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Improving Inventory Management Efficiency With Material Requirements Planning (MRP) Method On Logistics Materials at PT Borneo Indobara

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Abstract:
The background of this research addresses the challenge of inventory management efficiency at PT Borneo Indobara (PT BIB), a coal mining company, due to a significant increase in inventory volume and the non-optimization of traditional inventory control systems. Issues such as overstock, deadstock, and stockouts have negatively impacted operational costs and production continuity. This study aims to analyze the current inventory management conditions, identify factors that inhibit efficiency, and evaluate the effectiveness of applying the Material Requirements Planning (MRP) system in improving supply chain and inventory performance. The research employs a descriptive case study approach, collecting quantitative data from the company's SAP system to compare inventory metrics before and after the implementation of MRP. The results indicate that MRP has successfully reduced storage costs by approximately Rp1.5 billion per year, increased stock availability from 80% to over 95%, and reduced order lead time from 97 days to 37 days. The implications of this study include practical recommendations for PT BIB to further optimize inventory management practices, as well as theoretical contributions to expanding the literature on the application of MRP in the mining logistics sector, a field where it has been less frequently applied compared to the manufacturing industry.
Keywords: Inventory Management, Material Requirements Planning (MRP), Operational Efficiency, PT Borneo Indobara, Coal Mining.

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INTRODUCTION

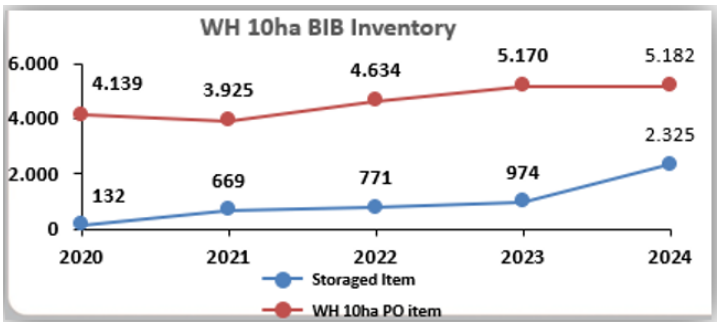
Inventory management is a crucial aspect of company operations, especially in industries that depend on the availability of equipment and spare parts. One category of inventory that directly impacts operational efficiency is spare parts inventory (Eloff & Carstens, 2013). Spare parts are stored in warehouses to support maintenance activities and act as a buffer against price and demand uncertainties. However, the erratic and irregular demand patterns for spare parts often complicate consumption planning and determination of optimal inventory levels. Additionally, many spare parts are specific to certain machinery or processes, resulting in limited supplier availability and extended lead times, sometimes exceeding one year (Soto, 2016).

PT Borneo Indobara (PT BIB) is a coal mining company operating in Tanah Bumbu Regency, South Kalimantan, Indonesia. Over the past decade, PT BIB has experienced a significant increase in annual coal production, from 6 million tons per annum (MTPA) in 2015

to 48 MTPA in 2024. This growth aligns with the company's expansionary and progressive strategy, which aims to reach 50 MTPA and continue scaling operations.

Figure 1. Map and condition of PT Borneo Indobara Logistics Warehouse Area

Along with the significant increase in coal production over the last four years (2020–2024), the volume of materials stored in PT BIB's 10-hectare warehouse has also increased drastically. The stored materials are categorized into several types, namely consumables, rotable parts, valued items (under *Material Requirements Planning*), and project residual materials. Based on internal data, the number of managed inventory items increased by 1,761.36%, rising from 132 items in 2020 to 2,325 items in 2024. Meanwhile, the total purchase orders (POs) issued increased from 4,193 in 2020 to 5,182 in 2024. The total value of stored inventory also surged from IDR 14 billion in 2020 to IDR 70 billion in 2024.



Gambar 2nd Graphic Inventory Warehouse Logistics

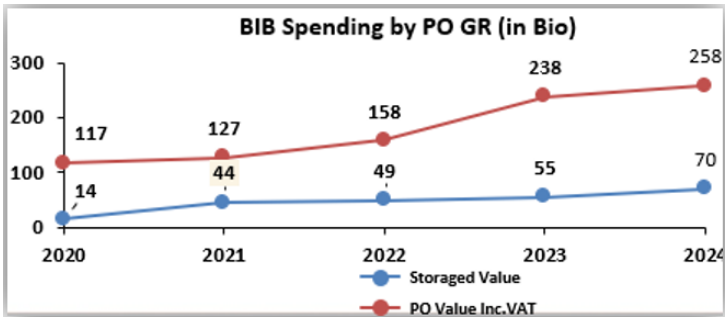


Figure 3. Logistics Warehouse Material Shopping Chart

With the significant increase in inventory volume, PT BIB faces challenges in efficient and systematic inventory management. Effective inventory management is indispensable for controlling materials in a timely and cost-effective manner. A robust inventory control process enables companies to order goods or raw materials optimally, minimize the risk of overstocking or stockouts, and optimize operational costs (Aisyah & Sumasto, 2020).

Currently, the inventory management system at PT BIB's warehouses has not optimally implemented the concept of safety stock. There are still gaps in stock availability during the reservation process, which ultimately disrupts the smooth operation of the company. Other problems arising from suboptimal inventory management include overstock, deadstock, and shortages, all of which directly impact operational efficiency and logistics costs. An effective inventory control process allows organizations to appropriately order goods or raw materials, minimize the risk of excess or insufficient stock, and optimize costs (Aisyah & Sumasto, 2020). Therefore, a more structured approach to inventory management is required to address these challenges. One method that can be applied is Material Requirements Planning (MRP).

