory. Raw material is one of the major inventory categories and the essentials that become a key component in the production process; it needs to be managed well to avoid delays. Since the availability of raw materials is crucial to the manufacturing process's ability to continue operating effectively, planning for raw material requirements is crucial and must be taken into consideration. In this instance, the planning of raw materials and material requirements has to be in line with every aspect of the business, including capital availability, the state of the production equipment, the condition of the human resources, received orders, and so on.

Material planning and procurement is part of inventory management and one of the most critical processes in a manufacturing company. The organization, SWID Mfg. Inc. is located in Calamba City, Laguna. Established and registered as a manufacturer of surface mounting components for punching paper carrier tape, which is used for multi-layered ceramic chip capacitors (MLCC). At present, the company produces around 75,000 rolls of various types and models of punched paper carrier tape annually. The procurement section of the company prepares the raw material order based on the customer's monthly forecast. However, after the Covid pandemic in 2020, the inaccuracy of the customer's forecast compared to its actual order started to cause problems in the material management of the business.

In practice, the customer provides a three-month forecast quantity in the second month of the preceding quarter. This will serve as the basis for the quantity of materials to be ordered, giving the company a three-month buffer stock for raw materials and half a month for the finished goods. However, the customer will also use a daily delivery schedule to issue the actual order once a week. There is a notable discrepancy between the customer's forecasted quantity and real delivery requests at the end of each month; on average, 88% of actual deliveries in 2021 have only been fulfilled in comparison to the monthly projected quantity. It decreases to 85% by the year 2022, and continues to decline in the year 2023 at 83%. Since the raw materials for three months were ordered once before the customer's forecast was received, this discrepancy leads to an accumulation of inventory.

For the material ordering frequency, a three-month purchase order is issued to the supplier every other month of the quarter. Considering the supplier's manufacturing lead time, preparation, sailing period, port processing, and delivery to the facility, a maximum of 30 days, including some days of delay like port congestion caused by typhoons, is considered reasonable enough to avoid a material shortage for the next quarter's customers' forecasted quantity. Although bulk orders of raw materials may be a good way to secure customer orders, there are still a few things to take into account. The company should consider the shelf life of the raw material, the ordering and holding costs, as well as the logistics expenses. Currently, the company lacks a standardized and optimal system for determining the correct amount of material to procure. A standard buffer stock of raw material is determined only through the forecast given by the customer. Furthermore, no study is underway to address the issue of forecast inaccuracy. Therefore, identifying the best forecasting technique for the customer demand and creating a suitable ordering cost measurement tool can help a company better control overall expenses and boost productivity.

### 1.1 Objectives

The main objective of the study is to give the business a Material Requirements Planning (MRP) system for material planning and procurement. The study specifically seeks to identify the most effective forecasting technique that will support the organization in material calculation and ordering management. Lastly, use the MRP system in Visual Basic for Applications in Microsoft Excel to create an optimal raw material supply based on demand and delivery lead time in order to lower material purchases and logistical expenses.

## 2. Literature Review

Prior to exploring the different interpretations of the term, itself, the meanings of the terms "inventory" and "management" will be looked at. Munyao et al. (2020), defined inventory as a company's tangible, unprocessed goods that are valued financially and are kept in various forms within its control while they are awaiting subsequent packaging, sorting, conversion, use, or sale. On the other hand, management is defined as "the organization of a person's or entity's operations to accomplish set targets" by Musau et al. (2020). Combining the two definitions seems to imply "the management and synchronization of a firm's underlying physical commodities with financial worth awaiting packing, arranging, transition, usage, or selling at a later period." In their search for appropriate definitions of the term "Inventory Management," Anantadjaya et al. (2021), said that the discipline deals with characterizing the quantity and shape of goods in possession. However, Müller et al. (2020), provided a more thorough description,

delineating a company's oversight and control over the acquisition, storage, and utilization of the components it will sell or the finished goods it will provide.

Raw materials are crucial to the operation of any production plan, as they are one of the key components in the procurement process. As a result, during the production process, raw materials are one of the elements that need specific attention. A well-planned inventory of raw materials is essential to the efficient operation of the production process. According to Sabaruddin and Meilestari (2024), the uninterrupted running of the production process holds huge importance for the company as it significantly impacts the profits and sales levels attained. Yamit (2021), states that businesses and organizations require inventory for three reasons: (a). When demand is unpredictably volatile (b). because of supplier supply instability (c). due to an order's lead time being unreliable. Due to the three aspects of this unpredictability, the business needs to manage its inventory in a preventative way, meaning that it can foresee the situations and difficulties that may arise there.

Undoubtedly, a company's inventory management has the following objectives: (a). On-time customer delivery (b). To supply adequate raw material stocks to ensure production continuity (c). To significantly increase the business's revenue and earnings (d). To make very few purchases. Planning and regulating inventory levels is the goal of inventory management, which also strives to lower inventory costs and raise customer satisfaction, (Mashayekhy, 2022). The operations of enterprises depend heavily on inventory management. According to Hills (2020), the majority of manufacturing enterprises' current assets consist of inventory, which makes up about 60%. Manufacturing companies have to commit to significant expenses because of the large amount of inventory they have on hand. Businesses must use effective and efficient inventory management systems in order to obtain a high rate of return on investment and higher productivity, as evidenced by the significant risk involved in investing such a large amount of cash. In order to maintain the proper level of working capital, a business must exercise appropriate control over supplies when it comes to inventory management. The inventory management strategy aims to achieve the intended return on equity investments, lower working capital expenditures without compromising the level of competitive customer service, and satisfy the market's demands for availability and service (Tejero, 2020). There isn't an identical inventory management system that works for all businesses; instead, each one must implement diverse processes based on its unique needs, demands, expenses, and goals (Ferrero Bécares, 2020).

