

## Integrated Capacity and Production Planning in The Garment Supply Chain

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### ABSTRACT

Forecasting is the prediction, projection, or estimation of the occurrence of an uncertain event or activity in the future. The purpose of forecasting is to use the best information currently available to guide future activities to achieve the goals of the organization many strategies need to be considered and carried out by a company to make the right planning to meet the existing target demand. In a business context, forecasting is very important because it helps companies plan production, manage inventory, plan finances, and make other strategic decisions. One of the shirt production companies in Surabaya is experiencing problems in meeting production demand. This happens because the forecasting calculation of the amount of demand is not accurate so the company cannot meet consumer demand which sometimes jumps high. Based on these problems, improvements are needed by analyzing production capacity planning so the purpose of this study is to obtain accurate capacity planning using the Rough-Cut Capacity Planning (RCCP) method. Based on data processing, it can be concluded that Overtime issued a total of IDR 426.796.700, and sub-contract issued a total of IDR 117.345.600. Based on the analysis using the Rough-Cut Capacity Planning (RCCP) method, this is due to several possibilities, including the lack of accuracy when doing the forecast with the existing reality, the existence of tools and machines that experience interference (error), and other factors.

*Keywords: RCCP, bill of labor, production capacity required, production capacity available*

### Introduction

Forecasting is a prediction that leads the company to know how many products will be sold in the future, the basis for making important decisions, and also a basis for planning decisions for making production schedules (Boone et al., 2019; Nikolopoulos et al., 2021; Campbell et al., 2020). The purpose of forecasting is to use the best information currently available to guide future activities to achieve the goals of the organization. This creates an opportunity for the company to meet the necessary needs. Many strategies need to be considered and carried out by a company to make the right planning in order to meet the existing target demand. In a business context, forecasting is very important because it helps companies plan production, manage inventory, plan finances, and make other strategic decisions (Arshad et al., 2021; Niu et al., 2021; Reyes et al., 2023). The key points about forecasting in a business context consist of accurate sales predictions so that companies can plan production and inventory more efficiently, a decision-making basis for production planning so as to avoid excess inventory that can lead to high storage costs or inventory shortages that can result in lost sales, inventory management that can manage inventory more effectively, financial planning so that companies can plan budgets and manage cash and make more prudent investment decisions, and business strategy development through understanding market trends and customer behavior so that

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companies can identify opportunities and challenges, and design appropriate strategies (Helo & Hao, 2022; Wolfshorndl et al., 2020; Kartanaité et al., 2021).

One of the shirt production companies in Surabaya is experiencing problems in meeting production demand. This happens because the forecasting calculation of the amount of demand is not accurate so the company cannot meet consumer demand which sometimes jumps high. Based on these problems, it is necessary to improve by analyzing production capacity planning. This problem is a common problem that occurs in the manufacturing industry, especially when companies face unexpected fluctuations in demand. In this case, analyzing and improving production capacity planning is a very important step to overcome these constraints. A step that can help companies improve production capacity planning is inventory adjustment. Production capacity planning should always consider existing inventory levels. If the company has a sizable inventory, there may be no need to drastically increase production capacity. However, if inventory is low and demand is increasing, companies should be prepared to increase production capacity as needed. Improvement in production capacity planning is a continuous process and requires dedication. Through careful analysis, the use of appropriate technology, and a responsive attitude to change, companies can improve their ability to better meet consumer demand. This is one way to increase company profits (Suryadi et al., 2022). The purpose of this study is to obtain accurate capacity planning using the Rough-Cut Capacity Planning (RCCP) method by adjusting between inventory and capacity by using the Rough-Cut Capacity Planning (RCCP) method.