Inventory in this category—valuated or *Material Requirements Planning* (MRP) inventory—generally consists of warehouse stock items whose purchase, receipt, storage, and usage values are all recorded in SAP and managed by the logistics team. The items stored in this warehouse typically include materials routinely used for the company's operations. The purpose of maintaining this warehouse stock is to avoid operational disruptions due to procurement lead times. MRP allows the company to plan material requirements more accurately based on production schedules and actual demand. By applying this method, organizations can reduce uncertainty in material procurement, optimize inventory levels, and improve cost efficiency and logistics performance.

This research aims to fill the gap in inventory management literature by focusing on the application of MRP in the logistics sector, which has predominantly been studied in manufacturing industries. One identified gap is the lack of research on MRP application within logistics operations, particularly in mining companies; thus, this study evaluates its implementation specifically in that context. In addition, the study explores the integration of real-time demand data to improve the accuracy of material planning, addressing the limitation of prior studies that primarily relied on historical data. The impact of MRP on operational efficiency is analyzed quantitatively using metrics such as storage costs and

stockout rates, contrasting with previous research that tended to be qualitative. Furthermore, this study confronts challenges related to optimizing MRP under conditions of unstable lead times and investigates its relationship with financial efficiency, including reductions in logistics costs and improvements in profitability.

Based on this background, the formulation of the research problem includes three main points: first, the current inventory management conditions at PT Borneo Indobara; second, the factors influencing the efficiency of inventory management within the company; and third, how the MRP method can be applied to enhance the efficiency of inventory management. By addressing these questions, this research is expected to provide concrete solutions for optimizing inventory systems within the logistics sector, especially in environments facing dynamic challenges such as lead time variability and the need for real-time data integration.

The main objectives of this study are to analyze the current inventory management conditions at PT Borneo Indobara; identify factors affecting inventory management efficiency; and evaluate the effectiveness of the MRP method in improving inventory management efficiency. This research will provide theoretical contributions by expanding the literature on inventory management, especially regarding the effective application of MRP in the logistics sector, thus serving as a reference for future studies. Moreover, the practical benefits include delivering actionable recommendations for PT Borneo Indobara to optimize MRP implementation, thereby increasing efficiency and reducing inventory management costs.

RESEARCH METHODS

This research is a case study with a descriptive approach aimed at analyzing the improvement of inventory management efficiency through the Material Requirements Planning (MRP) method on logistics materials at PT Borneo Indobara.

The data population includes all company logistics transaction records from 2020 to 2024, covering purchases, stock levels, lead times, and storage costs. The data sample was selected using purposive sampling based on materials categorized under Valuated/MRP, comprising 2,325 inventory items recorded in the SAP system. Stratified random sampling was applied to ensure representation across various material types, such as consumables, rotables, and project materials.

The primary research instrument consists of secondary data extracted from the company's SAP system, including stock reports, purchase orders, and material reservation records. To verify data accuracy, validity tests were conducted by cross-checking SAP data with physical documents such as Goods Issue (GI) and Purchase Requisition (PR) records. Reliability testing on key variables, such as stockout frequency and stock availability levels, was performed using the Cronbach’s Alpha method. Data collection techniques included document analysis, SAP system observation, and structured interviews with logistics and procurement personnel to validate findings. The research procedure involved problem

identification, historical data collection, MRP implementation, and evaluation of its impact on inventory efficiency.

RESULTS AND DISCUSSION

Evaluate the Inventory Management System Before MRP

Variables Based on internal data:

a. The number of items managed increased from 132 items in 2020 to 2,325 items in 2024.
b. Purchase orders (POs) increased from 4,193 to 5,182 POs.
c. The value of materials increased from IDR 14 billion to IDR 70 billion.

However, prior to the systematic implementation of MRP, the procurement process was reactive, relying on sudden demand from user units without proper demand planning. This leads to material fulfillment delays, high storage costs, and high stockout frequency.

Table 1. Inventory data before and after MRP

Material Number	Description	Category barang	ROP	Unit Price	Goods Receipt	Goods Issue	Before MRP					After MRP									
							Non MRP Value	Order Non MRP	Storage Cost/unit	Storage Fee	Lead Time	MRP Value	Order Cost/unit	Storage Fee	Lead Time	Fre Percentage MRP	Over	Stockout	(+)	(-)	Std Dev	Safety Stock
210000101070	PPE MTL 10CBM CM DNH THK RMU LG STL	Rotable	20	34.100.000	60	45	12.677.496.470	546	1.820.000	1.861.860.000	42	8.093.283.025	90	6.820.000	306.900.000	26	36%	6	15	20	21.21	3.3
210000161961	SWITCH NETWORK DNH DMA-DH PF210-42	Rotable	2	8.676.973	25	1	1.209.554.379	117	1.735.395	101.520.584	169	223.300.000	26	1.735.395	24.295.534	38	82%	11	2	3	15.81	1
210000174949	HARD DISK FOR D5-AL07 HIK210 AH 1TB	Consumable	4	15.115.309	10	6	967.379.776	64	3.023.062	96.737.978	157	103.322.000	10	3.023.062	15.115.309	53	89%	4	4	4	7.75	1
210000303131	MODULE SFP-KT-3PL 10EA HIK03 TELESIS	Consumable	4	2.140.300	4	1	156.247.740	73	428.076	15.624.774	280	10.554.000	4	428.076	856.152	69	93%	2	4	4	3.16	1
210000402020	NOZZLE FULL JET 3/4 HASS 2.5	Consumable	10	374.750	150	140	56.212.500	74	150.000	5.621.250	56	29.980.000	80	74.950	2.998.000	41	47%	0	10	10	37.42	1.7
210000833131	BOLT SS310 M30X125MM GDE K.FULL TH	Rotable	9	770.000	18	9	30.310.000	28	154.000	2.156.000	43	19.250.000	25	154.000	1.925.000	32	36%	1	9	9	9.49	1.5
210000901717	JOINT CLOSURE FO	Consumable	4	2.800.000	8	2	58.160.000	24	560.000	6.720.000	65	17.500.000	8	560.000	2.240.000	20	70%	1	6	4	4.47	1
210001014040	CAMERA HIKYTE DS-2CD33630P1-S/I4M	Rotable	1	8.100.000	1	1	20.750.000	3	1.620.000	2.430.000	45	6.300.000	3	1.620.000	2.430.000	30	71%	1	1	1	3.16	1
210001035555	LAMP FLUOR. E35647.1711.956K	Consumable	5	130.000	10	4	19.500.000	150	26.000	1.950.000	45	2.000.000	10	26.000	130.000	21	90%	0	5	5	6.32	1
210009009009	CLOTH GEOTEXTILE 250GR	Consumable	1	3.631.000	83	98	203.336.000	56	726.200	20.333.600	48	145.240.000	40	726.200	14.524.000	35	29%	7	1	15	31.30	2.5