A recent Polish study observed how inventory management affected the food industry's profitability. Based on a panel of 27 food subsectors examined between 2005 and 2017, the study was conducted. Commodities, work-in-process, finished goods, raw and other material stocks are all included in the inventory mix that is considered in the research. The study, which applied the day sales inventory (DSI) approach, showed that the proportion of total assets and current assets was declining. The effectiveness of inventory management increased in accordance with the said trend. Additionally, as the days in inventory ratio for materials and completed items decreases, the study discovered that the day sales inventory for total stocks obviously tends to decrease. According to Golas (2020), there is a positive correlation between improved inventory management efficiency and financial performance, as indicated by the return on operating assets. Mamoor and Raana (2020), conducted a similar study in Bangladesh and noted that small enterprises' capacity to effectively manage their inventory is critical to their potential to generate more profitability. Using regression analysis, 112 small businesses were evaluated during the past ten years. The study's findings indicate that there is a significant relationship between inventory value and profitability. Thus, for small firms to generate greater profitability, efficient inventory management is essential.

Inventory management is crucial for companies of all sizes for the following reasons: It might be difficult to decide when to resupply, what amounts to acquire or produce, when to sell, and at what price. Small businesses typically use spreadsheet (Excel) formulas to calculate quantities and reorder points, and they also frequently keep handwritten inventory records. Enterprise resource planning (ERP) software with specific features may be used by larger companies. SaaS (software as a service) applications with significant levels of customization are used by the biggest companies. Additionally, businesses are using artificial intelligence or machine learning to streamline these procedures. A study conducted in 2020 by Arasa and Achoura, demonstrated how strategic inventory management techniques affected the operation of supermarkets in Nairobi County, Kenya. In order to guarantee an accurate representation of the study population, a descriptive cross-sectional survey research design and stratified random sampling technique were utilized. 113 supermarkets were selected as a sample size from the target population of 158 stores. The results of the study showed a strong positive correlation between store performance and strategic inventory management techniques. The activity-based costing system and the e-inventory management system specifically showed the biggest impact on supermarket performance. The study concludes that strategic inventory management

techniques greatly enhance store performance. Therefore, the study suggests that to improve their performance through lower operating expenses and better inventory control, supermarket management in the county should use e-inventory management systems and activity-based pricing.

Effective inventory management, according to theories, prevents stockpiles, inventory inaccuracies, obsolete inventory, and profligacy for improved performance. Additionally, avoid stock-outs, theft, holding costs, money tied down, decreased use of machinery or equipment, and spoiling or deterioration. A company's performance, particularly in healthcare companies, encompasses a wide range of stakeholders, including the government, patients, physicians, and public sector organizations. This clearly sets healthcare apart from other services in terms of performance. Inventory control is essential to enhancing the operation of the company as a whole, but it becomes much more important in the healthcare industry. Unavailability of life-saving medications and equipment that raise the death rate is frequently overlooked by this industry (Hashmi et al., 2020). Inventory control is a critical matter in the Philippines. It is thought to be a primary objective that propels the company toward effective operational cost reduction. Establishing inventory goals should be done on time, using software, according to needs or economic order, and should also include information about the business's providers. In addition to lowering inventory expenses, searching for an accurate, dependable, and effective inventory management system also expedites inventory procedures. This implies that a solution that integrates effectively with inventory management must exist (Martinez, 2020).

**The Significance of Forecasting in Inventory Management**

To be able to have good inventory management, an accurate forecast of demand is needed. Forecasts play a major role in practice when making inventory decisions. Forecasting is a tool for making decisions that use past data and patterns to help businesses deal with the uncertainty of the future. In operational management, forecasting serves to lower production uncertainty so that proactive and anticipatory actions can be taken, as well as for scheduling production. Forecasting is a technique of predicting what will happen in the future based on previous and current occurrences. Essentially, it is a decision-making tool that assists firms in dealing with the impact of future uncertainty by analyzing historical data and trends. As pointed out by Hsieh et al. (2020), forecasting is a planning tool that allows organizations to outline their next actions and generate budgets that will hopefully cover any uncertainties that may arise.

Forecasting is critical in the supply chain, such as purchasing, inventory management, pricing, ordering, sales, and marketing (Hoeltgebaum et al., 2021). As Fildes et al. (2022), point out, high-accuracy demand forecasting has a significant impact on organizational performance since it improves various operations throughout the supply chain, including inventory management. Thus, precision in demand forecasting is critical, given that excessive stock products incur additional costs, whilst inadequate stocking results in lost revenues and poor customer satisfaction. Accurate forecasting helps reduce stockouts and excess production. This enables organizations to better plan their production, inventories, and logistics. Companies keep safety supplies in their inventory, which serves as a buffer against unanticipated fluctuations in demand or supply. A corporation has to find the appropriate level and maintain a safety stock level to meet customer demand while avoiding excess inventory and carrying costs. Forecasting and determining safety stocks collaborate to assist companies in cutting expenses, improving customer service, and optimizing inventory levels. Forecasting and calculating safety stockpiles are critical components of supply planning (Touvila, 2023).

Forecasting is becoming more and more important in inventory management. The expenses associated with overstock and out-of-stock will be decreased by forecasting with a specific degree of precision in advance. Raw materials, semi-finished goods, completed goods, replacement parts, and consumables used in its products are all included in inventory. Almost every organization faces the critical issue of effectively managing and controlling inventories due to poor forecasting. Proper inventory management is crucial since stocks take up a lot of space, hinder production unnecessarily, and financially strain firms greatly. By maintaining raw materials, spare parts, and other essentials in the business in sufficient numbers but not too much, efficient inventory control aims to provide uninterrupted production (Ifraz et al., 2023).

Although demand forecasting is a major component of inventory control, forecasting and inventory decision-making are kept apart in the literature on inventory control. Numerous models with various review structures, cost frameworks, and demand characteristics have been developed since Ford W. Harris established the economic order quantity (EOQ) model in 1913. These days, the majority of businesses employ these inventory models with either specialized inventory management software or more all-purpose ERP software. Nevertheless, inventory control models typically assume

that the future demand distribution is completely known, which is seldom the case in real life. While a great deal of research has been done on the best ways to forecast different kinds of needs, little is known about how forecasting and decision-making connect (Goltos et al., 2022).

