



## ANALYSIS OF PRODUCTION CAPACITY PLANNING AND CONTROL IN PT. KRAKATAU WAJATAMA WITH ROUGHT CUT CAPACITY PLANNING (RCCP)

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### ABSTRACT

Production planning and control is an absolute must for companies that produce goods or services. This is considered very important because it is the core of the entire production process. Every company may not carry out a production activity if it does not conduct production planning and control activities. Production plan at PT. Krakatau Wajatama on capacity planning and production of profile steel products requires a production plan based on demand that might come so that it needs an appropriate plan so that there is no overproduction. Therefore, integration between production plans and capacity plans needs to be done in order to obtain a realistic production plan. The method used is forecasting, capacity planning using RCCP can be done with the conversion process of the Production Plan or MPS based on order requests in bales in the period January 2019 to December 2019 into the time requirement of the production machine. Estimated results of 2019 demand for profile steel production are IWF-Flange, U-Chanal, L-Angels. In January 2019 it was 250836,713 minutes, February 2019 was 225731.5425 minutes, March 2019, and for IWF-Flange, U-Chanal, L-Angels products. In January 2019 it was 298080 minutes, February 2019 was 259200 minutes, March 2019 was 298080 minutes. company capacity planning needs on profile steel products namely IWF-Flange, U-Chanal, L-Angels using machine capacity that is used multiplied by hours per shift at times of shifts per day multiplied by workdays per period by converting production plans or MPS into capacity by using the RCCP concept with the Capacity Planning Using Overall Factors (CPOF) method.

Keywords: *Bill Of Labor Aproach (BOLA), Capacity Forecasting Rough Cut Capacity Planning*

### 1. INTRODUCTION

Planning and control of production is a thing absolutely that should be done by companies that produce goods or services. This is considered very important because it is the core of the entire production process. Each company is not probably going to do an activity of production, if not perform the activities of planning and control of production, because it affects directly to the amount of product that will be made, the number of sources of power ( force labor , machinery and facilities etc.) that will be used , as well as the level of achievement of the results of production on every period according to order.

Planning Capacity is the process to determine the capacity of production that takes an organization to meet the demand that keeps changing. The term "capacity" is the amount of maximum work of the organization are able to menyelesaikan in a time that is specified. Harianto, E. (2009) The difference between the capacity of the organization and request the customer will result in inefficiency, either in the form of resources are unemployed or customers are not satisfied. The goal of capacity



planning is to minimize this difference. Demand varies based on changes in the output of production, for example the increase or decrease in the number of products that exist, or producing the product new. Harianto, E. (2009).

If firms are not able to resolve the capacity of its production to the level of demand for the company will lose the chance of customers and the opportunity to earn profits more. By because the planning capacity that do it systematically is the thing most important to the company.

PT Krakatau Wajatama is a company that is engaged in the field of Steel produces steel profile and steel reinforcement. The entire production process uses a machine. Although the machine is very instrumental, human remains extremely necessary for the sake of the smooth production. The capacity of the engine is very influential in doing the planning capacity of company's production. One of the products that I research is the Profile Steel product with Billet and Bloom raw materials obtained from Krakatau Steel, Russia, Korea, India, Turkey, Brazil, Malaysia, Japan and others. Planning the capacity of production of steel profiles that must be considered in order to request the customer or market can be met and not exceeded of production are provided by the company.

Planning capacity by using RCCP can be done with the process of conversion of Plan Production or MPS based order request in bales in the period January 2019 to December 2019 to the needs of the capacity of a machine production. With RCCP illustrates the capacity demand compared to the capacity of the company as the view of the needs of capacity in future time based on planned and issued orders over a certain period of time.

Based on the description, this research will be conducted to research to know how the needs of the capacity of production at the company by using Rough Cut Capacity Planning (RCCP) with methods BALL (Bill Of Labor Oproach).

## 2. RESEARCH METHOD

The method of research on the planning capacity of production of which is the Capacity Planning Factors coveralls using (CPOF), Bill of Labor Approach (BALL), and Resources profile approach (RPA).