	RO140 M2																				
				60			**SUM 15.401 .949.8 65**	**SUM 211.4 95.41 9**	**97**	**AVG 8.655. 329.7 03**	**A V G**	**SUM 37.141 .399**	**37**	**64 %**			**7 4**	**S U M**				
												AVG 14.536 .820.1 53	**Del ta**							**8 2 %**	**A V G**	

Based on table 1 above, before the implementation of the Material Requirements Planning (MRP) method, the inventory management system at PT Borneo Indobara showed a number of significant weaknesses. Poorly planned inventory values lead to overstock in various materials, which has an impact on inventory value swelling. For example, the inventory value for PIPE MTL 100CM DIA 12MM THK 6M LG STL material reaches more than IDR 12.6 billion, with an annual storage cost of IDR 1.88 billion. This shows that companies store large quantities of materials without paying attention to actual needs and working capital efficiency (Eroglu & Hofer, 2011).

In addition, the procurement system has not taken into account fluctuations in demand and uncertainty in delivery time Lead time tends to be as high as an average of 97 days. The absence of safety stock calculations or reorder points causes the risk of stockout and procurement delays to be high. Reliance on manual methods and lack of integration with production needs planning lead to inefficiencies that have a direct impact on operational performance (Silver, Pyke, & Peterson, 2016).

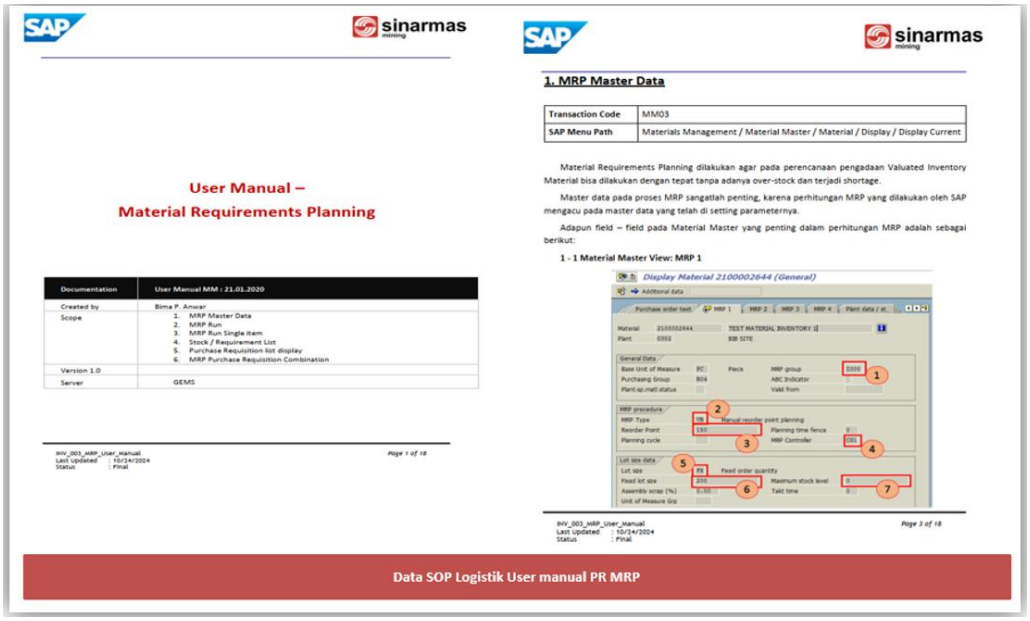
PT BIB's inventory management conditions prior to the implementation of MRP reflect the characteristics of traditional inventory systems that are reactive and less standardized. This is similar to the findings of Blanchard (2004) who stated that manual procurement systems tend to cause overstock and stockout problems due to the lack of integration between operational demand and material procurement. The disconnection of information between departments leads to procurement planning being speculative and often inefficient in the context of cost and time.

Application of the MRP Method

The implementation of MRP is carried out using an SAP module that integrates production schedules, historical demand data, and calculation of parameters such as EOQ, safety stock, and reorder points. MRP is used to plan routine goods needs based on actual demand.

Based on Table 1 above, after the implementation of the MRP system, there has been a significant increase in the efficiency of inventory management. The value of material inventory has decreased considerably, as in the same material, the value of inventory has decreased to an average of Rp 865 million or efficiency of ±64%. This decrease was also followed by reduced storage costs, which shows the success of MRP in adjusting the number of orders to real needs and actual procurement times. The MRP system also introduces the calculation of Economic Order Quantity (EOQ), Safety Stock, and Reorder Point which takes into account fluctuations in daily demand and standard deviation of material needs.

The implementation of MRP allows companies to rearrange order schedules and order quantities more precisely, so that the frequency of stockouts and overstocks can be reduced. This efficiency is in line with the research of Pacheco and Barba (2015), which states that the implementation of material needs planning can reduce the risk of procurement of spare parts with long lead times and limited suppliers.