The first step in estimating raw material requirements based on cement consumption is forecasting. Saptadi and Zarah (2023) assert that one significant factor influencing inventory costs is the choice of forecasting techniques. For inventory management, the combination of forecasting techniques increases accuracy and lowers error variation. In order to assist organizations in choosing the most effective inventory management system, a study was conducted to determine the forecasting method for the fluctuating stocks of Chrysotile fiber, the most critical material used to make roof fiber cement in a building material manufacturing facility in Jakarta, Indonesia. The aforementioned substance is imported, and its limited resources are located in only a few countries, including China, Brazil, and Russia. It has been noted from the material inventory data that there are times when inventories are extremely high and times when the inventory becomes so low that there has been a shortage in the manufacturing line. The sales data from the prior period was analyzed using a number of forecasting methodologies. Based on data processing and analysis, the best forecasting method is linear regression forecasting, which yields the minimum mean absolute percentage error (MAPE) value. This study by Taifur and Imaroh (2020), verifies that the company's inventory performance and cost efficiency are improved when MRP is used as the inventory management method, making use of the forecasted demand quantity.

In the food and beverages industries, forecasting is a very essential tool to determine the consumer's demand. Tea is one of a popular beverages all around the world. In many countries, it has a major impact on the evolution of local tea traditions. Most of the time, tea is offered for sale as dried tea leaves and processed, ready-to-drink tea drinks. Kale and Deshmukh (2020) anticipate that the ready-to-drink tea market will reach $38.96 billion by 2027, up from $29.66 billion in 2019. Seasonality is evident in the tea beverage sector's fluctuating customer demand behavior, as it is a subset of the beverage industry as a whole. Using Holt-Winters' method to forecast consumer demand and the Economic Order Quantity method to develop a material requirements plan, control inventories, and place material orders, Rhufyano et al. (2022) conducted a study for a small and medium-sized company in the tea beverage sector. The study focuses on maximizing inventories and reducing costs by employing a make-to-stock strategy. Therefore, the benefit-cost ratios of the 250 ml and 500 ml tea beverage products were 1.738 and 2.027, respectively, before the improvement was adopted. The benefit-cost ratio is 2.817 and 2.281, respectively, after the modification. These results imply an increase in the benefit-cost ratio. The analysis, calculation, and validation results have shown that the business's profit is raised and expenses are reduced by the use of MRP and demand forecasting.

**Material Requirements Planning (MRP) as Inventory Management System**

The MRP approach is one strategy that may be applied to inventory management (Sutrisno and Airlangga, 2020). Due to the trend of globalization, the importance of planning material requirements has grown in a number of fields in recent decades. Material requirements planning systems, which are based on the same resources, help companies streamline their current production and distribution processes by implementing management techniques that boost productivity and competitiveness. The supply chain process incorporates a material requirement planning system to plan, carry out, and control the economical forward and reverse flow and storage of goods, services, and related data at the point of origin and the point of utilization in order to satisfy consumer demands. Manufacturing companies can benefit from a number of advantages when establishing an MRP system, such as capacity planning, production orders, a bill of materials, inventory management, and a master production schedule. These advantages raise industrial operations' efficiency, maximize warehouse inventory, and guarantee the availability of raw materials and production components when needed, (Kithure and Paul, 2022).

To increase the business's performance, raw material requirements is planned using Material Requirements Planning (MRP). The primary objective of the study is to create an MPS (Master Production Schedule) in the MRP. Based on the customer's forecasts, an MPS was created that incorporated all planning procedures for calculating out the raw material needs. MRP enables the business to estimate the number of days needed to complete the production process, as well as the best time and quantity to order raw materials and store them in the warehouse as buffer stocks. Most production constraints and problems caused by the unexpected purchase of necessary raw materials can be resolved by using the MRP system internally. MRP enables timely planning of every step of the production process, including ordering raw materials, packing, and client delivery. The customer is more satisfied when deliveries are made on schedule. (Sitanggang and Muda, 2021).

A corporation with over 50 years of experience in the Peruvian market was the subject of research wherein the laboratory, which accounts for around 84% of the company's revenue and is responsible for producing and distributing white-label surgical sutures. A thorough investigation and analysis of the business revealed that, during the previous three years, its growth had been accelerating in an unfavorable manner. The business area increased sales by diversifying its customer base. However, the operational area was impacted by the ineffective procedure and the absence of preparation. The effects and repercussions included a scarcity of both completed goods and raw materials. Scenarios were assessed based on the raw material and final product inventory and lead time variables. Sales results are used as input in this project's Material Requirement Planning design, which enables the business to maintain the appropriate raw material and final product stock levels. By using MRP as a tool for calculation, the study was able to modify and increase the material procurement quantity that will support the laboratory manufacturing process to be able to produce enough finished goods that will support the increasing demand in the market, (Cerna et al., 2021).

**Inventory Management System Using VBA Programing in MS Excel**

Microsoft created and owns Visual Basic for Applications (VBA). It is a computer programming language that enables the user to design custom forms, graphs, and reports as well as develop macros to automate repetitive word and data-processing tasks using VBA. Given the existing lack of classification optimization evaluations, Visual Basic for Applications (VBA) programming is a great choice and a necessary tool for assessing inventory classification risks when employed in an Excel programming environment. In the majority of cases, businesses that use Microsoft Excel for manual reporting find that generating an accurate report demands complete focus. Especially if there was money involved with the reports, and procurement was one of those. Decisions on the values to be entered in various Excel spreadsheet cells were made in a few of the reports. A study was presented by Kalwar (2020) on how Microsoft Excel's VBA may be used to optimize purchase orders, procurement processes, and automation in order costing in the footwear industry. It offers the means through which automatic conditional decision-making can be performed. A productive system with an engaging user interface and a collection of macros that can complete hours-long tasks in minutes can be created.