### 2.1 Production Capacity

The capacity of production is the number of maximum output that can be produced in a unit of time specified, which is determined by the capacity of the resource that is owned, such as the capacity of the machine , the capacity of power work, the capacity of materials raw and capacity of capital ( Yamit, 2003). There are several types of capacity planning:

- (1) Short- term capacity planning, and
- (2) Long - term capacity planning.

Planning capacity -term short is used to handle it automatically the things that are sudden, for the fulfillment of the needs that are suddenly that must be met in time short.

According to (Krajewzki & Ritzman, 1989) in (Yamit, 2003), there are several ways to increase short-term capacity:

- (1) Increasing the amount of resources,
- (2) Improve resource use,
- (3) Modifying the product,
- (4) Improve demand, and
- (5) Does not fulfill demand.

While planning capacity period length is a strategy operation for the face of all the possibilities that occur, where the possibilities are already estimated earlier.

Some definitions of capacity in general is as follows:

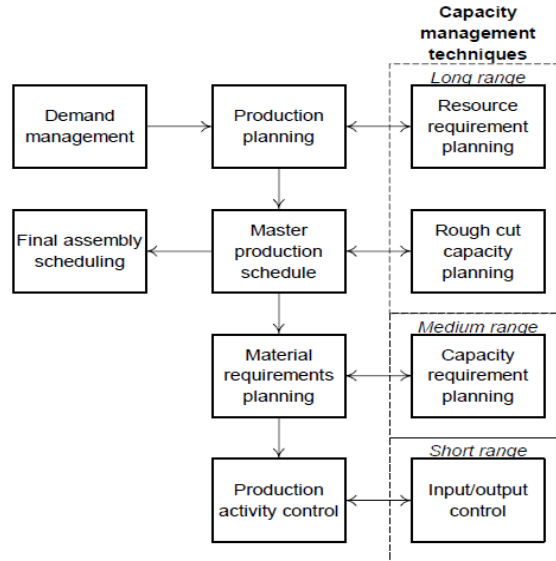
Design capacity is the level of output per unit time the factory is designed Rated capacity is the level of output per unit of time which indicates that the FASI litas is theoretical has the ability to produce.

Standard capacity is the level of output per unit of time which is defined as the "target" operation for the management, supervision and the operator machine.

Actual / operating capacity is the level of output on average per unit of time during the periods of time that has passed.



Peak capacity is the amount of output per unit of time that can be achieved through maximizing the output, and may be done by working overtime, add personnel work, remove the delays, reducing the hours of rest, etc.



**Figure 1.** Capacity Planning (Fogarty,dkk,1991)

Factory Capacity is the number of products that can be made in a certain time period. The term capacity can be viewed from four perspectives:

- (1) The capacity of the design is the output maximum in conditions ideal (not there is a conflict of scheduling, is not there a product defect / damaged, maintenance only the routine, and so forth).
- (2) Effective capacity shows the maximum output at the maximum output level of a certain operation. Generally the effective capacity is lower than the design capacity.
- (3) The capacity of the actual show output tangible that can be generated by the facility. The actual capacity must be worked out the same as the effective capacity.
- (4) In capacity planning there are 3 strategies:
  1. Capacity lead strategy is capacity is ahead of emand. The strategy is suitable for the market in the present.
  2. Capacity lag strategy is capacity is under demand. This strategy has the opportunity to experience losses.
  3. Average lead strategy capacity is aligned with demand where capacity that there are numbers that are available only as much demand.

**2.2 Rought Cut Capacity Planning (RCCP)**

This method changes the long - term production plan to the capacity requirements that will be compared to the available capacity. RCCP is a tool for verifying MPS. (Fogarty, et al, 1991)

Obstacles in implementing capacity management:

1. Need a lot of data
2. The process is iterative so it requires a lot of time
3. MPS is not stable

RCCP calculations used three methods (Fogarty, et al , 1991):

1. Capacity Planning using Overall Factors (CPOF)

The method that uses historical data and to determine the percentage of hours of production in total at the station work. This percentage is used to estimate work capacity at each work station for each time the master production schedule.