Gambar 4. User Manual – Material Requirements Planning SAP

The implementation of the Material Requirements Planning (MRP) method at PT Borneo Indobara is supported by the SAP system with the main reference in the form of a User Manual – Material Requirements Planning which was officially issued by the GEMS team in 2020. This document serves as a technical reference in the input of the parameters needed to support the automatic calculation of MRP, especially for materials with valued classification.

One of the critical steps in the MRP process is the configuration of the Material Master View, which is accessed using the transaction code MM03. This view allows the planner to set various important parameters as shown in figure 4 This documentation not only helps the user in understanding the technical filling of fields, but also becomes a standard procedure that ensures consistency between work units. With this guide, the calculation of material requirements becomes more precise and systematically documented.

The existence of this user manual strengthens the internal control structure and proves that the MRP approach at PT BIB is not only system-based, but also supported by a valid written technical policy. This ensures that the MRP process being run has an auditable and replicable operational basis for continuous improvement.long time and limited suppliers.

As part of the implementation of the MRP method at PT Borneo Indobara, the SAP system provides real-time monitoring facilities for purchase requisitions (PR) through the Transaction Code ME5A in Figure 5.2.2. This feature allows users, especially materials

planners, to track all PRs generated automatically by the system based on predefined MRP parameters

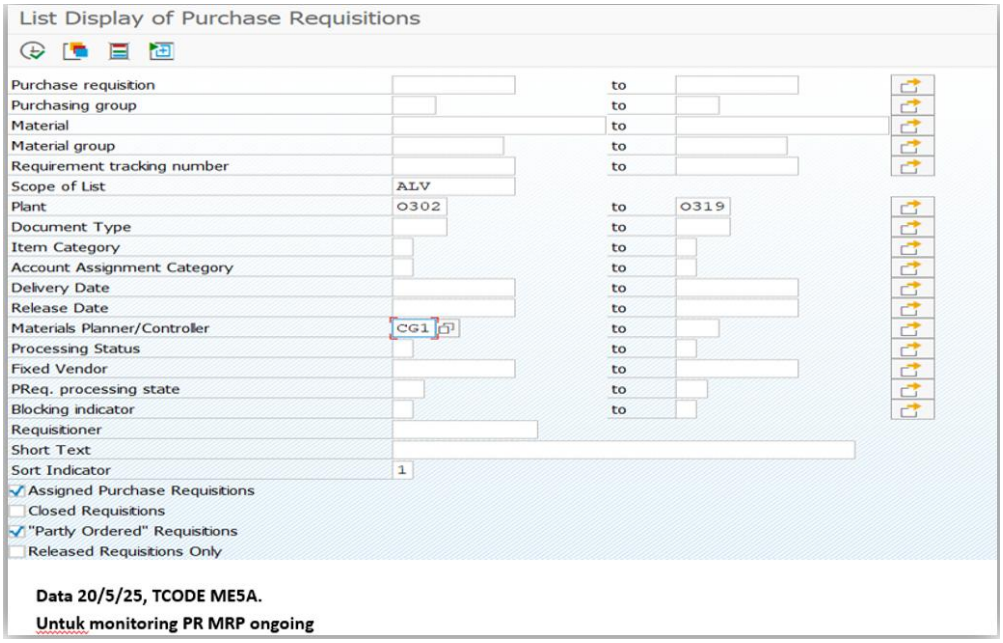


Figure 5. Monitoring PR MRP in SAP with TCODE ME5A

In Figure 5, you can see fields that can be customized to filter the PR list, such as the PR number, plant, material group, delivery date, and MRP controller. For example, the use of the code "CG1" in the Materials Planner/Controller column specifically indicates a specific planner's responsibility for material planning. It provides visibility and accountability in the procurement process generated by the MRP system.

MRP Implementation Results

After the implementation of the MRP method, there have been significant changes to the efficiency of inventory management, including:

Table 2. MRP Implementation Results

Indicator	Before MRP	After MRP
Stockout Frequency (per year)	± 74 incidents	± 60 incidents
Stock Availability Rate	80%	>95%
Storage Fee	± IDR 1.8 Billion / year	± Rp 300Million / year
Lead Time Rata-Rata	97 days	37 days

The reduction in lead time and storage costs after the implementation of MRP is in line with the basic concept of MRP put forward by Heizer and Render (2014), which is to synchronize material needs with production schedules systematically. By doing so, companies can reduce waiting time, speed up material rotation, and avoid unnecessary inventory accumulation. This effect has a direct impact on operational efficiency, as seen in the increase in the ratio of meeting production needs without delays at PT BIB.

As concrete evidence of the implementation of the Material Requirements Planning (MRP) method at PT Borneo Indobara, the SAP system records all Purchase Requisition (PR) generated automatically through the daily MRP Run function. Figure 6 shows the view of TCODE ME5A as of May 20, 2025, which shows a list of PRs that are still outstanding or have not been processed into Purchase Orders (POs). Important information such as material number, quantity, unit price, total value, and name of the applicant (Requested By) are displayed transparently and integrated with Plant 0302. This allows logistics and procurement teams to make procurement decisions quickly and data-driven.

