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INVENTORY SYSTEM DESIGN FOR PT MECHANICAL ELECTRICAL PROVIDER

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Abstract: PT Mechanical Electrical Provider (an alias name, henceforth MEP) is a company that focuses on the telecommunications sector as a mechanical & electrical supplier. It was found that the company was still experiencing inventory problems, such as needing more goods and excess goods from its inventory system. Therefore, this study aims to analyze the inventory problems and provides recommendations for the inventory system design. This study uses a qualitative approach by interviewing five officers and staffs in the Procurement Division. Next, this study uses fishbone analysis to find the causes of the problems faced by PT MEP. The Fishbone diagram shows several causes of the inventory problems: people, equipment, method, and material causes. This study uses the quantitative approach by applying the ABC Classification to determine the classification of each item and the best way to control it. There are 6 A-class items, 14 B-class items, and 21 C-class items pada PT MEP. From the ABC classification, A-class products use the Continuous Review Model (Q-system) calculation for an optimal amount and the right time of replenishing inventory. For class B and C classification, the design suggests a Periodic Review Model (P-system) to find the optimal amount for refilling using the difference between the target inventory and the amount of inventory at the time of checking. Through the new system, this research expects a more optimal inventory so that the company can reduce the cost losses incurred so far.

Keywords: ABC classification, Continuous Review Model (Q-system), Fishbone Diagram, Periodic Review Model (P-system), Telecommunication

Abstrak: *PT Mechanical Electrical Provider (MEP) merupakan perusahaan yang berfokus pada bidang telekomunikasi sebagai pemasok mekanikal & elektrikal. Hasil studi menemukan bahwa perusahaan masih mengalami masalah persediaan, seperti kekurangan barang dan kelebihan barang dari sistem persediaannya. Oleh karena itu, penelitian ini bertujuan untuk menganalisis permasalahan persediaan dan memberikan rekomendasi untuk perancangan sistem persediaan. Penelitian ini menggundakan pendekatan kualitatif melalui wawancara dengan lima pejabat dan staf di Divisi Procurement. Selanjutnya, penelitian ini menggunakan analisis tulang ikan untuk menemukan penyebab permasalahan yang dihadapi oleh PT MEP. Diagram Fishbone menghasilkan beberapa kemungkinan sebab permasalahan sediaan: orang/karyawan, peralatan, metode, dan material. Penelitian ini juga menggunakan pendekatan kuantitaif melalui penerapan Klasifikasi ABC untuk menentukan klasifikasi setiap item dan cara terbaik untuk mengontrolnya. Terdapat 6 jenis barang kelas A, 14 barang kelas B, dan 21 barang kelas C pada PT MEP. Dari klasifikasi ABC, produk kelas A menggunakan perhitungan Continuous Review Model (Q-system) untuk mendapatkan jumlah optimal dan waktu pengisian ulang persediaan yang tepat. Untuk klasifikasi kelas B dan C, desain sediaan menyarankan Periodic Review Model (Sistem-P) untuk menemukan jumlah pengisian ulang yang optimal dengan menghitung selisih antara target persediaan dan jumlah persediaan pada saat pengecekan. Melalui sistem yang baru, penelitian ini mengharapkan persediaan yang lebih optimal sehingga perusahaan dapat mengurangi kerugian biaya yang selama ini ditimbulkan.*

Kata kunci: *Klasifikasi ABC, Continous Review Model (Q-system), Diagram Fishbone, Periodic Review Model (P-system), Telekomunikasi*

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INTRODUCTION

Competition in the business world is increasing, especially with the ongoing Covid-19 pandemic. A survey by the Central Statistics Agency noted that in 2020, 82.85% of companies experienced decreased income (Subdirektorat Indikator Statistik, 2021). Most of these companies are in the food and beverage sector, services, transportation and warehousing, construction, processing industry, and trade. However, apart from the business sector that has been negatively affected, business sectors have the opportunity to develop during this pandemic, including the telecommunications sector. The results of a survey conducted by the Central Statistics Agency noted that the most rapid development of Information and Communication Technology (ICT) from 2016 can be seen in household internet use which has increased by 78.18% in 2020 (Direktorat Statistik Keuangan, 2021). This growth is also predicted to continue to increase, considering the digital trends in people's lives today.