Capacity Planning Using Overall Factors (CPOF) requires three data inputs. The data is as follows:



- a. MPS, MPS Data were prepared accounted for RCCP is in the form of units of time that can be done by multiplying the number of units that had been planned in the MPS at the time produce one unit of product.
- b. Data that states the total time to produce one type of product. Data is obtained by summing all the time that is required from each station work that is required to produce one unit of product from each - each type.
- c. The last data is the historical comparison data between work stations. This data will be used to calculate work capacity at each work station in each MPS period. .

2. Bill of Labor Approach (BOLA)

Methods that use the approach of the list of personnel work using the details of the data on the time standard for each product on station working.

3. Resources profile approach (RPA)

The approach method is there a difference with both methods at the top of which is located on the allocation of hours of production weekly on the station work individually. Load profile as a display of future capacity requirements based on planned and issued orders over a certain period of time . The calculation of critical resources is the use of machine hours to make a time capacity requirements report from the production process based on RCCP analysis for the feasibility of the master production schedule.

The five steps of RCCP include:

1. Obtain information about the production plan from MPS
2. Obtain information about product structure and lead time .
3. Determine the Bill of Resources
4. Calculate the requirements source power specific and make reports RCCP
5. Furthermore, the results of the RCCP are displayed in a diagram known as a Load Profile to illustrate the required capacity versus the available capacity. Load Profile is defined as a display of future capacity requirements based on planned and issued orders over a certain period of time.

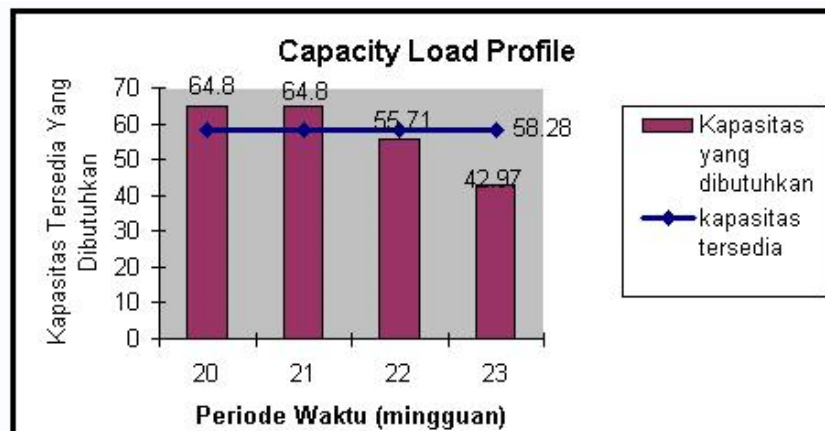


Figure 2. Example Load profile

Validation of the RCCP said to be feasible if the capacity that is needed everything can be met by the capacity available. Sugiyono, A. Rough-Cut Capacity Planning.

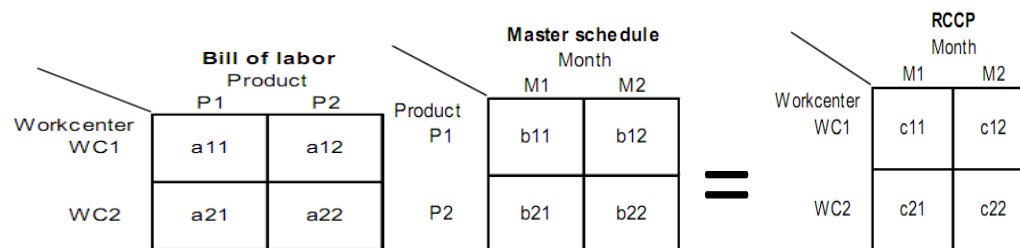
3.3 BOLA (Bill Of Labor Aproach)

BOLA (Bill of Labor Aproach) in principle is the multiplication of the processing time matrix with the MPS matrix (production plan). The results of the multiplicative is the total time it takes, because the mechanism that uses multiplication matrix, then BALL tend suitable for the calculation of capacity to the plant with a number of items of products is more than one kind.