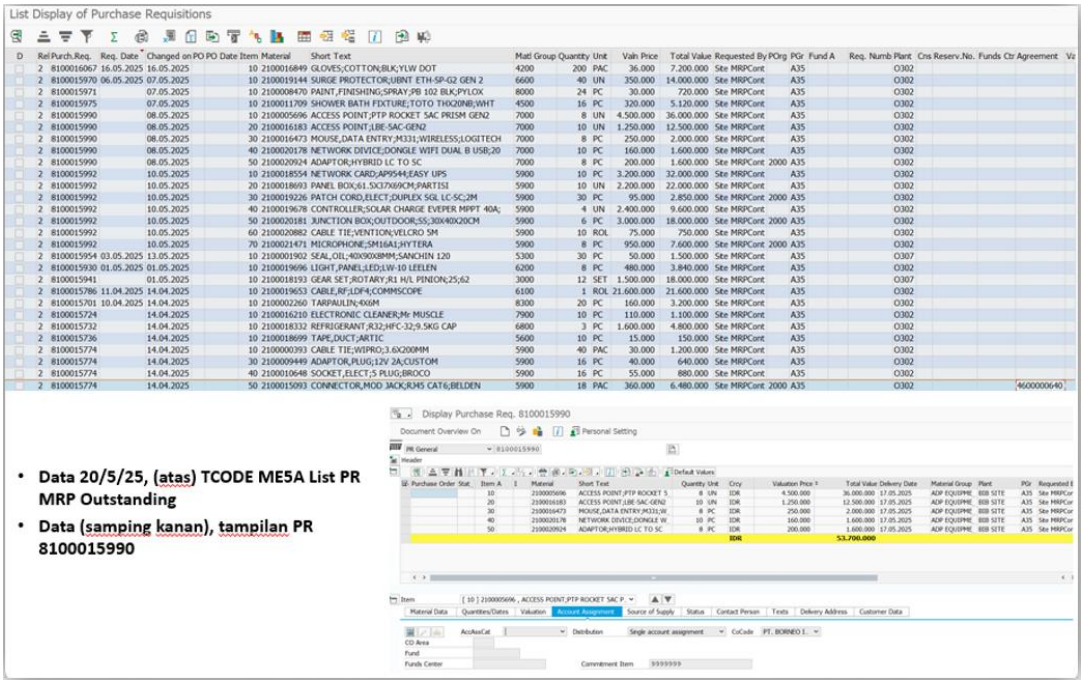
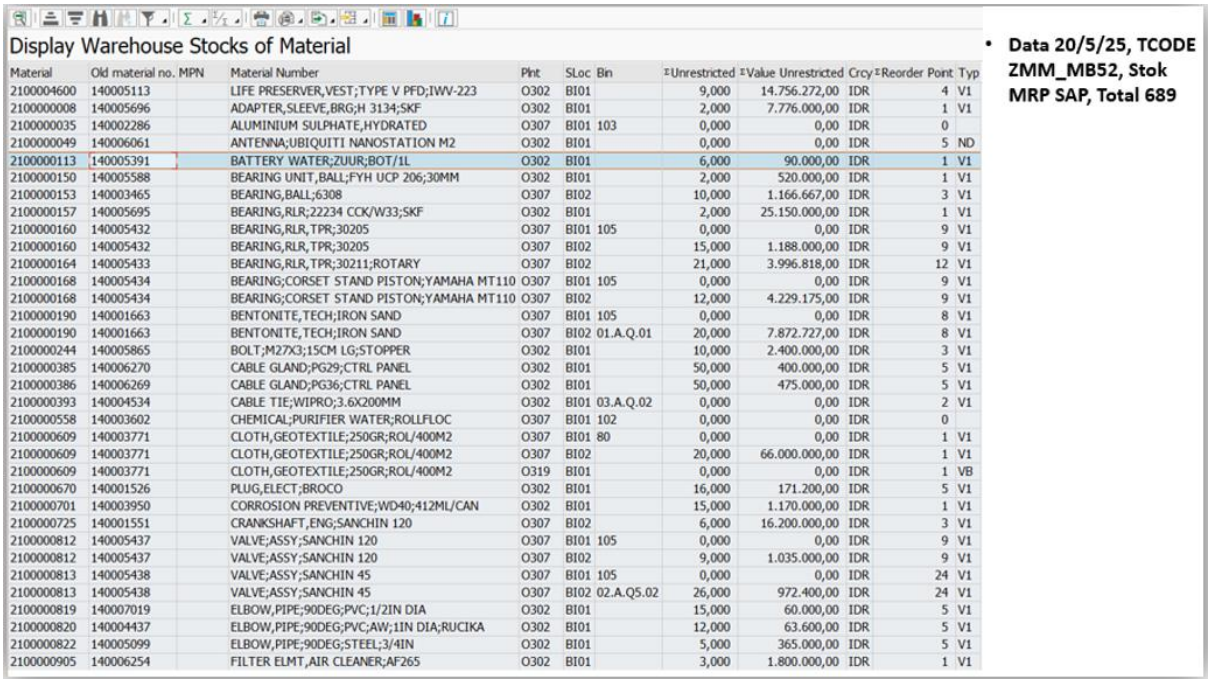


Figure 6. List and Details of MRP Purchase Requisition (TCODE ME5A)

At the bottom right of figure 5.3.2, you can see the detailed display of PR number 8100015990, which displays complete information including material description, date of need, default vendor, and a total value of IDR 53,700,000. This view provides full visibility to users and auditors to ensure that all PR has passed the authorization pipeline as per SOPs and planning parameters within SAP.

One of the advantages of implementing the SAP-based MRP system at PT Borneo Indobara is its ability to display complete and real-time material stock information through Transaction Code MB52. Figure 7 above is the result of the data display on May 20, 2025 which shows warehouse stock for 689 active material items that have been registered in the MRP system.