PT Mechanical Electrical Provider (an alias name, hereafter MEP) is a company that focuses on General Contractor and Supplier Mechanical Electrical in the telecommunication sector. As a supplier, PT MEP provides electrical supplies such as bolts, lugs, and various cables, with around 45-50 items available. The company's customers are companies engaged in the general contractor sector or telecommunications panel installation services. These supplies have different demands, so the company needs to consider the suitability of each item's availability with the requests that enter the company. Martono (2018) stated that good inventory management could provide added value through service levels, good quality goods, reduced processing costs, guaranteed availability, and guaranteed delivery times. The company needs to avoid inappropriate quantities, such as a shortage or excess of goods which indicates the company's inventory management could be more optimal. When this situation occurs, it will undoubtedly disrupt other processes of the company's business activities, such as goods piling up and shortage of goods.

An early observation found that the company was still experiencing several problems stemming from its inventory management, such as excess supplies. For example, the company made purchases that exceeded the orders for supplies that only one customer used. The following orders were anticipated; however, the company needed a place to store these abundant supplies. These excess supplies are a problem for the company since the storage space is getting less to store other items. In addition to excess goods, the company also experienced a shortage of inventory, which caused problems. For example, bolt and nut items require a 1-day lead time. If they are unavailable, the delivery to customers will be delayed to the next day, and customers are dissatisfied with the company's service.
The inventory system is essential because inventory management impacts the company's operations. In addition, inventory management also affects the company's ability to provide for consumer demand. If the company fails to ensure the availability of consumer demand, then the risk of transaction delays can occur, and customers might switch to competitors. Good inventory management can be seen starting from planning the inventory system. At this stage, the company needs to design a concept or system that they will use to control the inventory they have.

Based on these descriptions, research was conducted related to the design of the inventory system using the ABC Classification method, P-system, and Q-system at PT MEP. This research aims to improve the company's inventory management to be more efficient so that the company can handle the situation of excess and supply of supplies. This research also provides recommendations for a standard inventory system based on a solid theory.

METHODS

This research uses quantitative and qualitative methods to solve problems and provide recommendations for PT MEP. The research was conducted in 2022. The first stage is compiling data from interviews with employees from the Procurement Division. All employees in the Procurement Division was interviewed at least twice, that is, the Division Head, the Procurement Department Head, the Warehouse Department Head, and two staffs (one is the procurement staff and the other one is the warehouse staff). The results of the interviews will be analyzed using a Fishbone diagram to identify the causes of the constraints that occur on the research object, namely inventory management problems that are not yet optimal, such as excess and insufficient goods.

The data used in this study are primary data and secondary data; for primary data, we collected data through observation and interviews. Observations made are participant observations. Furthermore, the interviews were conducted in the form of semi-structured interviews, which were then developed into follow-up questions to explore the answers to the core questions. As stated previously, we interviewed all five employees in the Procurement Division (i.e., the Division Head, the Procurement Department Head, the Warehouse Department Head, and two staff). The interviews and observation lasted for approximately three months in 2022. Then, in collecting secondary data, we used historical data in the form of sales data and also documentation in the form of company profiles and organizational structures.

This study used data analysis methods for qualitative and quantitative techniques. The first stage is compiling data from interviews with employees from the Procurement division. The results of the interviews were analyzed using a Fishbone diagram to identify the causes of the problems that occur in inventory management. Furthermore, sales data was used to classify supplies based on the ABC Classification method. Based on this classification, we identified groups of supplies in class A, which were analyzed using the Q-system method, and those in classes B and C, which were analyzed using the P-system method.

