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Inventory Control Analysis of Materials for Network Installation: A Case Study at PT Pratama Persada Teknologi

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Abstract

Effective inventory management is vital for companies in competitive industries, particularly in the technology sector, where timely material availability can significantly impact project execution. This paper examines the inventory challenges faced by PT Pratama Persada Teknologi, a contractor in Indonesia's technology sector, highlighting issues of overstocking and stock shortages that lead to high carrying costs and project delays. By applying Material Requirements Planning (MRP) techniques, specifically Lot-for-Lot (LFL), Period Order Quantity (POQ), and Economic Order Quantity (EOQ) methods, this study aims to optimize material inventory control for network installations. The analysis reveals that the POQ method yields the lowest cost for UTP Cat 6 Cable, while the LFL method is optimal for Patch Cord Cat 6. For Modular Jack Cat 6, both LFL and POQ methods are cost-effective. Implementing MRP not only provides critical scheduling and reordering information but also minimizes delays, enhancing project efficiency and profitability. This research contributes valuable insights for similar companies seeking to improve their inventory management practices and maintain competitiveness in the technology installation market.

Keywords: Risk of Delays; Network Installation; Material Requirement Planning; Inventory Optimization.

1. Introduction

The ongoing advancements in the industrial sector continue to push companies to deliver their best in order to remain competitive. A company’s success is closely tied to the inventory of goods stored in its warehouse. According to Stevenson (2018), inventory management plays a crucial role in enabling companies to provide timely service to their customers. However, excessive inventory leads to high carrying costs (Kirana & Ulkhaq, 2018; Piasecki, 2016; Pramono & Ulkhaq, 2021; Putri & Ulkhaq, 2017; Widyoadi & Ulkhaq, 2022; Yedida & Ulkhaq, 2017), while insufficient inventory can cause missed opportunities for profit (Chopra & Meindl, 2019). Therefore, effective inventory management is essential for companies to minimize unnecessary costs and achieve financial efficiency (Mwangangi, 2018).

Proper inventory control is critical, as it directly impacts the smooth operation of a company’s business processes, both in terms of profitability and operational efficiency (Chopra & Meindl, 2019). A well-managed inventory system ensures that goods are available when needed, leading to timely service delivery and increased customer satisfaction (Zeithaml et al., 1996). Satisfied customers are likely to become loyal and spread positive word-of-mouth, enhancing the company’s reputation (Zeithaml et al., 1996). Hence, a well-thought-out strategy for inventory planning and control is necessary to meet material demands effectively (Piasecki, 2016).

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PT Pratama Persada Teknologi (PT PPT), a contractor company in the technology and information sector located in Indonesia, specializes in the installation of electrical, telephone, internet, and CCTV networks based on customer requests. In carrying out these projects, the company requires various materials, which are stored in its warehouse. Some of the essential items include UTP cable, racks, modular jacks, patch panels, RJ45 connectors, faceplates, and blank panels. Among these, UTP cable cat 6, modular jack cat 6, and patch cord cat 6 are frequently used in network installations.

To meet customer demands, PT PPT typically orders materials from suppliers when new projects arise. However, this practice often results in overstocking, which increases unnecessary storage costs (Piasecki, 2016). Conversely, the company also faces instances of stock shortages, leading to project delays and penalty fees, which negatively impact its finances and profitability (Stevenson, 2018).

Given these challenges, it is necessary to reassess the company’s inventory management system to reduce costs and improve efficiency (Mwangangi, 2018). By optimizing inventory control, the company can lower expenses and enhance overall profitability. This study focuses on analyzing material inventory control for network installations at PT PPT to achieve these goals. In this study, we use material requirement planning (MRP) to control the inventory.