Display Warehouse Stocks of Material

- **Data 20/5/25, TCODE ZMM_MB52, Stok MRP SAP, Total 689**

Material	Old material no.	MPN	Material Number	Plnt	SLoc	Bin	Unrestricted	Value Unrestricted	Crcy	Reorder Point	Typ
2100004600	140005113		LIFE PRESERVER,VEST;TYPE V PFD;IWV-223	O302	BI01		9,000	14.756.272,00	IDR	4	V1
2100000008	140005696		ADAPTER,SLEEVE,BRG;H 3134;SKF	O302	BI01		2,000	7.776.000,00	IDR	1	V1
2100000035	140002286		ALUMINIUM SULPHATE,HYDRATED	O307	BI01	103	0,000	0,00	IDR	0	
2100000049	140006061		ANTENNA;UBIQUITI NANOSTATION M2	O302	BI01		0,000	0,00	IDR	5	ND
2100000113	140005391		BATTERY WATER;ZUUR;BOT/1L	O302	BI01		6,000	90.000,00	IDR	1	V1
2100000150	140005588		BEARING UNIT,BALL;FYH UCP 206;30MM	O302	BI01		2,000	520.000,00	IDR	1	V1
2100000153	140003465		BEARING,BALL;6308	O307	BI02		10,000	1.166.667,00	IDR	3	V1
2100000157	140005695		BEARING,RLR;22234 CCK/W33;SKF	O302	BI01		2,000	25.150.000,00	IDR	1	V1
2100000160	140005432		BEARING,RLR,TPR;30205	O307	BI01	105	0,000	0,00	IDR	9	V1
2100000160	140005432		BEARING,RLR,TPR;30205	O307	BI02		15,000	1.188.000,00	IDR	9	V1
2100000164	140005433		BEARING,RLR,TPR;30211;ROTARY	O307	BI02		21,000	3.996.818,00	IDR	12	V1
2100000168	140005434		BEARING;CORSET STAND PISTON;YAMAHA MT110	O307	BI01	105	0,000	0,00	IDR	9	V1
2100000168	140005434		BEARING;CORSET STAND PISTON;YAMAHA MT110	O307	BI02		12,000	4.229.175,00	IDR	9	V1
2100000190	140001663		BENTONITE,TECH;IRON SAND	O307	BI01	105	0,000	0,00	IDR	8	V1
2100000190	140001663		BENTONITE,TECH;IRON SAND	O307	BI02	01.A.Q.01	20,000	7.872.727,00	IDR	8	V1
2100000244	140005865		BOLT;M27X3;15CM LG;STOPPER	O302	BI01		10,000	2.400.000,00	IDR	3	V1
2100000385	140006270		CABLE GLAND;PG29;CTRL PANEL	O302	BI01		50,000	400.000,00	IDR	5	V1
2100000386	140006269		CABLE GLAND;PG36;CTRL PANEL	O302	BI01		50,000	475.000,00	IDR	5	V1
2100000393	140004534		CABLE TIE;WIPRO;3.6X200MM	O302	BI01	03.A.Q.02	0,000	0,00	IDR	2	V1
2100000558	140003602		CHEMICAL;PURIFIER WATER;ROLLFLOC	O307	BI01	102	0,000	0,00	IDR	0	
2100000609	140003771		CLOTH,GEOTEXTILE;250GR;ROL/400M2	O307	BI01	80	0,000	0,00	IDR	1	V1
2100000609	140003771		CLOTH,GEOTEXTILE;250GR;ROL/400M2	O307	BI02		20,000	66.000.000,00	IDR	1	V1
2100000609	140003771		CLOTH,GEOTEXTILE;250GR;ROL/400M2	O319	BI01		0,000	0,00	IDR	1	VB
2100000670	140001526		PLUG,ELECT;BROCO	O302	BI01		16,000	171.200,00	IDR	5	V1
2100000701	140003950		CORROSION PREVENTIVE;WD40;412ML/CAN	O302	BI01		15,000	1.170.000,00	IDR	1	V1
2100000725	140001551		CRANKSHAFT,ENG;SANCHIN 120	O307	BI02		6,000	16.200.000,00	IDR	3	V1
2100000812	140005437		VALVE;ASSY;SANCHIN 120	O307	BI01	105	0,000	0,00	IDR	9	V1
2100000812	140005437		VALVE;ASSY;SANCHIN 120	O307	BI02		9,000	1.035.000,00	IDR	9	V1
2100000813	140005438		VALVE;ASSY;SANCHIN 45	O307	BI01	105	0,000	0,00	IDR	24	V1
2100000813	140005438		VALVE;ASSY;SANCHIN 45	O307	BI02	02.A.Q5.02	26,000	972.400,00	IDR	24	V1
2100000819	140007019		ELBOW,PIPE;90DEG;PVC;1/2IN DIA	O302	BI01		15,000	60.000,00	IDR	5	V1
2100000820	140004437		ELBOW,PIPE;90DEG;PVC;AW;1IN DIA;RUCIKA	O302	BI01		12,000	63.600,00	IDR	5	V1
2100000822	140005099		ELBOW,PIPE;90DEG;STEEL;3/4IN	O302	BI01		5,000	365.000,00	IDR	5	V1
2100000905	140006254		FILTER ELMT,AIR CLEANER;AF265	O302	BI01		3,000	1.800.000,00	IDR	1	V1

Figure 7. SAP MRP MATERIAL STOCK LIST (TCODE MB52)

The data displayed includes material number, description, plant, storage location, unrestricted quantity, stock value, and planning parameters such as Reorder Point (ROP) and MRP type. This information is critical in evaluating the availability and feasibility of stock to support operations, as well as being a reference in determining whether the system needs to generate additional Purchase Requisition (PR).

For example, some high-value materials such as Geotextiles have a value of up to IDR 66 million with an active ROP, indicating that the system must always keep stocks above the minimum threshold so as not to interfere with production continuity. On the other hand, there are also materials whose stock is still zero or below ROP, which is an indicator that the SAP system will soon run the MRP Run function to plan procurement. With this MB52 display, inventory management and planners can conduct a thorough evaluation of the actual stock status, identify potential overstock and stockout, and take corrective actions based on valid data. This proves that SAP-based MRP not only functions as a planning tool, but also as a strategic inventory control tool that supports the efficiency and effectiveness of the company's logistics.