Steps of RCCP with BALLS:



1. Calculate the machine time allocation for a product (or component) on each machine, then calculate the total time.
2. Calculate the proportion of processing time for each machine.
3. Determine the value of the time that is required to work on the product/components in accordance with the number of planned production (MPS).
4. Determine the time value on each machine based on the proportion of processing time.
5. Calculate the possible available time capacity for each machine (consider, maintenance, holidays, etc.)
6. Make a graph, then check whether all periods (months) time values (point 4) are all below available capacity (point 5), if yes, then MPS is valid, if not MPS needs to be revised.



**Figure 3.** Illustration of matrix multiplication

### 3. RESULTS AND DISCUSSION

The process of production which is used by PT Krakatau Wajatama in producing steel profiles using the machine automatically. Starting from material crude which called billets/ blooms (slab steel), which is an ingredient of raw import.

The process of production of steel profile consists of stages as follows:

- a) Billet or Blooms are as material raw early transported from the warehouse of materials by using the instrument of conveyance (Transfer Car) which is called Crane.
- b) Then the billets or blooms are inserted into the furnace, here the billets or blooms are heated to a temperature of 1200 °C with heating duration depending on the size of the billets or blooms processed. Furnace using the residue as a material fuel.
- c) After heated and then inserted into the process Rolling Miil, which is divided into five booths include:
  - d) Stand 1 (Rowging), with a rough forming Rolling Mill process.
  - e) Stand 2 (Freparing), this process is the preparation for forming rolling miil on stand 3.
  - f) Stand 3 (Universal), at the stand is the billets or blooms formed in accordance with the needs.
  - g) Stand 4 (Edging). the process of forming high foot billets or blooms.
  - h) Stand 5 (Finishing), the rolling process miil the latter.
- i) After passing through the processes that exist in each stand, then entered into the table cooling (Cooling Bed), which was previously the tip of the steel profile is flattened by means of cutting the so-called Hot Saw.
- j) Once on the table cooling the steel then straightened in Straightening Machine.
- k) Steel cut according to size, after the steel is checked and then do the packing and fastened.
- l) Then the steel is labeled and stored in a warehouse.

#### 3.1 Preparation of the Master Production Schedule (MPS)

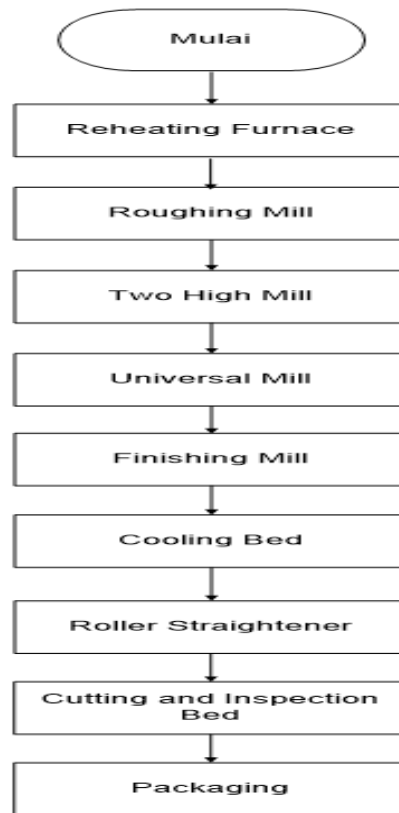
Estimated demand which was obtained was in the form of groups of products (product group) that needs to be done decomposition demand product group into demand for individual products. In Table 3 .1 shows a data unit of MPS in the month of January 2018 until the Dese mber 2018 which will be used to



calculate the capacity demands on product Steel profile that is in the form of Wide flange, U- Chanal, and L-Angel is as follows:

**Table 1. Data on the MPS unit in January 2018 till December 2018**

		Demand (ton)		
No	Month	Wide Flange	U-Chanal	L-Angel
1	January	39,527	39,908	39,975
2	February	36,771	35,071	35,617
3	March	38,011	40,040	39,205
4	April	41,922	38,950	39,447
5	May	39,367	41,021	38,685
6	June	41,500	39,300	39,500
7	July	39,000	39,500	38,500
8	August	40,000	39,800	38,950
9	September	39,500	39,700	39,500
10	October	38,500	41,300	39,500
11	November	39,000	38,900	38,700
12	December	40,500	41,000	40,200
	Total	473,598	474,490	467,779



**Figure 4.** Process flow profiles of steel products

The following is the data of the work process for each work center in the process of making Steel Profile products in the form of Wide flange, U- Chanal, and L-Angel:

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

Needs capacity (Capacity Requirement / CR) in each month is calculated by a formula as follows:



$$CR = QA \cdot cA + QB \cdot cB \dots\dots\dots(1) \text{ with the information:}$$

CR = Capacity requirements (hours)

QA = Product A (unit) production plan

CA = capacity requirements per product unit A (hours / units)

QB = Product B production plan (unit)

CB = Needs its capacity s per unit of product B (h / unit).

Standard capacity requirements per product unit in each work center are calculated based on setup time and operating time. To calculate the standard needs of capacity per unit on each work center used formula as follows:

$$c = s + o \dots\dots\dots(2)$$

with the information:

c = Capacity requirements per unit (hour / unit)

s = Average setup time (hours / unit)

o = Operating time per unit (hour / unit)

Standard capacity requirements per unit at each work center can be seen in Table 3.

**Table 2. Data time workmanship for Products Steel Profile**

<i>Work Center</i>	<i>Talk Time (menit/ton/work center)</i>		
	<i>Wide Flange</i>	<i>U-Chanal</i>	<i>L-Angel</i>
<i>Reheating Furnace</i>	0.4711	0.4712	0.4711
<i>Roughing Mill</i>	0.0894	0.0895	0.0895
<i>Two High Mill</i>	0.0612	0.0613	0.0613
<i>Universal Mill</i>	0.0772	0.0773	0.0772
<i>Finishing Mill</i>	0.0983	0.0984	0.0983
<i>Cooling Bed</i>	0.8611	0.8611	0.8611
<i>Roller Staighstener</i>	0.0533	0.0533	0.0533
<i>Cutting and Inspection Bed</i>	0.3242	0.3242	0.3242
<i>Packaging</i>	0.0646	0.0646	0.0646
<b>Total</b>	<b>2.1004</b>	<b>2.1009</b>	<b>2.1006</b>

Here is the data capacity of the engine in the process of product Steel profile which form Wide flange, U- Chanal, and L-Angel by work center, machine and the number of machines that are used.

**Table 3. Engine capacity data for Steel Product Profiles**

<i>Work Center</i>	<i>Machine</i>	<i>Number of Machine</i>
<i>Reheating Furnace</i>	<i>Furnace</i>	1
<i>Roughing Mill</i>	<i>Mill</i>	1
<i>Two High Mill</i>	<i>Two High</i>	1



	<i>Mill</i>	
	<i>Universal</i>	
<i>Universal Mill</i>	<i>Mill</i>	1
	<i>Finishing</i>	
<i>Finishing Mill</i>	<i>Mill</i>	1
<i>Cooling Bed</i>	<i>Cooling Bed</i>	1
<i>Roller</i>	<i>Roller</i>	
<i>Staightener</i>	<i>Staightening</i>	1
<i>Cutting and</i>		
<i>Inspection Bed</i>	<i>Cutting</i>	1
<i>Packaging</i>	<i>Packaging</i>	1
<b>Total</b>		<b>9</b>

In processing the data to obtain the value of capacity demand by using the concept RCCP by using methods Bill Of Labor approach (BALL). In Table 3.4 explains the calculation of ka pasitas demand for the product Steel Profile Be appearance Wide flange, U- Chanal, and L-Angel by time (download it) per period of months.