According to Nguyen (2020), Excel spreadsheets with VBA are the most advantageous solution for a small local company like the one in question right now because they are free. It is adaptable and convenient. The company's staff can have complete control over the software, and solution maintenance and development do not require the involvement of a third party. Excel spreadsheets and a VBA solution created a customized inventory solution using Excel spreadsheets and Visual Basic for Applications (VBA). Excel spreadsheets display data and the user interface in the solution, while VBA, a programming language developed by Microsoft, writes commands to automate various functions and processes. Numerous recent studies have demonstrated the beneficial usage of VBA in Microsoft Excel worksheets for operational optimization. Numerous publications described basic automation tasks utilizing VBA in Microsoft Excel and the advantages it offers the company, both financially and in terms of time savings. A spreadsheet was developed at the Pakistan Civil Aviation Authority and termed a small management information system in the more recent related studies by Chaudhry et al. (2021). This spreadsheet included all of the information about purchase orders and complaints from different locations around Pakistan. Employee time spent seeking and recording complaints is reduced because of the automated system spreadsheet that uses VBA.

**Synthesis**

The optimum forecasting technique must be identified utilizing the company's actual sales data from 2021 to the second half of 2024 in order to address the increasing non-moving inventory caused by inaccurate demand forecasts. Several time series forecasting techniques are used to test the real sales data. However, the Holt-Winters method is the best forecasting tool to determine customer orders for the following six months due to seasonality and trend. The outcome of the projection is used in the procurement and planning of materials. A weighted moving average is used in the Holt-Winters method, also called triple exponential smoothing, to ascertain the mean, trend, and seasonality (Brito et al, 2021).

An automated solution utilizing Visual Basic is proposed because the management still uses manual computation for material ordering in Excel. A material ordering system is designed after every relevant piece of information has been examined. To avoid opening multiple files, calculating material requirements manually, and performing repeated tasks, the Bill of Materials has been entered into the system, and material calculation has also been integrated into a Microsoft Excel macro.

## 3. Methods

Applied research has been carried out by the researcher since its objective is to provide standard and ideal inventory management for small and medium corporations. The particular method of study was developed to address practical problems rather than gather data merely for the benefit of information.

The study was conducted at SWID Mfg. Inc. in Calamba, Laguna, with an emphasis on the employees involved in the transactions, as well as the general manager. This is in line with the purposive sampling approach. Purposive sampling, sometimes referred to as subjective sampling, is a non-probability sampling method where the researcher selects the variables for the sample population at their own discretion. When used properly, deliberate sampling helps the researcher sort out irrelevant answers that don't suit the parameters of the study.

## 4. Data Collection

Discussion of the company's improvement plan with the general manager was the first step the researcher took to carry out this study. Since the researcher was still employed at the time of the research project, direct observation in the related process is very manageable. However, the access and use of relevant data from the company must be done with approval. A letter allowing the use of company data and information from each department for this study was submitted. After the approval, the researcher started to consolidate the information. With the data gathered and presented in graphical form, the researcher could dig deeper, understand the cause of the problem, and identify the study's objectives. After checking and summarizing the data, an inventory management model was formulated to determine the ideal order for each raw material.

## 5. Results and Discussion

### 5.1 Numerical Results

The yearly data of the customer's forecasted quantity against the actual delivery request is shown below. Except for the year 2020, which was during the COVID-19 pandemic, and there was no production from March to July, the actual delivery request from the customer has been declining since 2021. Only 88% of actual deliveries in 2021 have been fulfilled in comparison to the monthly projected quantity. As shown by the data, the actual requested delivery was 83% in 2023 and 85% in 2022; it was seen to be declining annually. Judging by the results of the customer's actual request for the second quarter of 2024, the total request by the end of 2024 is likely to be between 79% and 81% only (Table 1).

Table 1. Annual sales summary

ANNUAL SALES SUMMARY

| Year | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|
| FORECAST | 24362 | 45637 | 77838 | 47863 | 67550 | 65703 | 65393 | 62431 |
| ACTUAL | 22512 | 42904 | 73525 | 24944 | 59148 | 55676 | 54551 | 23757 |
| % | 92% | 94% | 94% | 52% | 88% | 85% | 83% | 38% |

To determine the forecast for the next six months, the actual sales result is tested using the Holt-Winters forecasting method using the following formula (Table 2 and Table 3).

Table 2. Holt-Winters forecasting method

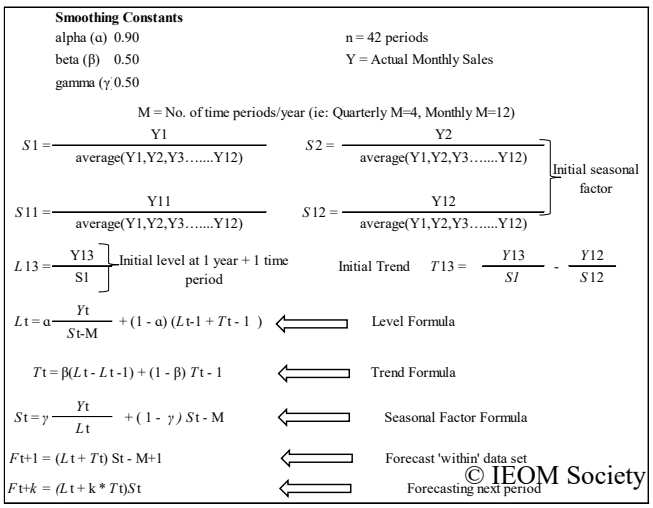


Table 3. Actual delivery results

| Actual Delivery Request from Jan 2021 to Jul 2024 | | | | |
|---|---|---|---|---|
| Month | 2021 | 2022 | 2023 | 2024 |
| January | 2,006 | 1,919 | 1,884 | 1,692 |
| February | 2,278 | 2,205 | 1,884 | 2,127 |
| March | 2,975 | 2,781 | 2,149 | 2,489 |
| April | 4,389 | 4,275 | 2,773 | 4,281 |
| May | 6,942 | 6,615 | 4,277 | 6,063 |
| June | 7,638 | 7,142 | 6,632 | 7,105 |
| July | 8,261 | 7,743 | 7,215 | |
| August | 8,306 | 7,814 | 7,412 | |
| September | 6,845 | 6,577 | 7,516 | |
| October | 3,591 | 3,174 | 6,463 | |
| November | 3,151 | 2,982 | 3,047 | |
| December | 2,766 | 2,449 | 2,828 | |
| Total | 59,148 | 55,676 | 54,080 | 23,757 |