Rough Cut Capacity Planning (RCCP) is a production capacity planning method that focuses on workstations or production centers in a manufacturing company (Tobon-Valencia et al., 2022). RCCP is the first step in production capacity planning that helps companies evaluate whether the existing production capacity is sufficient to meet the expected production demand (Smith, 2020; Shurrab et al., 2022); Oluyisola et al., 2020). This method is useful for identifying potential capacity issues and taking necessary actions before proceeding to more detailed production planning. An important point about RCCP is that it identifies capacity and availability at a particular production center or workstation. It includes an evaluation of the existing human resources, equipment, and facilities at each workstation. In RCCP, the capacity of each workstation is analyzed to ensure that it is sufficient to accommodate the expected production demand. This capacity loading includes the evaluation of working hours, operator requirements, and machine capacity. The RCCP method requires production forecasting as one of its main inputs. This forecasting can come from different forecasting methods, such as qualitative or quantitative forecasting, depending on the level of detail desired. The RCCP method helps companies identify potential capacity issues, such as workstations that are too congested or have too little capacity to meet demand. These capacity issues can include workstations or production centers that are either too congested or lack the necessary capacity to meet the demand for their products. RCCP plays a crucial role in avoiding production bottlenecks and ensuring that a company's resources are aligned with the demand for their products. It helps companies proactively address and resolve capacity-related challenges, making it an essential part of effective production planning and control. This allows the company to take preventive or corrective actions, such as rescheduling or increasing capacity. In general, the RCCP method is a useful tool in helping companies identify potential capacity issues and better plan their production capacity. However, companies also need to consider accurate forecasting methods and more detailed production planning strategies to ensure efficiency and on-time delivery. Efficiency and on-time delivery are critical for customer satisfaction and maintaining a competitive edge. Therefore, companies need to use a combination of accurate forecasting, sophisticated production planning techniques, and a commitment to continuous improvement to achieve these goals.

## **Material and Methods**

### ***Variable identification***

The dependent variable is the variable that is being studied and measured to assess the impact or influence of changes in other variables, which are called independent variables. The dependent variable is the outcome or response variable that researchers are interested in understanding, explaining, or predicting. It represents the outcome, effect, or response that researchers want to understand in relation to other variables. In a typical research study, you might have one or more independent variables (also known as predictor or explanatory variables) that are manipulated or observed to see how they affect the dependent variable. The goal is to analyze the relationship between the independent variables and the dependent variable to gain insights or make predictions about the phenomenon under investigation. The dependent variable is the central focus of a research study, as it represents the aspect of the phenomenon that researchers seek to understand or explain through their analysis. The dependent variable in this study is the required capacity while the independent variables in this study are workstation cycle time, production price data, process description data and production capacity, bill of materials, working hours and working days data, product demand data, number of machines and labor, and work efficiency data.

### ***Rough Cut Capacity Planning (RCCP)***

RCCP calculation using the Bill of Labor is obtained from the raw time matrix column multiplied by the product demand matrix. It's a preliminary step in production planning and scheduling to identify potential capacity constraints and make adjustments as needed. RCCP, which stands for Rough-Cut Capacity Planning, typically involves using a Bill of Materials (BOM) and a routing to estimate resource requirements and identify potential capacity constraints. RCCP calculation involves using the Bill of Materials (BOM) and routing information to estimate resource requirements for producing a specific product in relation to the product demand. It's a preliminary step in production planning and scheduling to identify potential capacity constraints and make adjustments as needed. The Bill of Labor (BOL) is a document that outlines the labor requirements for each product or item to be produced. It typically includes information such as the number of labor hours or workers required for each production task or operation. The "raw time matrix" you mentioned seems to be a table or matrix that specifies the labor times required for each product or item based on the Bill of Labor. This matrix lists the labor hours or labor requirements for each product. The RCCP calculation is required for the production time that each production work process is capable of producing so that the delivery of finished products to the customer can be determined appropriately.

### ***RCCP time calculation with available production time***

This excess or shortage of production time is a step that must be taken so that the available production time is balanced with the required production time. Balancing the available production time with the required production time is a critical step in production planning and scheduling to ensure that a manufacturing facility can meet its production demand effectively. This step involves assessing whether there is an excess or shortage of production time and taking appropriate actions to address it. The goal of balancing available production time with required production time is to maintain an efficient and cost-effective manufacturing process while meeting customer demand. Continuous monitoring, adjustments, and optimization are often necessary as production requirements and resource availability can change over time.

