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Analysis of Production Capacity Planning Using *Rough Cut Capacity Planning* (RCCP) Method in the Manufacturing of Cleaning Tools (Case Study at CV Berkah Jaya Klaten)

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Abstract: Amidst the growing competition in the industry, CV Berkah Jaya Klaten faces challenges in planning the production capacity of cleaning tools to meet market demand. This study aims to provide solutions to production capacity planning issues by applying the Rough Cut Capacity Planning (RCCP) method using the Capacity Planning Using Overall Factors (CPOF) technique and a system simulation approach. The planning process begins with demand forecasting using IBM SPSS Statistics 25 software, which produces the smallest Mean Absolute Percentage Error (MAPE) value using the Simple Seasonal method. These forecasting results are used to determine the Master Production Schedule (MPS). Processing RCCP data with the CPOF method requires MPS data, processing time for each workstation, and historical proportions calculated from standardized processing times. The system simulation of production capacity planning is conducted to model real conditions and evaluate various production scenarios. The simulation results reveal that the required production time capacity each month always exceeds the available time capacity, indicating the need for capacity adjustments to avoid bottlenecks and improve efficiency. With this approach, CV Berkah Jaya Klaten can plan production capacity more efficiently and effectively, ensuring product availability in accordance with customer demand.

Keywords: Production Capacity, Master Production Schedule (MPS), Rough Cut Capacity Planning (RCCP), Capacity Planning Using Overall Factors (CPOF).

1. BACKGROUND

In the midst of increasingly intense competition in the manufacturing industry today, businesses must maintain a balance between product quality, market demand, and production capacity. To meet market demand swiftly and in adequate quantities while maintaining quality standards, production capacity planning is essential. Meeting customer needs and expectations is the primary goal to enhance profitability. Therefore, an efficient capacity planning strategy is crucial for the success of manufacturing business operations. CV Berkah Jaya Klaten is a manufacturing company that produces cleaning tools such as brooms, floor wipers, mops, dusters, dustpans, and various types of doormats. The company faces challenges in managing future demand surges due to a lack of comprehensive planning and accurate forecasting techniques. Currently, the company's operational strategy focuses more on fulfilling existing customer orders without conducting in-depth analysis of potential demand growth. To become more responsive to market demand fluctuations, the company needs to improve its planning capabilities and supply chain management.

CV Berkah Jaya Klaten faces various issues affecting production efficiency and quality, including a lack of structured planning, production delays, and defective products. The primary causes are inadequate worker proficiency and suboptimal workstation conditions, such as outdated and frequently malfunctioning mop cloth spinning machines and cutting machines.

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Additionally, delays in the supply of raw materials, such as plastic broom frames, broom handles, and coconut fibers, present significant challenges. These materials must be sourced from other industries, and delivery delays disrupt the production schedule. Comprehensive and strategic corrective actions are urgently needed to enhance efficiency, quality, and the operational performance of the company.

The main challenge faced by CV Berkah Jaya Klaten is ensuring that production timelines can meet the demand levels agreed upon with customers. In 2022, sales of cleaning tools reached approximately 55,220 units, while in 2023, they increased to around 64,350 units, reflecting a demand growth of 16.53%. This upward trend in demand raises the question of whether the company needs to increase the number of machines or workforce. Evaluating production capacity and strategizing human resource management becomes crucial to ensure the company can handle the surge in demand and effectively meet market needs.Therefore, the researcher is interested in conducting a comprehensive study on production capacity planning to anticipate the rising demand for cleaning tools. Consequently, this research is titled "Analysis of Production Capacity Planning Using the Rough Cut Capacity Planning (RCCP) Method for Cleaning Tool Manufacturing at CV Berkah Jaya Klaten." This study is expected to provide valuable insights for CV Berkah Jaya Klaten in enhancing operational efficiency and ensuring the company remains competitive in an increasingly challenging market.

2. THEORETICAL REVIEW

Capacity is defined as the future benefits that an organization can obtain, encompassing the available resources (Gammell & McNair, 1994). According to McNair and Vangermeersch (2020), capacity refers to an organization's ability to create value from its resources. Hilton et al. (2006) state that capacity measures the capability of production processes to transform resources into goods or services for consumers. The Statement on Management Accounting (1996) describes capacity as the potential of production activities to generate added value, emphasizing its role as a strategic asset for competitive advantage. Capacity includes physical resources, technology, expertise, and management systems that support production efficiency. Understanding capacity is crucial in cost management to reduce production costs and increase profitability. Additionally, it plays a significant role in managerial decision-making processes.