## 5.2 Graphical Results

Figure 1 represents the material ordering system's primary interface. The main screen features three command buttons for new order, delete order, and product BOMs. The details saved in the BOM will function as a database, including all necessary information. Once the BOM is submitted, the easy interface allows users to simply access and manage their orders. This streamlined method not only improves efficiency but also lowers the likelihood of material procurement problems. Seven (7) functions in the system will assist the company in tracking material inventories and projecting monthly material purchases. Each month, the user will be able to adjust the quantity of finished goods, raw materials, and customer demand.

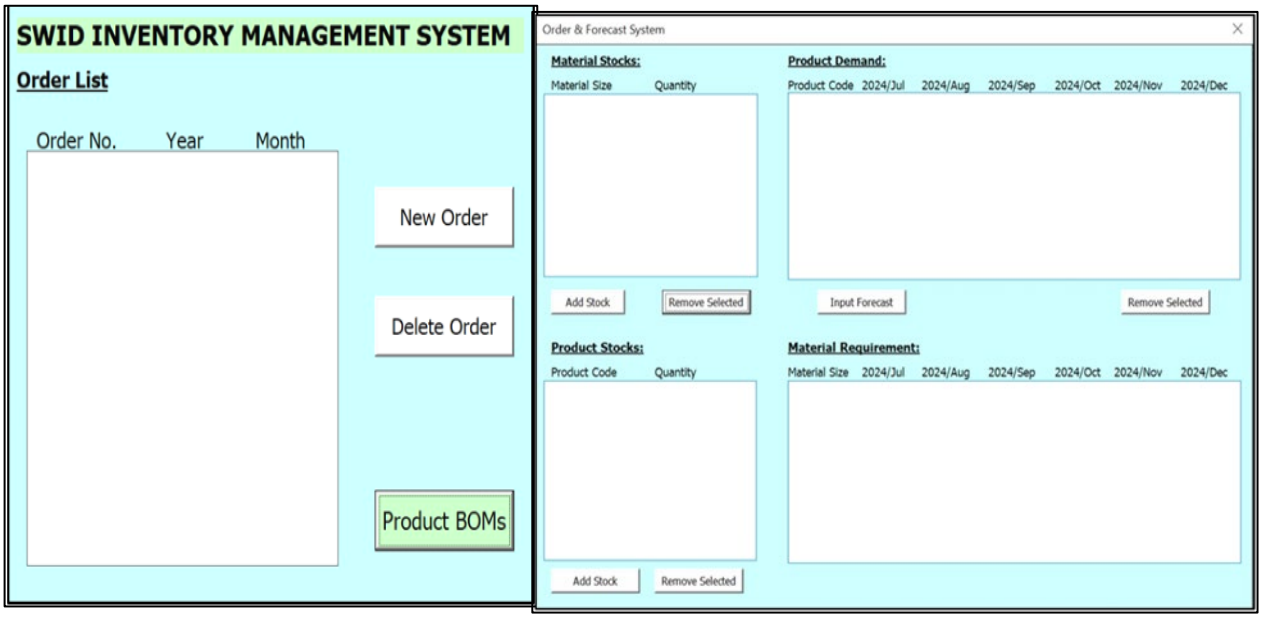


Figure 1. Inventory Management System Design

The BOM functionality makes it simple for users to add new items or remove non-moving products from the system if management needs to. Additionally, the system eliminates the need for manual computation of the material required by calculating and converting the material into products. The user will only enter the number of materials without multiplying manually, since one raw material is equivalent to 20 products, it also facilitates the user's input procedure. This function helps to avoid raw material miscalculations, which have occasionally occurred in the past. Lastly, a report in the form of a printable Excel sheet will be created for every order placed in the system. Because it is simpler and most businesses and organizations are more accustomed to it, Microsoft Excel is used. According to Safitri et al. (2020), Microsoft Excel is one of the computer programs that can be used in learning media. Excel can obtain data, analyze it using Visual Basic for Applications (VBA), and then run it as a controller (Figure 2).