In practice, various tools and software systems, such as Manufacturing Resource Planning (MRP) and Enterprise Resource Planning (ERP) systems, can help manufacturers manage these aspects of production planning and scheduling efficiently. These systems enable real-time tracking of production capacity, demand, and resource allocation, making it easier to make informed decisions to balance

production time effectively. The steps taken, among others, can be done by adding machines, increasing working hours/overtime, subcontracting, and increasing labor.

## Results and Discussion

### *Process description and production capacity data*

This research was conducted by describing the t-shirt production process from start to finish and collecting data on the t-shirt production capacity. This is done to see concretely the suitability between the product forecasting value and production capacity. Balancing production capacity with product forecasting values is crucial for ensuring that a manufacturing operation can meet customer demand efficiently (Tien et al., 2019). Regular monitoring, adjustment, and coordination among different departments (such as sales, production, and procurement) are essential to maintaining this balance. This allows companies to adapt to changing market conditions, unexpected demand fluctuations, and other variables that can affect the alignment between forecasted demand and production capacity. The following is the sequence of the t-shirt production process in the company (Figure 1):

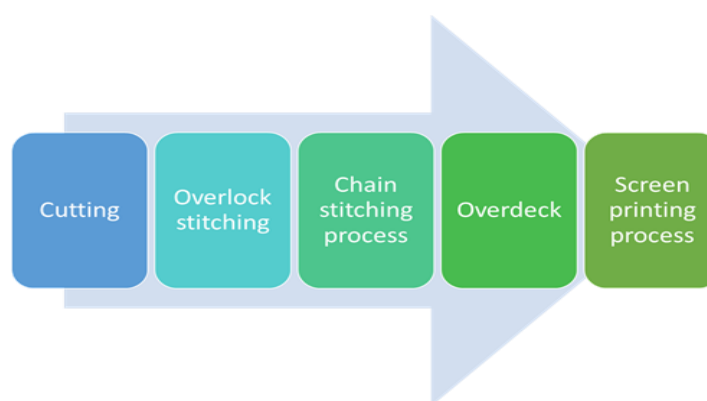


Figure 1. T-shirt production process

The capacity that can be produced in each process consisting of cutting, over-lock stitching, chain stitching process, over the deck, and screen-printing process in one of the garment companies in Surabaya, with the following details (Table 1):

Table 1. Production capacity data

No.	Process	Machine capacity (pcs/day)	Total machine	Total capacity (pcs/day)
1.	Cutting	151	4	604
2.	Overlock stitching	117	4	468
3.	Chain stitching process	687	4	2748
4.	Over deck	619	4	2476
5.	Screen printing process	454	2	908

### *Work time measurement*

Measurement of work time is carried out using the stopwatch method (stopwatch time study) repetitively. The stopwatch method, also known as the stopwatch time study, is a widely used technique in industrial engineering and manufacturing for measuring work time, particularly in repetitive tasks (Illing et al., 2020; Jäger et al., 2022). It is a fundamental part of time and motion studies aimed at improving efficiency, productivity, and process optimization. The reason researchers use stopwatches in this work measurement is because the work process that takes place has the characteristics of work that can be specified, the work that takes place is repetitive and produces

relatively the same output. The following is the data from the measurement of work time at each station, namely (Table 2):

At the production price, it is known that producing t-shirts, it requires a worktime of 55000 while overtime is 55500 and sub-count is 5620 with demand data of 47750 pcs per year.