The ABC Classification is a method that sorts inventories based on the value of the goods so that higher-valued inventories have more meticulous management (Swink et al. 2019). There are several steps in the application of this method (Krajewski et al. 2015, namely:

1. Collect all types of inventory by including the amount of usage each year and the price of each unit and add up the total value for each type of inventory.
2. Make an inventory sequence based on the total value from the largest to the smallest, then accumulate the value. This stage uses Pareto analysis.
3. Based on the calculations, the inventory is classified according to the following conditions: Class A has 80% inventory value. The number of inventories are roughly 20% of total; Class B has 15% inventory value. The number of inventories are roughly 30% of total; Class C has 5% inventory value. The number of inventories are roughly 50% of total.

Martono (2018) states that inventories in the group A classification are controlled in the following way: strict, monitored according to the circulation of goods, reviewed by management, and fast moving, located close to the entry and exit of goods. Inventories that fall into groups B and C generate less income than group A, but that does not mean that this group is not considered. Martono (2018) also states that goods in the B classification group are controlled in the following way: done weekly or monthly, for medium moving (B): located a bit far from access to goods in and out, and slow moving (C): located far from access to goods in and out.

The Continuous Review Model (Q-system) can determine the optimal amount and the right time to place an order (Swink et al. 2019). In addition, the Q-system can also be used to calculate overall inventory costs by taking into account order costs, supply costs, and backorder costs. Determination of the number of orders can be set through the Economic Order Quantity (EOQ). Then to determine the order time, the company can use the Reorder Point (ROP) calculation method, as follows (Schroeder et al. 2013):

$$EOQ = \sqrt{2SD/iC}$$

description: EOQ (Economic Order Quantity); D(Annual demand); S (Ordering cost); i (Inventory percentage); C (Price per unit)

$$ROP = (\bar{d})\bar{t}$$

description: ROP (Reorder point);d (Average daily demand); t (Average lead time)

$$\text{Safety Stock} = Z\sigma_{dlt}$$

description: Z (Service level); σ_{dlt}(standart deviation of demand during lead time

In applying the P-system method, the company must apply an inventory target for each period. There are several conditions for deciding on an inventory target, one of which is deciding on an inventory target when demand is variable and lead time is constant. Schroeder et al. (2013) state that the formula for finding the target inventory (T) is as follows:

$$T = \bar{d}\,(P + L) + \text{safety stock}$$

description: T (Inventory target); d (Average daily demand); P (Monitoring period); L (Lead time)

This study refers to inventory management theory (Schroeder et al. 2013) and its implementation in Indonesia (Octaviana et al. 2018; Ngadono et al. 2020; Rusman et al. 2019; Sandrawati, 2021 dan Tannady et al. 2021). Figure 1 depicts the flow of the study, which starts with an observation for approximately three months, collecting the data, and analyzing the data for design recommendation.

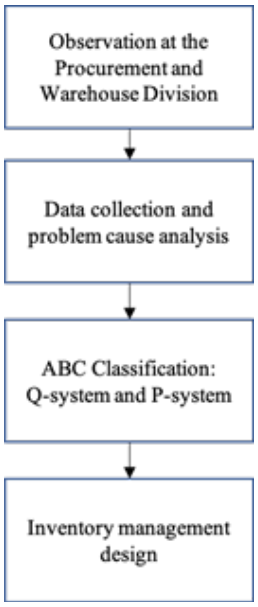

Figure 1. Flow of the Research

RESULTS

Inventory is the stock of goods used to facilitate production and meet customer demand (Swink et al. 2019). Based on this statement, inventory is an important asset. Inventory is an enormous asset, but it can also become a waste for the company, so it needs reasonable control to prevent this (Siregar et al. 2020). Limited space makes the company unable to prepare a buffer stock for long or oversized items. Aside from that, it was found that the company experienced a shortage of some supplies and an excess of other supplies.

Figure 2 shows four occurrences of out-of-stock and two times of excess supplies. These conditions certainly affect other company activities. To find the cause of this, an analysis is carried out using a method. The Fishbone diagram is a method that can be used to analyze the causes and effects of a situation by collecting all potential causes and then narrowing them down by eliminating those that are unrelated (Brenig-Jones and Dowdall, 2018).