**Table 4. Demand capacity data for Steel Product Profiles ( minutes )**

Machine	January	February	March	April	May	June	July	August	September	October	November	December
<i>Furnace</i>	56258.0418	50627.442	36376.9288	56686.1759	56099.392	56677.26	55122.65	55947.105	55923.54	56206.36	54934.15	57336.97
<i>Roughing Mill</i>	10683.2423	9613.9034	10490.6109	10764.3583	10653.097	10762.7	10467.6	10624.125	10619.7	10673.5	10431.8	10888.1
<i>Two High Mill</i>	7315.8803	6583.5596	7183.9917	7371.3625	7295.2382	7370.24	7168.2	7275.375	7272.36	7309.24	7143.68	7456.16
<i>Universal Mill</i>	9222.4428	8299.3419	9056.1672	9292.5218	9196.5377	9291.09	9036.35	9171.48	9167.61	9214.09	9005.41	9399.34
<i>Finishing Mill</i>	11741.9938	10566.7268	11530.2688	11831.2527	11708.978	11829.42	11505.05	11677.105	11672.18	11731.32	11465.67	11967.21
<i>Cooling Bed</i>	102823.951	92532.9449	100969.142	103606.691	102533.76	103590.33	100748.7	102255.625	102212.57	102729.23	100404.26	104795.87
<i>Roller</i>												
<i>Staightening</i>	6364.553	5727.5647	6249.7448	6413.0027	6346.5909	6411.99	6236.1	6329.375	6326.71	6358.69	6214.78	6486.61
<i>Cutting</i>	38712.722	34838.2078	38014.3952	39007.4198	38603.467	39001.26	37931.4	38498.75	38482.54	38677.06	37801.72	39455.14
<i>Packaging</i>	7713.886	6941.8514	7574.7376	7772.6074	7692.1158	7771.38	7558.2	7671.25	7668.02	7706.78	7532.36	7861.82
<b>Demand</b>	<b>250836.713</b>	<b>225731.5425</b>	<b>227445.987</b>	<b>252745.392</b>	<b>250129.18</b>	<b>252705.67</b>	<b>245774.25</b>	<b>249450.19</b>	<b>249345.23</b>	<b>250606.27</b>	<b>244933.83</b>	<b>255647.22</b>
<b>Capacity Total</b>												

Capacity available (CA) in each month is calculated based on the percentage of operator work , hours of work per week , number of weeks , efficiency and utilization factors . The capacity available is calculated by a formula as follows:

$$CA = p \cdot h \cdot w \cdot e \cdot u \dots\dots\dots (3)$$

with information:

- CA = Capacity available (hours)
- P = Percentage of work (%)
- H = Working hours per week (hours/week)
- W = Number of weeks (weeks)
- E = Efficiency
- U = Utilization

Example calculation in January 2018:





*Furnace Machine* = demand (ton) x processing time ( minutes / ton / workcenter )  
 = ( 39527x0.4711) + ( 39908x0.4712) + (39975x 0.4711)  
 = 56258.0418

*Roughing Mill* = demand (tonnes) x time proses ( min / ton / workcenter )  
 = ( 39527x0.0894) + ( 39908x0.0895) + (39975x0.0895)  
 = 10683.2423

*Two Hogh Mill* = demand (ton) x processing time ( minutes / ton / workcenter )  
 = ( 39527x0.0612) + ( 39908x0.0613) + (39975x0.0613)  
 = 7315.8803

*Universal Mill* = demand (ton) x processing time ( minutes / ton / workcenter )  
 = ( 39527x0.0772) + ( 39908x0.0773) + (39975x0.0772)  
 = 9222.4428

*Finishing Mill* = demand (ton) x processing time ( minutes / ton / workcenter )  
 = ( 39527x0.0983) + ( 39908x0.0984) + (39975x0.0983)  
 = 11741.9938