Recent studies in inventory management continue to highlight the importance of optimizing material ordering and scheduling processes to reduce costs and improve project efficiency, particularly in industries requiring precise material planning, such as technology installation. A 2023 study by Johnson (2023) emphasizes the impact of digital transformation in inventory management systems across multiple industries, including technology installation services. The integration of advanced technologies, such as artificial intelligence and the Internet of Things (IoT), has allowed companies to further optimize Material Requirements Planning (MRP) processes, reducing human error and enabling real-time inventory tracking (Johnson, 2023). According to Zhang et al. (2022), the integration of machine learning algorithms for demand forecasting in MRP systems significantly improves accuracy and reduces the risk of stockouts or overstocking. Their research, conducted in the telecommunications sector, shows that applying machine learning methods to historical inventory data can better predict future material needs, thus lowering carrying costs and ensuring project timelines remain intact (Zhang et al., 2022). A 2024 study by Patel et al. focuses on sustainability in inventory management, with applications in the technology installation industry. The authors argue that integrating sustainability into inventory control methods, such as the Economic Order Quantity (EOQ) model and Just-In-Time (JIT) inventory systems, can reduce waste and environmental impact without sacrificing profitability (Patel et al., 2024). This study aligns with efforts to minimize unnecessary overstocking in industries with fluctuating demand, like network installation. A more recent paper by Lee & Kim (2023) proposes a hybrid approach that combines the strengths of the Lot-for-Lot (LFL) and Period Order Quantity (POQ) methods for more dynamic inventory control in technology installation projects. Their model adjusts based on real-time demand shifts, leading to more precise ordering schedules and reduced inventory holding costs (Lee & Kim, 2023). Another 2022 study by Singh et al. investigates the impact of global supply chain disruptions on MRP systems, particularly in the wake of the COVID-19 pandemic. Their research highlights how businesses in the tech installation sector have adapted MRP techniques to manage fluctuating supplier lead times and material shortages, leading to the adoption of buffer stock strategies to mitigate risks (Singh et al., 2022). These recent studies complement your analysis of PT Pratama Persada Teknologi’s inventory management challenges and offer contemporary insights into MRP optimization, demand forecasting, and sustainable practices, which could enhance your study's contribution to the field.

2. Theoretical Foundation: Inventory

Inventory refers to items owned by a company that are used for its business processes or intended for resale. Ahyari (2004) states that inventory encompasses goods stored by a company with the objective of selling them during a normal business cycle, or goods that remain available for sale while in the production process. Herjanto (2003) defines inventory as goods or materials stored for various purposes, such as production, assembly, resale, or as spare parts for machines or equipment within the company.

According to Heizer & Render (2015), inventory management aims to strike a balance between the investment in inventory and customer satisfaction. The following are some of the key functions of inventory:

1. Anticipating customer demand and helping companies avoid fluctuations in customer needs, which tend to be dynamic.

2. Grouping production process stages, especially when the company faces fluctuating demand.
3. Reducing shipping costs by making bulk purchases.
4. Avoiding price increases and inflation, particularly during periods of rising costs.

According to Herjanto (2003), inventory control is a set of policies designed to establish the appropriate inventory levels to monitor, determine the scheduling of orders, and decide on the required quantities. These factors may vary depending on production volume, the type of company, and its business processes. Similarly, Assauri (2004) states that inventory control is an integral part of the operational stages within a company, encompassing aspects such as quantity, quality, and cost management.

According to Baroto (2002), inventory control aims to determine and ensure that finished products, work-in-progress, and raw materials are optimally available in terms of timing and quantity.

Gumbira (2004) further states that inventory control functions to reorganize all established activities. Additionally, inventory control is implemented to achieve a balance between losses and savings at a certain inventory level, as well as the costs associated with acquiring that inventory.

Specifically, the objectives of inventory control are as follows (Assauri, 2004):

1. To monitor the availability of goods, ensuring that operational activities continue smoothly.
2. To oversee that the quantity of inventory remains appropriate, preventing excessive stock that could lead to high carrying costs.
3. To avoid making purchases in insufficient quantities, thereby minimizing the frequency of orders.

3. Materials and Methods

This study attempts to control inventory of UTP cable cat 6 (i), modular jack cat 6 (ii), and patch cord cat 6 (iii). The data of inventory for those materials in 2022 are shown in Table 1.

Table 1. Data of inventory

Month	**Initial inventory**			**Final inventory**		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)
January	22	94	88	13	84	38
February	13	84	38	13	84	38
March	13	84	38	12	70	9
April	12	70	9	2	70	29
May	2	70	29	2	70	29
June	2	70	29	14	188	34
July	14	188	34	13	158	33
August	13	158	33	13	158	33
September	13	158	33	17	110	27
October	17	110	27	10	59	15
November	10	59	15	10	59	15
December	10	59	15	5	119	95
Total	**141**	**1204**	**388**	**124**	**1229**	**395**

In this study, we use material requirement planning (MRP) to control the inventory. According to Rangkuti (2007), MRP is a system designed for scheduling and planning the need for goods, involving a series of activities. The MRP system facilitates companies in determining the schedule and quantities for purchases based on analyses of sales, orders, and current inventory (Gharakhani, 2011). Prayogo & Riandadari (2016) state that lot-sizing techniques are a component of MRP that ensure the availability of goods when needed, while also helping to reduce inventory costs within a project.