Based on Figure 3, there are four categories causing inventory management problems in companies. In the first category (method), it was found that the procurement system at PT MEP was not based on inventory classification. The absence of classification causes the Company to fail to prioritize the availability of supplies. In addition, orders are also made not following the inventory fulfilment method, so there are often shortages and excesses of the goods that have been ordered.

Secondly is the problem with the existing equipment. The Company faces a situation where the available space in the warehouse is limited so that it cannot load large and long goods. The third category in this diagram is material. The problem encountered is that the products in the Company are very diverse. Each product has different handling needs and also different demands from each customer. Sometimes this makes the existing supply out of control.

Finally, the last category (people) refers to those involved in the inventory management system. Two problems were found in this category: warehouse workers and suppliers. Warehouse workers are often negligent in monitoring outgoing supplies so that sometimes items no longer available in the warehouse are still listed. In addition to outgoing goods, negligence also occurs with incoming goods. Warehouse workers sometimes do not record the goods received by the Company so that it can allow repeated orders for products already stored in the warehouse. Furthermore, the supplier sometimes fails to inform the lack of quantity. This cause hinders or delays the business process due to waiting for the availability of the ordered goods.

After compiling a Fishbone diagram to identify the problems faced by PT MEP, the next step is to classify inventory. One of the methods used to classify inventory is the ABC method (Martono, 2018). The classification was based on the Company's sales data for 2020. There were six items classified as class A, 14 items classified as class B, and 21 items classified as class C.