Production capacity refers to the maximum amount that can be produced in one hour. There are three perspectives on capacity (Kusuma, 2009): design capacity, which represents the highest output achievable under ideal conditions without scheduling disruptions, defective

products, or routine maintenance; effective capacity, which is the maximum output at a specific operational level, typically lower than design capacity; and actual capacity, which is the real output achieved, ideally closer to effective capacity. Production planning is the process of organizing human resources, raw materials, and capital so that products can be manufactured according to the plan (Lengkey et al., 2014). The primary mission of manufacturing companies is to meet consumer needs with products aligned with their preferences. Production capacity planning has several objectives (Kusuma, 2009), including forecasting production demand, determining the economical amount of raw materials, balancing production needs, devising methods to fulfill orders, tracking the availability of finished goods, and creating detailed production schedules based on available capacity and changes in demand.

The production process in manufacturing companies is crucial, making production efficiency a critical factor. An effective production system is built through planned activities that monitor and adjust production outcomes according to the plan. Proper planning directs production activities and helps companies achieve their goals more effectively, starting from demand planning to determining the Master Production Schedule (MPS). In mass production involving a single type of product, planning directly transitions to MPS without the disaggregation stage. Forecasting market conditions or consumer needs includes determining the product, quantity, production timing, and required resources (Gaspersz, 2005). Production planning aligns predicted demand with available production capacity. However, companies do not always adhere strictly to forecast results without consideration, due to uncertainties, the type of manufacturing company, and the costs of altering production levels. Rough Cut Capacity Planning (RCCP) is a critical stage involving an analysis of production facility capacity on the shop floor to align with the master production schedule. RCCP focuses on critical workstations or bottlenecks with limited capacity, enabling companies to anticipate constraints and take measures to address them. Companies utilize standard capacity units, known as the bill of capacity, to calculate the workload at each workstation and compare it with available capacity. This ensures that production capacity is optimized according to needs, avoids delays, and enhances overall efficiency and productivity.

(Suwarso et al., 2021) demonstrated that the capacity required by Loca Nusa SMEs from August to February far exceeded the available capacity, rendering production planning unfeasible. (Sugiatna, 2021) found that PT. XYZ was only able to meet 33% of the required capacity out of the total available capacity in 2022, highlighting a significantly greater demand for capacity than the company possessed.

(Syukriah et al., 2023) identified significant capacity shortages at Work Center I, II, IV, and VII in CV Family Bakery, which were addressed by adding overtime hours and a new baking machine. (Aji, 2020) at PT. BARALI CITRAMANDIRI revealed production delays and difficulties in meeting customer demand, which were resolved by using the RCCP method for more efficient production planning. (Matswaya et al., 2019) at PT Buana Spring Foam demonstrated that by using RCCP, the foam mattress production capacity plan was feasible with sufficient capacity to meet customer demand.

Based on the research model, the hypothesis formulated is as follows:

Ho = There is no significant relationship between the use of production capacity planning system simulation and the improvement of efficiency and effectiveness in addressing production capacity shortages in the company. Ha = The use of production capacity planning system simulation is significantly related to the improvement of efficiency and effectiveness in addressing production capacity shortages in the company, thereby helping the company make more accurate decisions in optimizing production capacity utilization.

3. RESEARCH METHOD

The following is the framework of the research titled "Analysis of Production Capacity Planning Using the Rough Cut Capacity Planning (RCCP) Method in the Production of Cleaning Equipment at CV Berkah Jaya Klaten":

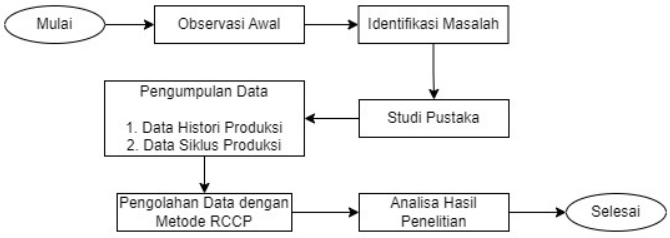

Figure 1. Research Design

Type of Research

This research takes a holistic approach to CV Berkah Jaya Klaten, considering various production aspects such as processes, workforce, and equipment. A survey method is used to collect data about production conditions, challenges, and best practices in capacity planning, as well as to analyze historical data on product demand and resource availability. This research evaluates the alignment of production capacity with market demand. The aim is to provide insights into the effectiveness of production capacity planning in optimizing the operational performance of CV Berkah Jaya Klaten.

Research Variables

This research involves two main variables: fixed variables, which include product demand, production hours, number of employees, efficiency, and available capacity for the years 2022-2023, and variable variables, which cover demand forecasting and required capacity for the years 2024-2025.