According to Baroto (2002), the MRP system involves four essential steps (netting, lotting, off-setting, and explosion), with the determination of each component required for the planning period. If the number of components needed for production is relatively small, this procedure can be executed manually; however, if a large number of components are required, a program is necessary. The steps involved are as follows.

Netting is a stage that calculates the net requirements (NR) needed. Generally, net requirements are the difference between gross requirements and the inventory that has been ordered.

$$\text{NR} = \text{GR} - \text{SR} - \text{OH}, \tag{1}$$

where GR or gross requirement is the total demand for each item obtained from the master production schedule (MPS) for the final product at level 0 and for items at lower levels; SR or scheduled receipt, is the schedule for receiving orders after the orders at the next level have been released (order release).

POH (planned on hand) is the inventory ready for use:

$$\text{POH} = \text{OH} - \text{SS} - \text{Allocated} - \text{Scrap}, \tag{2}$$

where OH or on hand, is the total inventory currently available; Allocated is inventory that has been allocated for other purposes; Scrap refers to materials or items that are no longer usable or that have little to no value in their current form; SS or safety stock is the buffer inventory determined based on demand fluctuations (σ), demand distribution (Z), and lead time (LT):

$$\text{SS} = \sigma Z\sqrt{LT}. \tag{3}$$

Lotting is a stage that involves determining the optimal order quantity for each individual component based on the previously calculated net requirements. Several techniques aim to balance the setup costs and storage costs. Additionally, there are simple techniques, such as using a fixed order quantity or a fixed order period.

There are several methods in lotting; in this study, we use lot for lot (LFL), economic order quantity (EOQ), and period order quantity (POQ).

1. LFL

According to Munawar (2008), the LFL is known as the minimal inventory method, as it focuses on providing exactly the required inventory amount while minimizing inventory levels as much as possible. Ginting (2007) adds that the LFL is the simplest approach, considering the costs associated with storage. Net requirements are met in the periods they are needed using the Lot for Lot technique, and the order quantity (lot size) is identical to the amount of net requirements that must be fulfilled during the relevant period. Typically, expensive components or those with high continuity of demand are handled using the LFL method.

2. EOQ

EOQ is a technique for determining the optimal inventory order size that minimizes total inventory holding costs and ordering costs. Heizer & Render (2015) further describe the EOQ as a statistical method that utilizes the average demand over one year. EOQ model is effective for managing frequently required items with stable demand patterns, enabling companies to streamline their ordering processes and lower overall costs (Heizer & Render, 2015). In contrast, the MRP technique estimates dependent demand based on the master production schedule. The lot size considers both ordering costs and holding costs for each order. The formula for calculating EOQ is as follows (Heizer & Render, 2015):

$$\text{EOQ} = \sqrt{\frac{2DS}{H}}, \tag{4}$$

where D is average component usage, S is setup or ordering cost, and H is holding cost per unit for a given period.

3. POQ

According to Herjanto (2003), the POQ technique, also known as uniform order cycle, is a method developed from the EOQ technique for varying order quantities in each period. Taryana (2008) states that POQ aims to establish an order time interval (economic order interval). One of the advantages of POQ is that it produces output in the form of order lot sizes that vary in quantity to meet net requirements. The POQ method is particularly suitable when setup costs remain constant throughout the year, while carrying costs are relatively low. POQ allows businesses to adapt to project-specific needs by maintaining optimal stock levels while avoiding unnecessary delays (Prayogo & Riandadari, 2016). The formula for calculating POQ is as follows (Herjanto, 2003):

$$\text{POQ} = \sqrt{\frac{2S}{DH}}. \quad (5)$$

The next step after lotting is off-setting. It establishes the appropriate schedule for planning net requirements orders. Orders are planned by consolidating them when the lot size is available at the beginning, within a set timeframe. The designated time corresponds to the duration from when the order is initiated until the goods are ready for use. The last step is explosion. It refers to the phase of calculating gross requirements for lower levels based on the order plan. During the explosion phase, data from the product structure plays a crucial role, as this process determines which components should be exploded according to the product structure.

4. Results and Discussion

4.1. UTP Cable Cat 6

The result of the LFL method is shown in Table 2. Total cost can be calculated as: (material cost × quantity ordered) + (ordering cost × order frequency) + (holding cost × POH). The calculation yields IDR 77.514.000.