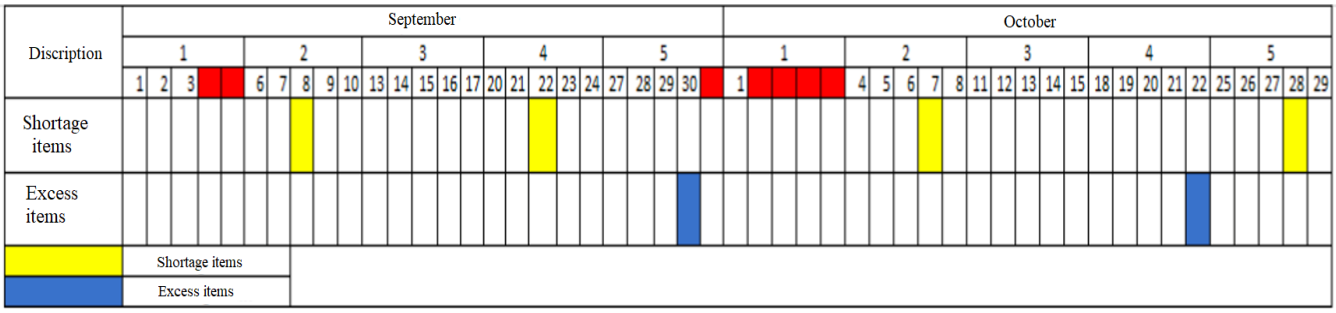

Figure 2. Observations of less and more goods events

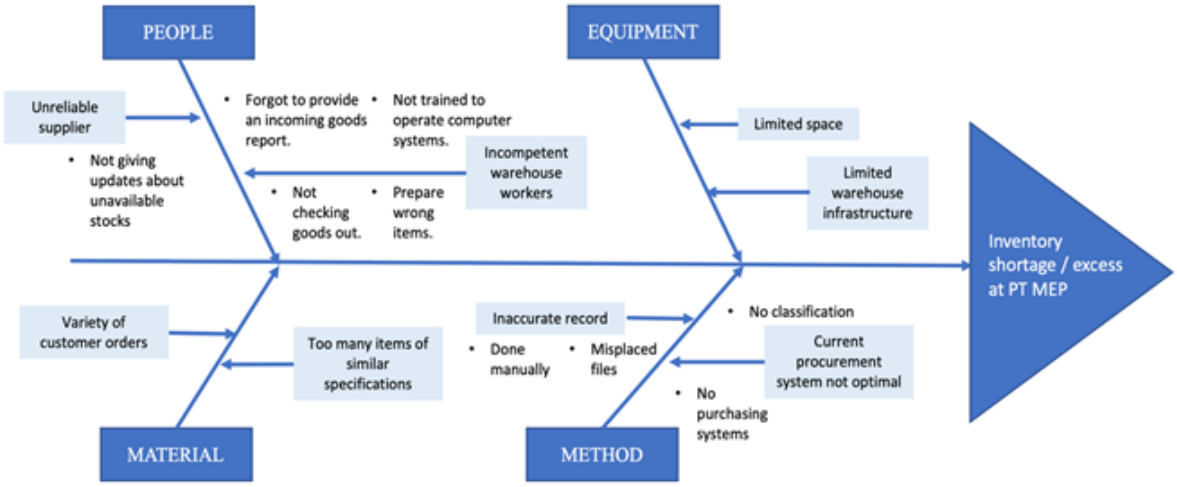

Figure 3. Fishbone analysis of inventory problems in the company

Class A classification (shown in Table 1) has a fast movement and needs to be managed strictly, accurately, and calculated using a continuous review model (Q-system). The primary purpose of its use is to find out the best time and amount for filling inventory because, based on the ABC Classification, goods classified as class A require continuous monitoring. This decision is because items with this classification have the most significant impact on the value of the Company's inventory. To find out the optimal amount for filling inventory, it is recommended to use the Economic Order Quantity (EOQ). This method can determine the optimal amount and the right time to place an order (Swink et al. 2019). Meanwhile, the Company can use the Reorder Point (ROP) calculation method to determine the ordering time.

PT MEP determines the ordering fee into two: a fee of Rp 100,000 is charged for goods taken directly from the supplier, and a fee of Rp 150,000 for goods delivered directly by the supplier to the warehouse. Storage for one year is subject to a fee of 15% of the price of each item. The holding cost is determined based on the storage space condition where no special handling is given to the existing inventory. The EOQ calculation used the company's sales in 2020. The following is an example of calculating the EOQ for Cable NYFGBY 4 x 16. Table 2 details the EOQ for all A-class items.

From the observations, the lead time for all goods is constant for one day, and the calculation of the reorder point (ROP) uses the company's sales in 2020. The following is an example of a calculation for Cable NYFGBY 4 x 16, which result in 30,02 or 30 items (rounded).

The next step after calculating the reorder point is to calculate safety stock. This calculation is additional anticipation to prevent the company from experiencing a stockout situation. This study uses a service level of 90% to avoid stockout situations during the replenishment period. In calculating the standard deviation of demand during lead time, some information is used, namely the standard deviation of demand (σ_d) and lead time

(L). The following is an example of calculating the standard deviation of demand during lead time for Cable NYFGBY 4 x 16.

$$\sigma_{dlt} = \sigma_d \sqrt{L}$$

$$\sigma_d = 17.98(1) = 17.98$$

It was found that the standard deviation of demand during the lead time of these goods was 18 (rounded). The following is a safety stock calculation for NYFGBY 4 x 16 cable items. For 90% service level, z = 1.28 (from Normal Distribution Curve table).

Safety stock = $z\sigma_d$
Safety stock = (1.28)(17.98) = 23.02 or 23 (rounded)

Furthermore, after knowing the safety stock value of the item, the next step is to recalculate the reorder point by adding the safety stock value. This is done because the condition of demand at the company is variable or not constant, therefore there is a possibility that demand will increase when the company's inventory state has entered the number of reorder points. The following is an example of calculating reorder points added to the value of safety stock. The same procedure was done for all A-class items. The results are shown in Table 2.

Table 3 lists goods classified as B and C. Class B and C goods have regular and slower movements and will be managed simply. They need good record-keeping to guarantee availability, which can be done weekly, monthly, and even every few months. Class B and C will be calculated using the Periodic Review Model (P-system).