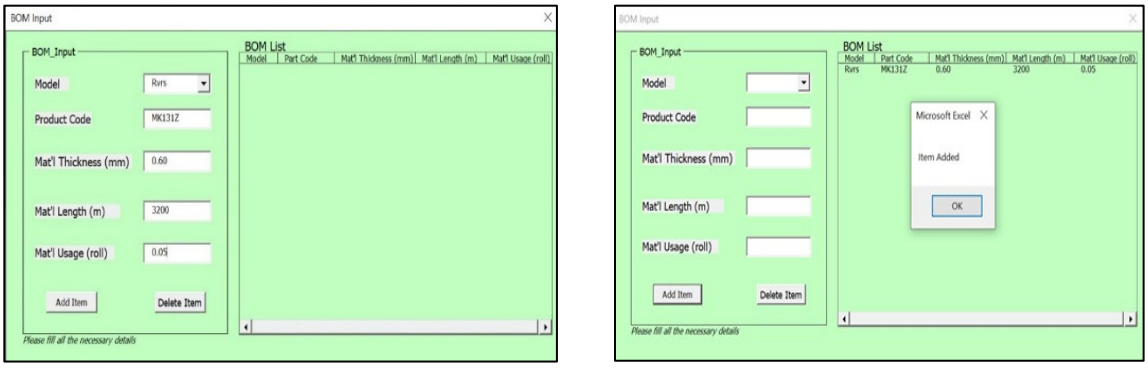


Figure 2. Interface for Bill of Material Input

Table 4. Master Data Input for Bill of Materials

| Model | Product Code | Material Specification | | Material Usage (roll) |
|---|---|---|---|---|
| | | Length (m) | Thickness (mm) | |
| Rvrs | MK131Z | 3200 | 0.60 | 0.05 |
| Rvrs | MK131U | 3200 | 0.60 | 0.05 |
| Trvrs | MJ159A | 3200 | 0.60 | 0.05 |
| Rvrs | MK133C | 3200 | 0.75 | 0.05 |
| Rvrs | MK133Q | 3200 | 0.75 | 0.05 |
| Rvrs | MK131W | 3200 | 0.75 | 0.05 |
| Rvrs | MK131V | 3200 | 0.75 | 0.05 |
| Trvrs | MJ263L | 3200 | 0.75 | 0.05 |
| Trvrs | MJ264A | 2100 | 0.95 | 0.05 |
| Trvrs | MJ271C | 2100 | 0.95 | 0.05 |

Table 4 shows the list of products and material details. According to Jacobs and Chase (2020), the BOM is the complete product description, including all of the parts, components, sub-assemblies, and materials used in a product or manufacturing design.

Table 5. Current Inventory Status

| Product Code | Inventory Status | | | | |
|---|---|---|---|---|---|
| | Finished Goods | Work In Progress | Total | Material Thickness (mm) | Raw Materials |
| | Slitted | | | Big Rolls | |
| MK131Z | 114 | 22 | 136 | 0.60 | 154 |
| MK131U | 40 | 10 | 50 | | |
| MJ159A | 125 | 25 | 150 | | |
| MK133C | 95 | 20 | 115 | 0.75 | 222 |
| MK133Q | 64 | 15 | 79 | | |
| MK131W | 28 | 6 | 34 | | |
| MK131V | 82 | 17 | 99 | | |
| MJ263L | 198 | 40 | 238 | | |
| MJ264A | 622 | 125 | 747 | 0.95 | 652 |
| MJ271C | 730 | 146 | 876 | | |
| Total | 2,098 | 426 | 2,525 | Total | 1,028 |

Table 6. Adjusted Customer Forecast using Holt-Winters Method

| Product Code | Forecast 2024 | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|
| | Jul | Aug | Sep | Oct | Nov | Dec | |
| | Ordering Quantity (Rolls) | | | | | | |
| MK131Z | 425 | 449 | 395 | 274 | 240 | 212 | 1,995 |
| MK131U | 145 | 138 | 139 | 111 | 105 | 120 | 758 |
| MJ159A | 458 | 481 | 434 | 257 | 240 | 232 | 2,101 |
| MK133C | 337 | 329 | 272 | 195 | 166 | 187 | 1,485 |
| MK133Q | 233 | 271 | 214 | 173 | 149 | 172 | 1,212 |
| MK131W | 106 | 105 | 95 | 60 | 57 | 64 | 487 |
| MK131V | 306 | 316 | 265 | 208 | 196 | 238 | 1,529 |
| MJ263L | 747 | 737 | 667 | 356 | 380 | 403 | 3,291 |
| MJ264A | 2284 | 2283 | 2020 | 794 | 700 | 403 | 8,484 |
| MJ271C | 2688 | 2786 | 2099 | 1039 | 910 | 745 | 10,268 |
| Total | 7,728 | 7,895 | 6,600 | 3,468 | 3,144 | 2,776 | 31,610 |

Table 5 shows the company's current inventory stocks, while Table 6 illustrates the adjusted forecasted quantity of each product using the Holt-Winters forecasting method.

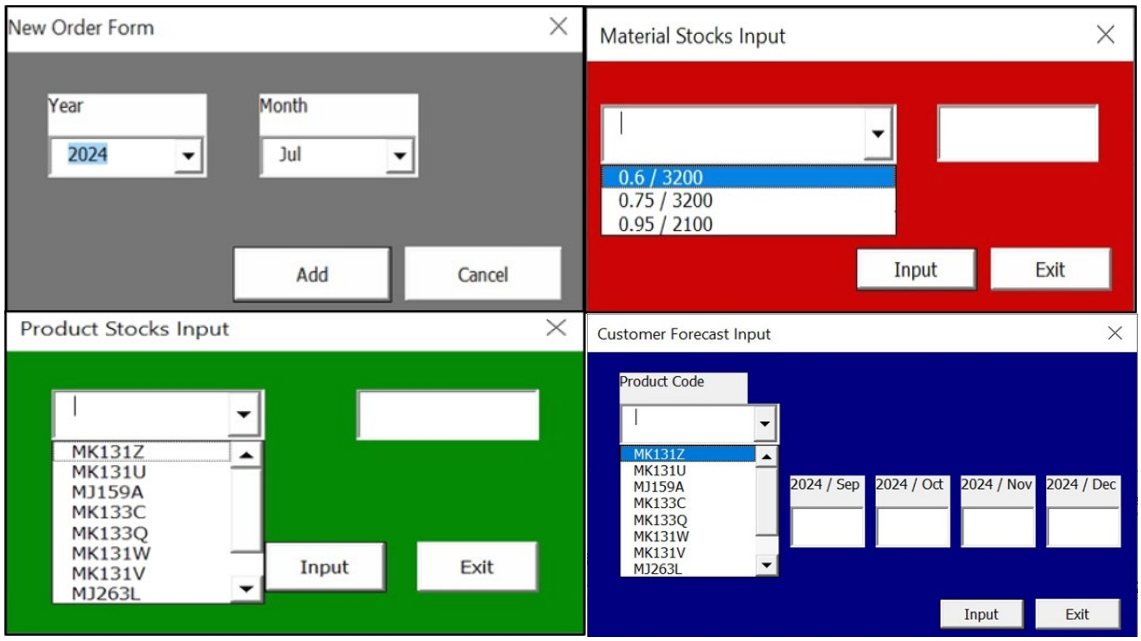


Figure 3. Interface for New Order, Material, and Product Stocks, and Customer Forecast Input

After completing the Bill of Materials, the user can begin calculating the material requirements by entering the initial raw material and product inventories (Figure 3), as well as the customer forecast using the updated projection from the Holt-Winters calculation result. The system will automatically produce the required number of raw materials for the following six months once input is completed.