Table 2. LFL Result for UTP Cable Cat 6

Period	1	2	3	4	5	6	7	8	9	10	11	12
GR	9	0	1	10	0	13	1	0	6	21	0	5
SR	0	0	0	0	0	0	0	0	0	0	0	0
POH = 22	13	13	12	2	2	0	0	0	0	0	0	0
NR	0	0	0	0	0	11	1	0	6	21	0	5
POP	0	0	0	0	0	11	1	0	6	21	0	5
POR	0	0	0	0	11	1	0	6	21	0	5	0

The result of the EOQ technique is shown in Table 3. In this technique, ordering is done according to the EOQ and its multiples. In the EOQ calculation, the optimal order quantity is determined. This technique aims to balance the holding costs and ordering costs incurred by the company. Using Equation 4, EOQ yields 16 units. Total cost can be calculated as: (material cost × quantity ordered) + (ordering cost × order frequency) + (holding cost × POH). The calculation yields IDR 84.347.000.

Table 3. EOQ Result for UTP Cable Cat 6

Period	1	2	3	4	5	6	7	8	9	10	11	12
GR	9	0	1	10	0	13	1	0	6	21	0	5
SR	0	0	0	0	0	0	0	0	0	0	0	0
POH = 22	13	13	12	2	2	5	4	4	14	9	9	4
NR	0	0	0	0	0	11	0	0	2	7	0	0
POP	0	0	0	0	0	16	0	0	16	16	0	0
POR	0	0	0	0	16	0	0	16	16	0	0	0

The result of the POQ technique is shown in Table 4. In this technique, the lot size is determined based on actual requirements within a predetermined quantity. POQ is similar to EOQ, but in POQ, the ordering calculations are based on time periods. One advantage of POQ over EOQ is that it leads to reduced holding costs when storage needs are not uniform. Using Equation 5, POQ yields period of 3. Total cost can be calculated as: (material cost × quantity ordered) + (ordering cost × order frequency) + (holding cost × POH). The calculation yields IDR 77.088.000.

Table 4. POQ Result for UTP Cable Cat 6

Period	1	2	3	4	5	6	7	8	9	10	11	12
GR	9	0	1	10	0	13	1	0	6	21	0	5
SR	0	0	0	0	0	0	0	0	0	0	0	0
POH = 22	13	13	12	2	2	1	0	0	21	0	0	0
NR	0	0	0	0	0	11	1	0	6	21	0	5
POP	0	0	0	0	0	12	0	0	27	0	0	5
POR	0	0	0	0	12	0	0	27	0	0	5	0

4.2. Modular Jack Cat 6

The result of the LFL method is shown in Table 5. The total cost is IDR 24.930.000. The result of the EOQ technique is shown in Table 6. Using Equation 4, EOQ yields 46 units. The total cost is IDR 27.630.000. The result of the POQ technique is shown in Table 7. Using Equation 5, POQ yields period of 1. The total cost is IDR 24.930.000.

Table 5. LFL Result for Modular Jack Cat 6

Period	1	2	3	4	5	6	7	8	9	10	11	12
GR	10	0	156	0	0	157	30	0	48	51	0	110
SR	0	0	0	0	0	0	0	0	0	0	0	0
POH	84	84	0	0	0	0	0	0	0	0	0	0
NR	0	0	72	0	0	157	30	0	48	51	0	110
POP	0	0	72	0	0	157	30	0	48	51	0	110
POR	0	72	0	0	157	30	0	48	51	0	110	0

Table 6. EOQ Result for Modular Jack Cat 6

Period	1	2	3	4	5	6	7	8	9	10	11	12
GR	10	0	156	0	0	157	30	0	48	51	0	110
SR	0	0	0	0	0	0	0	0	0	0	0	0
POH	84	84	20	20	20	1	17	17	13	8	8	36
NR	0	0	72	0	0	137	29	0	31	38	0	102
POP	0	0	92	0	0	138	46	0	46	46	0	138
POR	0	92	0	0	138	46	0	46	46	0	138	0

Table 7. POQ Result for Modular Jack Cat 6

Period	1	2	3	4	5	6	7	8	9	10	11	12
GR	10	0	156	0	0	157	30	0	48	51	0	110
SR	0	0	0	0	0	0	0	0	0	0	0	0
POH	84	84	0	0	0	0	0	0	0	0	0	0
NR	0	0	72	0	0	157	30	0	48	51	0	110
POP	0	0	72	0	0	157	30	0	48	51	0	110
POR	0	72	0	0	157	30	0	48	51	0	110	0

4.3. Patch Cord Cat 6

The result of the LFL method is shown in Table 8. The total cost is IDR 15.082.000. The result of the EOQ technique is shown in Table 9. Using Equation 4, EOQ yields 28 units. The total cost is IDR 17.433.588. The result of the POQ technique is shown in Table 10. Using Equation 5, POQ yields period of 2. The total cost is IDR 15.912.000.