Operational Definitions of Variables

The variables in this study include Product Demand, which is the quantity of products requested by customers during a specific period, measured through interviews; Production Hours, which refers to the actual hours worked in the production process during a certain period, also measured through interviews; Utilities, which measure the efficiency of resource usage such as energy, water, and raw materials in the production process, measured as efficiency percentages and collected through interviews; Efficiency, which indicates the production level compared to the required inputs, measured as the percentage of successful production achieved compared to the input used, through observations; and Available Capacity, which refers to the total available production capacity during a period, measured in the number of units of available capacity according to the type of production, through interviews.

Population, Sample, and Sampling Method

This research focuses on the cleaning equipment products produced by the company as the population, with the sample taken from production during the last two years (January 2022 – December 2023).

Data Collection Methods

In this study, data was collected through three methods:

Observation, which involves direct observation by the researcher of the production processes and capacity planning at CV Berkah Jaya Klaten to understand capacity management and the interaction of production elements.

Interviews, which involve direct communication between the researcher and relevant parties at CV Berkah Jaya Klaten, such as production managers and production staff, to gain a deeper understanding of the processes and capacity planning.

Documentation, which includes the collection of data from relevant documents such as production records, financial reports, and available production planning documents at the company.

Data Analysis

The data analysis techniques used in this study include:

1. Descriptive Analysis, to provide an overview of the production conditions, available capacity, market demand patterns, and capacity planning practices at CV Berkah Jaya Klaten, based on data from documentation, interviews, and observations.
2. Forecasting, to predict product demand using SPSS Statistics 25 software.
3. Master Production Schedule Calculation, to determine the production schedule from August 2024 to July 2025.
4. Required Capacity Calculation, using the Rough Cut Capacity Planning (RCCP) method to determine the optimal required capacity by considering lead time, machine capacity, and labor availability. These techniques will provide in-depth understanding of capacity planning and recommendations for improving the company's responsiveness to market demand.

5. RESULTS AND DISCUSSION

CV Berkah Jaya Klaten, established by Mr. Bagas Sugiharto on September 24, 1998, is a manufacturing company that produces cleaning equipment located in Klaten. The company manufactures various brooms, floor cleaning tools, mops, feather dusters, dustpans, and doormats. The products are marketed both locally and outside the city. CV Berkah Jaya Klaten employs five staff members, consisting of three in the production department, one in shipping, and one in the cashier department.

Several operational and production issues affecting efficiency and quality at CV Berkah Jaya Klaten include the lack of structured planning, which makes it difficult to manage demand surges. Additionally, delays in production and defective products can be caused by insufficient labor, suboptimal working conditions, and machines that often break down due to aging. The production schedule is also disrupted if raw materials such as broom frame plastic, broom handles, mop fabrics, and coconut husks are not supplied promptly.

Analysis of Production Capacity Planning Methods Used

1. Production Process

Production is the process of creating goods or services by improving them with the use of labor, machines, raw materials, and capital (Reksohadiprodjo, 2010). At CV Berkah Jaya Klaten, raw materials such as plastic broom frames, broom handles, and mop cloths are supplied by other industries and then undergo various production processes. Figure 2 shows the flowchart and explanation of the cleaning tools production process.

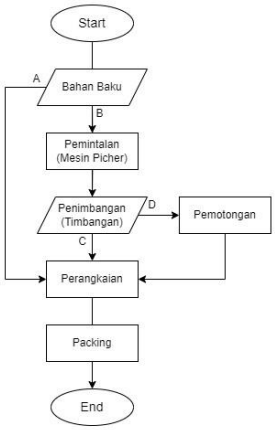

Figure 2. Production Process Flow Diagram

Description: A = Non-fabric raw materials. B = Fabric raw materials.

C = Does not exceed maximum weight. D = Exceeds maximum weight

2. Demand Forecasting

The production planning for cleaning equipment at CV Berkah Jaya Klaten is carried out through forecasting over a 12-month period, from August 2024 to July 2025, to predict future conditions based on historical data. Although this forecasting is important, excessive predictions can lead to increased production, shipping, and storage costs, particularly for items that are susceptible to changes (Ishak, 2010). Demand patterns are analyzed using sales data from January 2022 to December 2023, which recorded sales of Product A (cloth mop) and Product B (non-cloth mop). In 2022, the average monthly sales of Product A reached 573.33 units, with a peak of 5,400 units in October, while Product B averaged 4,937.50 units per month, with a peak of 5,950 units in the same month. In 2023, the average sales of Product A increased to 618.33 units, and Product B rose to 5,252.50 units, with the highest sales for Product A in August and December at 650 units, and Product B reaching 6,000 units in December.