In addition to providing an inventory management plan for the company, several suggestions might complement the inventory system design regarding the problems identified through fishbone analysis: (1) Establish a standard operational procedure (SOP) for employees so that the inventory control process can run according to the design. This recommendation will solve problems caused by warehouse employees where errors often occur during the procurement process, such as mistakes in preparing goods to be sent to customers and negligence in reporting incoming and outgoing goods; (2) Use digital-based records. Seeing the risk of losing documents that are vulnerable to occur, digital-based records such as using shared Microsoft Excel can assist companies in archiving documents with better security.

Table 1. List of A-Class Items

Description	Accumulated %	Classification
Cable16 NYFGBY 4 x	31%	A
Cable A3CS 70m	53%	A
Cable BC 50mm	63%	A
Stick Rod 5/8 (4mtr)	71%	A
G. Master 50mm (2950)	76%	A
Busbar Alumunium 300 x 100 x 0,8	79%	A

Table 2. Economic order quantity and reorder point for A-class items

Description	Economic Order Quantity (EOQ)	Reorder Point (ROP)	Safety Stock (SS)	ROP + SS
Cable16 NYFGBY 4 x	374	30	23	53
Cable A3CS 70m	1746	144	147	291
Cable BC 50mm	605	34	23	56
Stick Rod 5/8 (4mtr)	17	1	12	13
G. Master 50mm (2950)	78	3	18	21
Busbar Alumunium 300 x 100 x 0,8	228	7	1	8

Table 3. List of B-Class and C-Class Items

Description	Accumulated %	Classification
Cadweld Powder 90gr	81%	B
Steelwire	83%	B
Crocodile Clamps	85%	B
Skun 70 + Vinyl Green	86%	B
Cable NYY 3 x 2.5	88%	B
Nuts Bolts M10 x 20 Ss	89%	B
Skun 50 + Vinyl Green	90%	B
L Clamps + Rubber	91%	B
Anaconda Hose 1 ½"	92%	B
Cable NYY 2 x 2.5	92%	B
Copper Bonded ¾ (3mtr)	93%	B
Bimetal	94%	B
Ceramic Insulator 40 x 50	95%	B
Abbus Padlock 50	95%	B
Lumina Photocells	96%	C
Ceramic Insulator 40 x 40	96%	C
Anaconda Hose 1 ¼"	96%	C
Sealant Black	97%	C
Kend Padlock 50mm	97%	C
Anaconda Hose ¾"	98%	C
Pipe Clamps 1 ¼" – 3" HDG	98%	C
Skun 16 + Vinyl (Red, Blue, Black, Yellow)	98%	C
Nuts Bolts M8 x 30 Ss	98%	C
C Clamps + Ss Bolts	99%	C
Copper Bonded 5/8 (3mtr)	99%	C
Cable Ties 30cm	99%	C
Busbar Galvanized 200 x 100 x 0.8	99%	C
Splitzen	99%	C
Tiger's Nail	100%	C
Synabolt M12 x 60	100%	C
Anaconda Hose 1/2	100%	C
Isolation	100%	C
Dynabolt M12 x 130	100%	C
Big Cable Ties	100%	C
Duradus	100%	C

PT MEP could also implement lean management systems to increase efficiency and provide more value to its customers. Previous studies on lean system implementation in Indonesia have shown these benefits (Wirawan and Yunus, 2022). Furthermore, the company could periodically assess its procurement and warehousing performance and analyzes value-added and non-value-added business process (Rousul and Hidayati, 2022). That way, the company will stay ahead in its service to its customers.

Managerial Implications

Through good inventory management, the company can improve company efficiency and customer service levels. Managers need to review inventory management within the company. Managers can apply basic inventory management concepts such as ABC classification, as well as the Q-system and P-system. These concepts help managers focus on essential and valuable inventory and exercise appropriate controls.