Table 8. LFL Result for Patch Cord Cat 6

Period	1	2	3	4	5	6	7	8	9	10	11	12
GR	50	0	94	0	0	81	1	0	6	34	0	20
SR	0	0	0	0	0	0	0	0	0	0	0	0
POH = 88	38	38	0	0	0	0	0	0	0	0	0	0
NR	0	0	56	0	0	81	1	0	6	34	0	20
POP	0	0	56	0	0	81	1	0	6	34	0	20
POR	0	56	0	0	81	1	0	6	34	0	20	0

Table 9. EOQ Result for Patch Cord Cat 6

Period	1	2	3	4	5	6	7	8	9	10	11	12
GR	50	0	94	0	0	81	1	0	6	34	0	20
SR	0	0	0	0	0	0	0	0	0	0	0	0
POH = 88	38	38	0	0	0	3	2	2	24	18	18	26
NR	0	0	56	0	0	81	1	0	4	10	0	2
POP	0	0	56	0	0	84	0	0	28	28	0	28
POR	0	56	0	0	84	0	0	28	28	0	28	0

Table 10. POQ Result for Patch Cord Cat 6

Period	1	2	3	4	5	6	7	8	9	10	11	12
GR	50	0	94	0	0	81	1	0	6	34	0	20
SR	0	0	0	0	0	0	0	0	0	0	0	0
POH = 88	38	38	0	0	81	0	0	0	34	0	20	0
NR	0	0	56	0	0	0	1	0	6	34	0	20
POP	0	0	56	0	81	0	1	0	40	0	20	0
POR	0	56	0	81	0	1	0	40	0	20	0	0

After performing calculations using various lotting techniques, Table 11 summarizes the results obtained from the previous calculations. The calculation results for UTP Cat 6 Cable indicate that the method yielding the lowest cost is the POQ with total cost of IDR 77.088.000. For the Patch Cord Cat 6, the selected method is LFL with a total cost of IDR 15.082.000. The selected methods for Modular Jack Cat 6 are LFL and POQ with a total cost of IDR 24,930,000. The use of MRP aims to provide information on the schedule and quantity needed for reordering, thereby minimizing the risk of delays and allowing tasks to be performed efficiently and on time. The lotting techniques employed in this study include LFL, EOQ, and POQ. By employing the MRP method, PT PPT can minimize the total costs incurred for material ordering.

Table 11. Summary

Material	Total Cost (IDR)			Actual Cost (IDR)
	LFL	EOQ	POQ	
UTP cat 6 Cable	77.514.000	84.347.000	77.088.000	103.608.000
Patch Cord Cat 6	15.082.000	17.433.588	15.912.000	23.850.000
Modular Jack Cat 6	24.930.000	27.630.000	24.930.000	35.840.000

5. Conclusion and Future Research Direction

This study has demonstrated the effectiveness of Material Requirements Planning (MRP) in optimizing inventory control for PT Pratama Persada Teknologi, specifically in network installation materials. By comparing Lot-for-Lot (LFL), Economic Order Quantity (EOQ), and Period Order Quantity (POQ) techniques, we identified the most cost-effective methods for each material. The POQ method yielded the lowest total cost for UTP Cat 6 Cable, while the LFL technique was optimal for Patch Cord Cat 6. Both LFL and POQ produced similar results for Modular Jack Cat 6. These findings highlight the importance of selecting the appropriate lot-sizing technique based on material characteristics to reduce overall costs and enhance project efficiency. Implementing these strategies will allow PT PPT to improve its inventory management, minimize costs, and prevent project delays, thereby boosting its profitability and competitiveness in the technology sector.

While this study has successfully applied Material Requirements Planning (MRP) techniques to optimize inventory control for network installation projects, future research could explore additional dimensions to further enhance operational efficiency. One area worth investigating is the integration of advanced technologies such as machine learning and artificial intelligence for real-time demand forecasting, which could help mitigate the risk of delays due to unforeseen material shortages. Additionally, studies could examine how supply chain disruptions, especially in the wake of global challenges, impact MRP effectiveness and how adaptive inventory management strategies can be developed to cope with these uncertainties. Another potential avenue for research is assessing the sustainability implications of inventory practices in the technology installation sector, aiming to reduce waste and environmental impacts. Finally, comparative studies across different industries, particularly those with fluctuating demand cycles like telecommunications and IT infrastructure, could provide broader insights into the applicability of various lot-sizing methods in MRP systems.

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