At CV Berkah Jaya Klaten, demand forecasting is conducted using IBM SPSS Statistics 25 with three approaches: Simple, Simple Seasonal, and ARIMA. The accuracy of the forecast is evaluated through three indicators: Mean Absolute Error (MAE), Mean Square Error (MSE), and Mean Absolute Percentage Error (MAPE). MAE indicates the error in the same unit as the original data, MSE measures the average squared difference between the forecasted and actual values, while MAPE calculates the percentage difference between the actual data and the forecast results. Forecast quality is considered excellent if MAPE <10%, good if MAPE is

between 10%-20%, fair if MAPE is between 20%-50%, and poor if MAPE >50% (Kristien Margi S; Sofian Pendawa W Pendawa, 2015).

Table 1. Comparison of MAE, MSE, and MAPE Values

No.	Forecasting Method	Comparison Values		
		MAE	MSE	MAPE
1	Simple Seasonal	52,632	5747,4	2,261
2	Simple	62,604	7377,9	2,973
3	ARIMA	101,059	14268	4,102

Source: Data Processing Results 2024

"Based on the calculations using IBM SPSS Statistics 25, the most suitable method for forecasting the sales of cleaning equipment is Simple Seasonal.

Table 2. Results of Simple Seasonal Forecasting for Cleaning Equipment Sales

Month	A	B	Month	A	B
Aug-24	631	5300	Feb-25	631	5011
Sep-24	646	5155	Mar-25	611	5161
Oct-24	606	5445	Apr-25	626	5181
Nov-24	606	5245	May-25	636	5216
Dec-24	646	5294	Jun-25	631	5170
Jan-25	616	5136	Jul-25	631	5260

Source: Data Processing Results 2024

3. Master Production Schedule

Production scheduling plays a crucial role in determining the sequence of tasks to improve efficiency and reduce costs. The Just-In-Time Production (JIP) method is very effective in scheduling product orders, as it helps determine the required resources and capacity, as well as ensuring timely delivery of products to customers. Based on the sales forecast of cleaning tools for one month, JIP regulates the frequency of product deliveries or pickups within that period. The JIP schedule for cleaning tools, measured in units (pcs), is shown in Table 3.

Table 3. Master Production Schedule for Cleaning Tools

Month	JIP/ Month (pcs)		Bulan	JIP/ Month (pcs)	
	A	B		A	B
Aug-24	631	5300	Feb-25	631	5011
Sep-24	646	5155	Mar-25	611	5161

Month	JIP/ Month (pcs)		Bulan	JIP/ Month (pcs)	
	A	B		A	B
Oct-24	606	5445	Apr-25	626	5181
Nov-24	606	5245	May-25	636	5216
Dec-24	646	5294	Jun-25	631	5170
Jan-25	616	5136	Jul-25	631	5260

Source: Data Processing Results

Implementation of Rough Cut Capacity Planning (RCCP) Method Using CPOF (Capacity Planning using Overall Factor)

Processing RCCP data with the CPOF approach requires information from the Master Production Schedule (MPS), process time at each workstation, and Historical Proportion (HP). HP measures the proportion of time spent on each process compared to the total production time of cleaning tools and is calculated based on the standard time for each process at the workstation in minutes.

$$PH_{Pemintalan} = \frac{WP}{WP\,t} = \frac{1}{4,1} = 0,244 \quad \text{..... (2)}$$

Description: PH = Historical Proportion WP = Process Time (minutes/pcs)

WPt = Total Process Time (minutes/pcs)

Table 4. Process Time and Historical Proportions

Process	Fabric Wound Equipment		Non Wound Fabric Equipment	
	Time (minutes	PH	Time (minutes	PH
Spinning	1	0,244	0	0
Weighing	0,1	0,024	0	0
Cutting	0,5	0,122	0	0
Assembly	1,5	0,366	1,5	0,6
Packaging	1	0,244	1	0,4
Total	**4,1**	**1**	**2,5**	**1**

Source: Data Processing Results 2024

After the historical proportion values are known, the next step is to calculate the processing time per workstation. The production quantity per workstation is calculated using formula (3). The total production of cloth tools and non-cloth tools is then accumulated to

obtain the calculation of the required time capacity per month. The details of the time capacity required per month can be seen in Table 5.