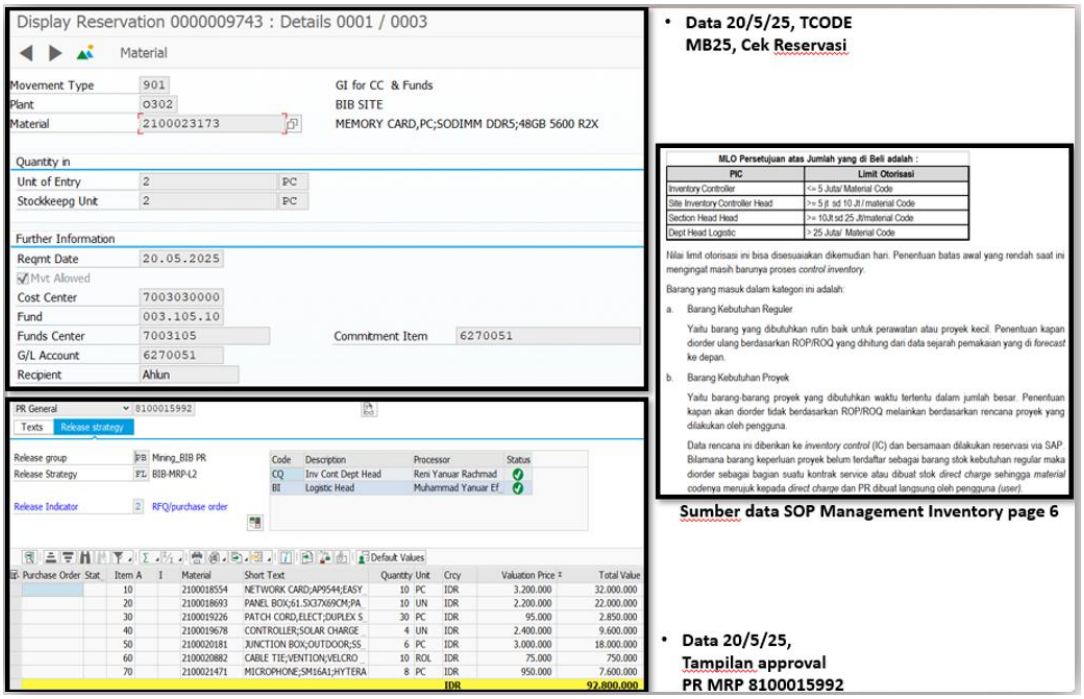


Figure 8. Check Reservations and Purchase Authorization Limits in the MRP Process

Another important feature in the MRP-based inventory management system at PT Borneo Indobara is the ability to check material reservations through SAP with Transaction Code MB25. This feature allows users to view the status and order details of goods that have been ordered by the user unit, but have not been executed as a purchase order (PO). The example in the image shows the DDR5 Memory Card material with the number of orders as many as 2 units that have been recorded in the system for the needs of Plant 0302.

In addition to systematization through SAP, the company also implements a control policy through an authorization structure that is standardized in the Inventory Management SOP Figure 9 This authorization structure is very important in ensuring that material procurement is carried out with the principles of prudence, layered supervision, and measurable accountability. While the MRP system automatically generates PRs based on planning parameters (such as ROP and Safety Stock), the PR approval process must still go through approval according to this authorization structure before proceeding to the PO stage.

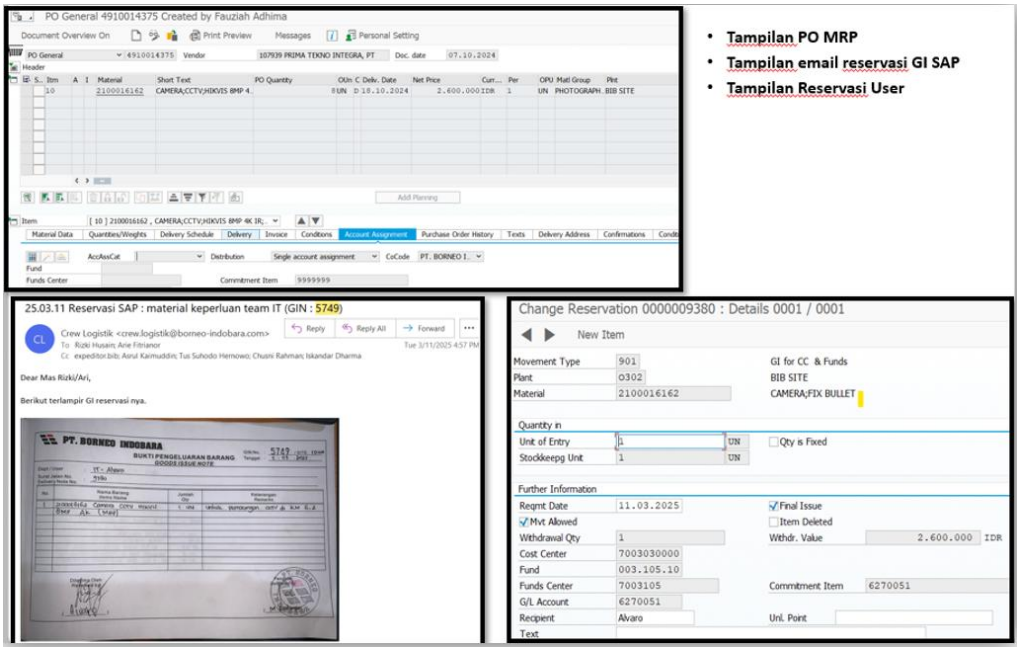


Figure 9. MRP Advanced Process: Purchase Orders, Reservations, and User Requests

After the SAP system generates a Purchase Requisition (PR) from the MRP process, the next stage is the creation of a Purchase Order (PO) by the procurement team. The top image shows an example of PO MRP No. 4910014375 made for the purchase of CCTV Camera materials, with the quantity and delivery date determined based on the actual needs of the system. This PO is the result of further validation of PRs that have been approved according to authorization, and serves as the basis for the delivery of goods from vendors to the BIB Site location.