### **Bill of Material**

A Bill of Materials (BOM) is a structured list of components, parts, and raw materials required to manufacture or assemble a product (Acerbi et al., 2021). The bill of materials (BOM) of t-shirt products consists of fabric and yarn, with the BOM as follows in Figure 2:

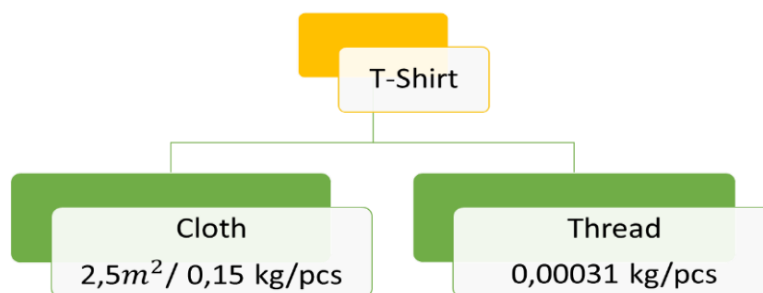


Figure 2. BOM on t-shirt job

### **Calculation of forecasting recommendations**

The calculation of forecasting recommendations is carried out to balance the capacity value with consumer demand. forecasting recommendations are used to predict future consumer demand, which is then used to ensure that an organization's capacity is aligned with that demand. This helps to optimize resource allocation, improve customer service, and enhance overall operational efficiency. An accurate forecasting value is needed with an error value or difference that is not too far away. Therefore, while striving for the highest level of accuracy, it's crucial to understand that some level of forecasting error is inherent in any model or method. The recommendation for forecasting calculations is considered very important in this study. In the calculation of forecasting recommendations from the production of shirts in a year, the Moving Range value is 7786, with a calculation result of 1112.71, which means that it is within the limits of BKA and BKB or can be said to be good. While the calculation of the total standard time is 0.1197 hours/shirt.

### **RCCP calculation**

After the calculation of forecasting recommendations, the RCCP calculation is carried out on t-shirt production as the basis of production capacity planning that focuses on workstations or production centers in a manufacturing company. Rough-Cut Capacity Planning (RCCP) is an essential step in the production planning and control process for manufacturing companies. It serves as a bridge between the production forecast and the actual production planning, helping to ensure that the required capacity is available to meet production demands, particularly in the context of t-shirt production or any manufacturing operation. RCCP focuses on aligning the production capacity with the forecasted demand by examining the production facilities, workstations, or production centers within a manufacturing company. It's especially important for companies, such as those involved in T-shirt production, where efficient capacity planning can significantly impact operations. The RCCP calculation is obtained from the product of production demand and standard time. The RCCP calculation is exemplified in the first month. In the first month, RCCP results amounted to 490.77 hours.

### **Calculation of production capacity shortage with overtime**

After identifying the total length of working days, worktime shortages, and overtime in the work on t-shirt products for one year, it is known that the overtime cost is Rp. 426,796,700.00. The results show that 2 months in 1 year still experience a shortage of production time, and this is still considered or said to be not good.

### **Calculation of production capacity shortage with sub-contract**

Based on data about working hours and days, production prices, raw time, lack of production capacity with overtime, and production capacity with overtime, it can produce a calculation of the amount of money that must be paid to the sub-contract. Sub-contract costs are the result of multiplying overtime by the price per pcs of sub-contract with a total result in a year of IDR 117.345.600.00.

### **Conclusion**

Based on the results of calculations that have been carried out using the Rough-Cut Capacity Planning (RCCP) method, it can be seen that the T-shirt job has a shortage of time on work time. It is necessary to continue with overtime and sub-contract on T-shirt jobs. By doing overtime details in 1 year, there is still a shortage in terms of meeting demand. The sub-contract still experiences a shortage with a detailed final price of IDR 117,345,600.

Based on the analysis using the Rough-Cut Capacity Planning (RCCP) method, this is due to several possibilities, including the lack of accuracy when doing the forecast with the existing reality, the existence of tools and machines that experience interference (error), and other factors. Therefore, the company requires Overtime and sub-contract (3rd party) to assist in fulfilling consumer demand. So that the production process in the company can anticipate soaring demand at any time. When a manufacturing company anticipates soaring consumer demand that cannot be met through regular production capacity, it may resort to using overtime and subcontracting (third-party assistance) to bridge the gap.

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