In implementing a better inventory system, managers need to develop appropriate technology, such as using computers and the Internet. In today's digital era, managers also need to improve the capabilities of employees who are responsible for inventory and warehouses so that they can better use the technology developed by the company and achieve the expected benefits.

Theoretical Implications

Companies commonly encounter problems in inventory management. Logistics and warehouses are often considered trivial, so they do not get particular focus and attention. Logistical problems -in this case, inventory and warehouse- could increase company costs, reduce profits, and decrease the company's image. Inventory management can be a strategic aspect that impacts company performance (Chebet & Kitheka, 2019) and competitiveness in the industry (Atnafu & Balda, 2018).

This study analyzes the causes of inventory problems in the warehouse. Although the tool used is simple, namely the Fishbone diagram, its application for companies is essential. The company's understanding of the causes of inventory problems will help the company understand the actual conditions in the field. This study also provides recommendations for classifying inventories according to the value of the goods (in terms of price and frequency of use). Previous studies have demonstrated the benefits of a sound inventory management system (Koumanakos, 2008; Gołaś, 2020).

Furthermore, technological developments now allow companies to implement information technology or IT-based inventory and warehousing systems (Tejesh & Neeraja, 2018; Salih et al. 2023) and internet-based (Mashayekhy et al. 2022). The industry has also implemented intelligent inventory management, which can significantly increase company efficiency (Kobbacy & Liang, 1999). Inventory can also be managed through an automated warehouse management system to be more efficient and reliable (Atieh et al. 2016).

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

PT MEP experienced several inventory problems: shortages for some supply items and excess for others. Solving problems in the company's inventory system uses several theories. The fishbone diagram determines the causes of inventory management problems. ABC classification is used to identify inventory according to its class and find out the best way to control goods with that classification. Furthermore, using these two inventory system theories has been proven effective as a foundation for designing company inventory systems. Inventory with class A will use the Continuous Review Model (Q-system) theory, and this method will help companies find the optimal amount and the optimal time to replenish stock. Goods with class B and C classification will use the Periodic Review Model (P-system) theory. The use of this method will help companies to find out what is the optimal amount to replenish with inventory target calculations.

Recommendations

For further research, it is recommended to use sales data from different years that are not in a pandemic situation to make the calculations more accurate for normal conditions. Moreover, future research could integrate the findings with better warehousing management system and IT-based inventory management systems. Future studies could also examine the impact of these implementation on the company's performance, as well as its competitiveness in the market.

REFERENCES

Atnafu D, Balda A. 2018. The impact of inventory management practice on firms' competitiveness and organizational performance: Empirical evidence from micro and small enterprises in Ethiopia. *Cogent Business & Management* 5(1): 1–16. https://doi.org/10.1080/23311975.2018.1503219

Atieh AM et al. 2016. Performance improvement of inventory management system processes by an automated warehouse management system. *Procedia Cirp* 41: 568–572. https://doi.org/10.1016/j.aej.2018.02.003

Brenig-Jones M, Dowdall J. 2018. *Lean Six Sigma For Leaders A practical guide for leaders to transform the way they run their organization*. UK: John Wiley & Sons: Cornwall.

Chebet E, Kitheka S. 2019. Effects of inventory management system on firm performance– an empirical study. *International Journal of Innovative Science and Research Technology* 4(9): pp.34-242.

Direktorat Statistik Keuangan. 2021. *Statistik Telekomunikasi Indonesia 2020*. BPS–RI, Jakarta. https://www.bps.go.id/publication/2021/10/11/e03aca1e6ae93396ee660328/statistik-telekomunikasi-indonesia-2020.html

Gołaś Z. 2020. The effect of inventory management on profitability: Evidence from the Polish food industry: Case study. *Agricultural Economics* 66(5): 234–242.