Next, Figure 9 at the bottom left shows the SAP reservation documentation sent via internal email by the logistics team to the user. The email includes an attachment to the GI (Goods Issue) Reservation Form with GIN number: 5749, which is evidence of manual validation outside of the system of the process of disbursing goods for the purposes of the relevant department (Ellitan, 2021; Moeheriono, 2014). This shows that although SAP systems have automated most processes, the verification process of physical documents is still used as an additional control (Afandi, 2018). Meanwhile, the bottom right image shows the SAP Change Reservation view with the details of the material to be removed from the system (Febriansyah & Santoso, 2021).

The integration between POs, reservation systems, and physical documents shows that the inventory management process at PT BIB has reflected the principle of closed-loop control in MRP (Kibtiah & Wahyuningsih, 2019). Not only relying on an automation system, but also ensuring clarity of responsibilities, audit trails, and alignment between departments (logistics, users, and procurement). This confirms that the implementation of MRP not only reduces costs and lead time, but also strengthens governance and operational accountability (Anggraeni & Arief, 2022).

The implementation of MRP has been proven to improve the accuracy of material requirement planning and logistics cost efficiency (Bowersox et al., 2013; Braglia et al., 2014). These systems enable data-driven decision-making and support procurement planning proactively, rather than reactively. The above results also show that MRP can more effectively address demand uncertainty and lead time variability. Nevertheless, challenges remain, especially in ensuring consistent data updates and coordination between procurement units and users.

The findings of this study are in line with the results of the research of Silver, Pyke, and Thomas (2016) who stated that the application of the MRP method is able to reduce storage costs and improve the overall efficiency of the supply chain. In the context of PT Borneo Indobara, the implementation of MRP has been proven to reduce storage costs by ± Rp 1.5 million per year, demonstrating consistency between practice in the field and theories put forward in the literature. This reinforces the argument that MRP is not only relevant for the manufacturing industry, but also highly applicable in the mining logistics sector.

Research by Chopra & Meindl (2016) emphasizes the importance of integrating real-time demand data in MRP systems to improve planning accuracy. At PT BIB, the implementation of MRP with the support of the SAP system allows the simultaneous processing of historical and actual data. As a result, the system is able to predict material requirements more accurately, reducing the frequency of stockouts by up to 19%. This supports the theory that MRPs integrated with modern ERP systems are able to significantly improve the reliability of material procurement.

In addition, Utami's (2018) study shows that the implementation of MRP in manufacturing companies has succeeded in reducing inventory costs by up to 82%. Although the sectors studied are different, this study shows a similar pattern to PT BIB, which also experienced cost reductions and improved warehouse performance after the implementation of the MRP system. This comparison confirms that the MRP method has high flexibility to be applied in various industrial sectors, including the energy and mining sectors.

However, some of the challenges also identified in the Wagner & Lee (2024) study regarding the impact of periodic forecast updates in MRP are also seen in PT BIB, especially when there is a sudden change in procurement schedules or uncertainty from suppliers. Therefore, even though MRP provides a systematic and efficient framework, companies still need to anticipate external dynamics such as lead time fluctuations and supply delays with an adaptive approach (Lee, 2021).

In addition to supporting the automation of the planning process, the implementation of MRP integrated with SAP also provides convenience in controlling and tracking material expenditure. This process can be seen from a series of data that shows the flow starting from the formation of Purchase Order (PO), material reservations through internal emails, to recording goods issue transactions (Goods Issue/Reservation) in the system. This integration shows that the MRP system is not only a need prediction tool, but also a means of accurate

distribution control to the end user, by documenting every step digitally and manually as proof of accountability.

The process of reserving goods displayed in the system (TCODE MB25 and GIN documents) is proof that requests from user units are managed systematically and documented (Widajanti, Sumaryanto, & Handayani, 2020, 2021). Validation conducted through reservation forms, official emails, and SAP systems shows that the company has a solid verification mechanism in place to ensure the suitability of requests with stock and procurement policies (Randi & Meirini, 2021). This reinforces the findings in the thesis that the success of the MRP system depends not only on the need calculation algorithm, but also on the management of the distribution and disbursement processes of goods that are disciplined and well documented (Rofidah et al., 2016; Vollmann et al., 2019). In fact, the success of the MRP implementation can also be seen from the increase in collaboration between departments that previously worked separately (Stevenson, 2020). With a central system like SAP, both logistics teams, users, procurement, and inventory controllers can monitor each other's ongoing processes and make decisions faster and more accurately (Rachmawan, 2018). This reduces reliance on manual interventions, which have often been a source of operational errors (Solihul, 2024).

The adjustment of SOPs and the use of MRP modules in SAP not only increases internal efficiency, but also strengthens the company's competitiveness in the mining industry. With a planned and controlled inventory, PT BIB is able to maintain operational continuity amid global supply challenges, while increasing the accountability of the company's high-value asset management (Tasia & Hasnawati, 2022; Wibowo, 2014).

CONCLUSION

The analysis and implementation of the MRP system at PT Borneo Indobara demonstrated that the previous inventory management system was ineffective in addressing overstock and stockout issues. The adoption of MRP significantly improved inventory management efficiency by reducing storage costs, increasing stock availability, and shortening order lead times. MRP proved reliable for managing routine material requirements in a structured way, using actual demand data and estimated lead times. Future research could explore the integration of real-time data analytics and machine learning techniques to further enhance MRP accuracy and adaptability in dynamic inventory environments.

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