Required Capacity (RC) = Total Processing Time x Master Production Schedule

= TPT x MPS …….(3)

Table 5. Calculation results of the required time capacity

Bulan	JP Pel Kain	JP Non Pel Kain	Total Waktu	Bulan	JP Pel Kain	JP Non Pel Kain	Total Waktu
Aug-24	2587,1	13250	15837	Feb-25	2587,1	12527,5	15115
Sep-24	2648,6	12887,5	15536	Mar-25	2505,1	12902,5	15408
Oct-24	2484,6	13612,5	16097	Apr-25	2566,6	12952,5	15519
Nov-24	2484,6	13112,5	15597	May-25	2607,6	13040	15648
Dec-24	2648,6	13235	15884	Jun-25	2587,1	12925	15512
Jan-25	2525,6	12840	15366	Jul-25	2587,1	13150	15737

Source: Data Processing Results 2024

Next, to calculate the available processing time capacity, data on the number of workers, working hours, and working days is required. Using formula (4), the available processing time capacity is calculated based on 6 workers, with 7 working hours per day and an average of 26 working days per month. This results in an available processing time capacity of 7 hours x 26 days, or (7 hours x 60 minutes) x 26 days, which equals 10,920 minutes. Once the available processing time capacity is known, which is 420 hours or 10,920 minutes per month, the next step is to compare it with the processing time required each month from August 2024 to July 2025. The results of the comparison of processing time capacity can be seen in Figure 3.

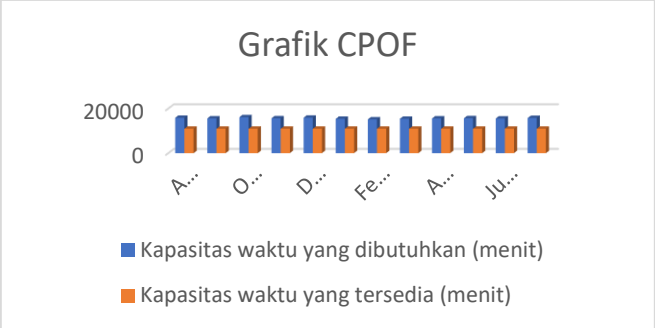

Figure 3. CPOF Graph

In the CPOF graph, the required process time capacity always exceeds the available process time capacity each month. If the required process time capacity does not exceed the available capacity, then the required process time is considered valid (Widiyanto, 2018).

The calculation results reveal that the required production time capacity each month consistently exceeds the available capacity, which is 10,920 minutes or 420 hours per month. This indicates a mismatch between the required and available capacity, which needs to be addressed in future production planning.

Production Capacity Planning System Simulation

In the production capacity planning system simulation, the company can test the effectiveness of various steps that have been mentioned.

1. Revised MPS (Master Production Schedule)

The company can shift production between months to optimize resources and evaluate the impact of uncertainties such as changes in demand or the availability of raw materials.

2. Implementing Overtime

The company can assess the impact of adding working hours on overall production, production costs, and employee well-being. This helps the company make informed decisions about using overtime to effectively and efficiently address production capacity shortages.

3. Enforcing a Shift System

The company can simulate shift arrangements, additional working hours, and shift patterns, as well as predict their impact on capacity and production costs. This enables the company to make precise decisions about designing shift systems to address production capacity shortages and balance market demand with production capability.

4. Subcontracting Work

The company can model outsourcing scenarios, predict their impact on internal capacity, operational efficiency, and overall costs. This allows the company to make informed decisions about optimizing the combination of internal and external work to address production capacity shortages and meet market demand efficiently.

5. Utilizing Finished Goods Inventory

The company can address production capacity shortages, predict their impact on production and inventory availability, and evaluate the financial implications. This enables the company to make informed decisions about managing finished goods inventory to balance market demand and production capacity.

6. Adding Human Resources (HR)

The company can increase human resources, predict their impact on capacity, productivity, and operational costs, and evaluate the balance between costs and benefits. This enables the company to make informed decisions about expanding human resources to effectively address capacity shortages.

6. CONCLUSION AND RECOMMENDATIONS

In facing the challenges of production capacity planning, the implementation of a capacity planning system simulation has shown that the required process time capacity often exceeds the available capacity. This highlights the need for several solutions to address this imbalance, such as revising the Master Production Schedule (MPS), using overtime and shift systems to temporarily increase capacity, outsourcing some tasks to subcontractors, utilizing finished goods inventory, and adding human resources. Each solution must be carefully considered to ensure a balance between productivity, quality, cost, and employee well-being.

For future improvements, the company is advised to encourage the use of more advanced planning and simulation technologies, strengthen cooperation with subcontractors to improve quality and timeliness, and continuously develop employee skills in capacity planning. Continuous evaluation and monitoring of the capacity planning process are crucial to adjust strategies in line with market changes and internal needs. Further research is recommended to improve the simulation model to make it more user-friendly and ensure that the simulation results can be applied effectively.

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