Kobbacy KA, Liang Y. 1999. Towards the development of an intelligent inventory management system. *Integrated Manufacturing Systems* 10(6): 354–366. https://doi.org/10.1108/09576069910293022

Koumanakos DP. 2008. The effect of inventory management on firm performance. *International journal of productivity and performance management* 57(5): 355–369. https://doi.org/10.1108/17410400810881827

Martono R. 2018. *Manajemen Logistik* (2nd ed.). Jakarta: Gramedia Pustaka Utama.

Mashayekhy Y, Babaei A, Yuan XM, Xue A. 2022. Impact of Internet of Things (IoT) on inventory management: A literature survey. *Logistics* 6(2): 1–33. https://doi.org/10.3390/logistics6020033

Ngadono TS, Ikatrinasari ZF. 2020. April. Raw Materials Inventory Planning in Automotive Industries by EOQ Method Consider with the Contract Agreement. In *IOP Conference Series: Materials Science and Engineering* 847(1): 012049. DOI: 10.1088/1757-899X/847/1/012049.

Octaviana M, Baihaqi I, Bramanti GW. 2018. Penetapan Kebijakan Persediaan Spare Parts: Studi Kasus Pabrik Perakitan Sepeda Motor. *Jurnal Teknik ITS* 7(1): A45–A49. https://doi.org/10.12962/j23373539.v7i1.28685.

Rousul K, Hidayati A. 2022. Business Strategy Sixtrees 2022-2023. *Business Review and Case Studies* 3(3): 280–292. https://doi.org/10.17358/brcs.3.3.280.

Rusman M et al. 2019. Inventory planning analysis for vehicle spare parts by using Continuous Review method: A green engineering approach. *IOP Conference Series: Earth and Environmental Science* 343(1): 012006. https://doi.org/10.1088/1755- 1315/343/1/012006.

Salih HS, Ghazi M, Aljanabi M. 2023. Implementing an Automated Inventory Management System for Small and Medium-sized Enterprises. *Iraqi Journal for Computer Science and Mathematics* 4(2): 238–244. https://doi.org/10.52866/ijcsm.2023.02.02.021

Sandrawati L. 2021. *Analisis Metode Economic Order Quantity (EOQ) dalam Pengendalian Persediaan Bahan Baku pada CV Kampung Kaos Kidung di Desa Prajegan Kecamatan Sukorejo Kabupaten Ponorogo* (Undergraduate thesis, IAIN Ponorogo). http://etheses.iainponorogo.ac.id/id/eprint/13029.

Schroeder RG, Goldstein SM, Rungtusanatham MJ. 2013. *Operations management in the supply chain: Decisions and cases*. Windsor, NJ, USA: McGraw-Hill/Irwin.

Siregar I, Rizkya I, Sari RM, Syahputri K. 2020. Inventory Optimization in the Cigarette Industry. *IOP Conference Series: Materials Science and Engineering* 851(1): 012031. https://doi.org/10.1088/1757-899X/851/1/012031.

Subdirektorat Indikator Statistik. 2021. *Analisis Hasil Survey Dampak Covid-19 Terhadap Pelaku Usaha*. Jakarta: BPS RI.

Swink M, Melnyk SA, Hartley JL. 2019. *Managing Operations Across the Supply Chain* (4th ed.). UK: McGraw-Hill Higher Education.

Tannady H, Renwarin JMJ, Cora AND, Purwanto E. 2021. Production Planning and Inventory Control of Atonic Fertilizer Products Using Static Lot Sizing Method. *IOP Conference Series: Earth and Environmental Science* 819(1): 012087. https://doi.org/10.1088/1755-1315/819/1/012087

Tejesh BSS, Neeraja SJAEJ. 2018. Warehouse inventory management system using IoT and open source framework. *Alexandria engineering journal* 57(4): 3817–3823. https://doi.org/10.1016/j.aej.2018.02.003

Wirawan H, Yunus E. 2022. Pengaruh praktik lean manufacturing terhadap profitabilitas melalui minimisasi persediaan di industri elektronik dan Otomotif Indonesia. *Jurnal Aplikasi Bisnis dan Manajemen* 8(2): 524–524. https://doi.org/10.17358/jabm.8.2.524