## 5.3 Proposed Improvements

In this phase, all of the relevant information, such as material and product inventory, as well as product demand, is completely recorded into each user form. Once all the data is entered, the system will calculate the expected remaining material stocks at the end of each month (Figure 4). The calculation converts material stocks to product with the use of material usage per piece from the BOM, then adds the product stocks, and finally deducts the product demand every month. The user can then determine which month and how many materials need to be ordered. The negative numbers are an indicator that the material needs to be purchased, and it accumulates as the month goes by. It can be seen in Figure 4, shown.

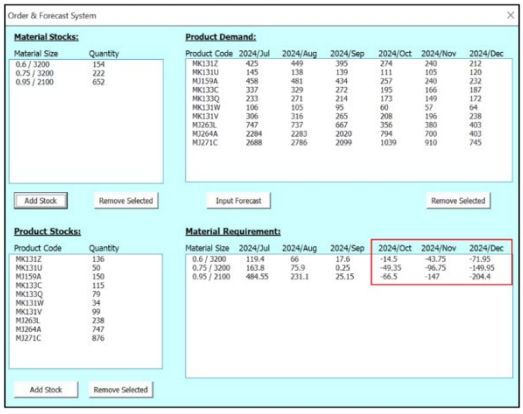


Figure 4. Interface for the Material Requirement

### 5.4 Validation

The researcher explains the system to the general manager and understands the flow easily. The general manager appreciates the simplicity of the system and believes it will enhance the company's inventory management. The material calculation is one of the features that he likes the most because there are several instances in the past when the person in charge forgot to convert the raw material to product and caused miscalculation of the raw material requirements. The usual process is to calculate the raw material stocks manually in an Excel sheet. Using the system, the user only needs to input the number of raw materials, and it will be automatically computed. The estimated remaining stocks at the end of every month are also shown in the system.

## 6. Conclusion

The level of inventory, ordering frequency, and status of customers' forecasts were used to assess the company's present inventory management position. It is strongly recommended that the system be used regularly to assess its performance and impact on the company's expenses and profits. Although the number of shipments per quarter remains constant at one, the number of containers varies. It is decreased from seven 40-foot containers to five 40-foot containers and one 20-foot container, for a total of six containers, resulting in a 14% reduction in container units. While the logistics cost savings are 18%, equivalent to Php 175,000. In terms of raw material purchases, comparing the original customer's projection to the modified forecast quantity using the Holt-Winters method yields a difference of 124 big rolls, or USD 56,252.70, or 23% of the savings for the quarter.

This study aims to strengthen the company's inventory management system, evaluate the inaccuracy of customer forecasts, and offer a system that will assist management in determining how to order materials through Material Requirement Planning and in utilizing the best forecasting technique to ascertain the ideal amount of material to be ordered. The system helped make the material computation easier. Raw material purchases and inventory levels are significantly impacted by the forecasting tool's use and the comparison report for the customer projection. The researcher also provided a Visual Basic system so that the user only needs to use a single application to record all pertinent data, including deliveries and production output.

For further research, the management is able to modify the framework anytime to include the daily output, delivery to customers, and defects for all manufacturing processes in the system to properly monitor the inventory movement of raw materials, semi-processed goods, and finished goods. This eliminates the need for a daily physical count and will assist the employee in generating an inventory report with ease. Although the commodity and raw material are very easy to count due to their physical size, it will still save time.

In the future, considering lean concepts and a Kanban system would enhance the current Material Requirements Planning (MRP) framework by transitioning from a push system based on forecasts to a pull system based on actual consumption. While the paper focuses on MRP for long-term planning and Holt-Winters forecasting to combat inaccuracies, the following lean concepts can aid with lead times and material flow. Currently, goods are ordered in bulk (3-month buffers) every other month based on quarterly projections, resulting in an average delivery fulfillment of only 83-88% and significant inventory accumulation. Utilize the existing MRP to create high-level procurement targets, but use Kanban indicators for real-time manufacturing. Rather than daily supply schedules given once a week, a Kanban system would activate production only when the customer's real stock levels dropped, preventing spoiling and accumulation as observed in the study. Lean Logistics can also assist reduce lead times by reassessing the 30-day buffer. Lean approaches aim to identify and eliminate non-value-added time (waste) in the logistics chain. While port congestion is external, improving the preparation and processing processes may shorten the cycle. The VBA-based technology already automates calculations to reduce errors. Complementing VBA with Lean Visuals by adding Lean and developing a Visual Management dashboard within the Excel tool that shows low stock as red and optimal stock as green levels based on real-time inventory rather than just the 6-month forecast.

## References

Adiele, K., and Ihunwo, E., "Requirements of Material Planning and Supply Chain Performance of Oil and Gas Firms in Port Harcourt, Nigeria," *Research Journal of Management Practice*, vol. 2, no. 2, 2022.

Aditya, S., and Dahda, S. S., "Storage Optimization at PT XY Using Class Based Storage and FSN Analysis Methods," *G-Tech: Jurnal Teknologi Terapan*, vol. 9, no. 1, pp. 157–168, 2025. https://doi.org/10.70609/gtech.v9i1.5845

Al-Hadi, A. K. A., and Ismail, S. Z., "Developing Palm Oil Inventory Control System Using MS Excel Macro," *Journal of Modern Manufacturing Systems and Technology*, vol. 5, no. 1, pp. 51–55, 2021. https://doi.org/10.15282/jmmst.v5i1.6102

Arasa, R., and Achuora, J., "Strategic Inventory Management Practices and the Performance of Supermarkets in Nairobi County, Kenya," *European Journal of Business and Management Research*, vol. 5, no. 2, 2020. http://dx.doi.org/10.24018/ejbmr.2020.5.2.108

Aurélio Paulo Leandro, A. P., da Silva, S., and Nascimento, M. H. R., "Methodology for Inventory Risk Analysis and Management Using Excel and Visual Basic Modeling," *International Journal of Advanced Engineering Research and Science*, vol. 8, no. 10, 2021. https://dx.doi.org/10.22161/ijaers.810.39

Barkah, N., Farida, I., and Yasmin, A., "The Design of an Accounting Information System Based on VBA Macros in Microsoft Excel," *International Journal of Innovative Research in Multidisciplinary Education*, vol. 3, no. 3, pp. 415–429, 2024. https://doi.org/10.58806/ijirme.2024.v3i3n22

Brito, G. R. A., Villaverde, A. R., Quan, A. L., and Perez, M. E. R., "Comparison Between SARIMA and Holt–Winters Models for Forecasting Monthly Streamflow in the Western Region of Cuba," *SN Applied Sciences*, 2021. https://doi.org/10.1007/s42452-021-04667-5

Cerna, F., Gómez, C., Sánchez, N., Luna, A., and Chong, M., "Model Design of Material Requirement Planning (MRP) Applied to a Surgical Sutures Company," 2021. https://doi.org/10.1007/978-3-030-69314-5_12

Christian, Gozali, L., and Widodo, L., "Planning for Procurement of Raw Materials and Supplies for Small and Medium Enterprise," *Proceedings of the 6th Industrial Engineering and Operations Management Bangladesh Conference*, Dhaka, Bangladesh, pp. –, 2023. https://doi.org/10.46254/BA06.20230120

Christifan, A. J., and Gozali, L., "Application of MRP System for Control of Raw Material Inventory with EOQ Lot Sizing," *IOP Conference Series: Materials Science and Engineering*, vol. 1007, 2020. https://doi.org/10.1088/1757-899X/1007/1/012029

Cinelli, M., Ferraro, G., Iovanella, A., Lucci, G., and Schiraldi, M., "A Net Perspective for the Analysis of Bill of Material," *Procedia CIRP*, vol. 88, pp. 19–24, 2020. https://doi.org/10.1016/j.procir.2020.05.004

Cipta, H., Rima Aprilia, R., and Kurniawan, H., "Material Requirements Planning Method for Controlling Inventory of Raw Materials," *Jurnal Teknik Informatika C.I.T Medicom*, vol. 15, no. 1, pp. 1–8, 2023.

Franceschetto, S., Amico, C., Brambilla, M., and Cigolini, R., "Improving Supply Chain in the Automotive Industry with the Right Bill of Material Configuration," 2023. https://doi.org/10.1109/EMR.2023.324176

Gołaś, Z., "Effect of Inventory Management on Profitability: Evidence from the Polish Food Industry," *Agricultural Economics*, vol. 66, pp. 234–242, 2020. https://doi.org/10.17221/370/2019

Goltsos, T., Syntetos, A., Glock, C., and Ioannou, G., "Inventory Forecasting: Mind the Gap," *European Journal of Operational Research*, vol. 299, pp. 397–419, 2021. https://doi.org/10.1016/j.ejor.2021.07.040

Grenci, R., "Introducing Business Analytics in Context: An Excel Project to Analyze Product and Sales Data for Inventory Purchase Decisions," *Journal of Innovative Education*, pp. 190–200, 2021. https://doi.org/10.1111/dsji.12277

Jenkins, A., "What is Inventory Management? Benefits, Types, & Techniques," Oracle NetSuite, 2023.

Kaewchura, P., Sritongb, C., Sriardc, B., and Nimad, T., "Role of Inventory Management on Competitive Advantage of Small and Medium Companies in Thailand," *Turkish Journal of Computer and Mathematics Education*, vol. 12, no. 8, pp. 2753–2759, 2021.

Kalwar, M. A., "Optimization of Procurement & Purchase Order Process in Footwear Industry by Using VBA in MS Excel," *International Journal of Business Education and Management Studies*, vol. 5, no. 2, 2020.

Kalwar, M. A., Khan, M. A., Wassan, A. N., Phul, Z., Shaikh, S. A., and Marri, H. B., "Automation of Post-Order Costing Analysis Using VBA in Microsoft Excel: A Case Study," *Working Papers on Operations Management*, vol. 14, no. 2, pp. 101–137, 2023. https://doi.org/10.4995/wpom.18697

Kalwar, M. A., Shahzad, M. F., Wadho, M. H., Khan, M. A., and Shaikh, S. A., "Automation of Order Costing Analysis Using VBA in Microsoft Excel," *Journal of Applied Research in Technology & Engineering*, vol. 3, no. 1, pp. 29–59, 2022. https://doi.org/10.4995/jarte.2022.16390

Kalwar, M. A., Wassan, A. N., Khan, M. A., Wadho, M. H., Shaikh, S. A., and Marri, H. B., "Automation of Production Plan Generating Workbook Using VBA in Microsoft Excel," *Journal of Applied Research in Technology & Engineering*, vol. 4, no. 2, pp. 111–129, 2023. https://doi.org/10.4995/jarte.2023.18941

## Biography

**Evelyn Valdez** is a Master of Science in Industrial Engineering student at the Lyceum of the Philippines University, Batangas. She earned a bachelor's degree in Industrial Engineering from the University of Batangas, Batangas City,

Philippines. Former Production Manager at SWID Mfg. Inc, in Calamba, Laguna Philippines. She recently moved to Germany and is currently working as a Logistics Associate at Amazon Erfurt GmbH, Erfurt, Thuringen, Germany.