*Cooling Bed* = demand (ton) x processing time ( minutes / ton / workcenter )  
 = ( 39527x0.8611) + (39908x0.8611) + (39975x0.8611)  
 = 102823,951

*Straightening Roller* = demand (ton) x processing time ( minutes / ton / workcenter )  
 = ( 39527x0.0533) + (39908x0.0533) + (39975x0.0533)  
 = 6364,553

*Cutting* = demand (ton) x processing time (minutes / ton / workcenter )  
 = ( 39527x0.3242) + (39908x0.3242) + (39975x0.3242)  
 = 38712,722

*Packaging* = demand (ton) x processing time (minutes / ton / workcenter ) =  
 (39527x0.0646) + (39908x0.0646) + (39975x0.0646)  
 = 7713,886

Total demand capacity = *Work Work Center capacity*  
 = (56258.0418+10683.2423+ 7315.8803 + 9222.4428 + 11741.9983 +  
 102823.951 + 6364.553 + 38712.722 + 7713.886)  
 = 250836,713 Minutes

On the table at the bottom is pointing right capacity perusa pany based on the number of machines (work center) and the capacity of time ( minutes ) per period of months.

**Table 5. Plans capacity of the company (minutes)**

Month	Total Machine (Work Center)	Shift Per Day	Minute Per Shift	Work Day Per Month	Company's Capacity
January	9	3	480	23	298080
February	9	3	480	20	259200
March	9	3	480	23	298080
April	9	3	480	22	285120
May	9	3	480	23	298080
June	9	3	480	22	285120
July	9	3	480	23	298080
August	9	3	480	23	298080
September	9	3	480	22	285120
October	9	3	480	23	298080
November	9	3	480	22	285120
December	9	3	480	23	298080



Example calculation of the month January 2019

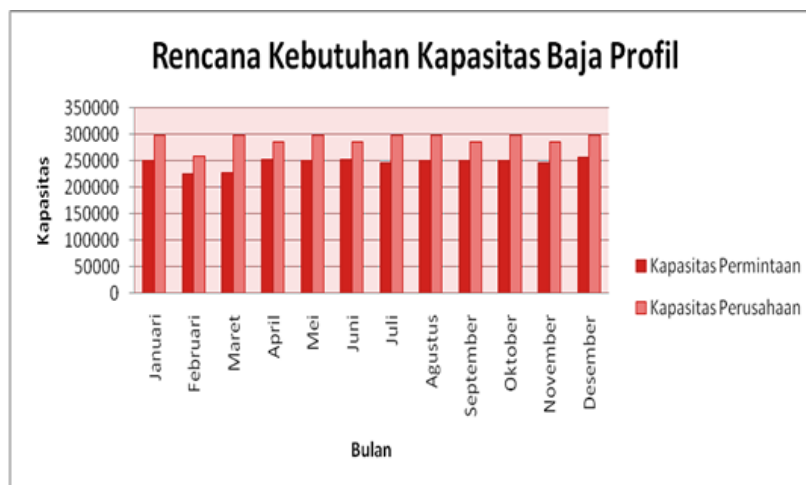
Capacity Company = The number of machines (work center) x shifts per day x minute per shift x days of work per month = 9 x 3 x 480 x 23 = 298 080 min

The following is the plan for capacity requirements for Profile products in the form of Wide flange, U-Chanal, and L-Angel.

**Table 6. Plan Profile Steel capacity requirements**

Month	Company Capacity (minute)	Demand Capacity (minute)
January	298080	250836.713
February	259200	225731.542
March	298080	227455.987
April	285120	252745.392
May	298080	250129.18
June	285120	252705.67
July	298080	245774.25
August	298080	249450.19
September	285120	249345.23
October	298080	250606.27
November	285120	244933.83
December	298080	255647.22

Comparison chart between the needs of capacity demand with the needs of the capacity of the company



**Figure 5. Comparison graph between the needs of capacity demand with the needs of the capacity of the company**

**Results**



### 1. Demand capacity for profile steel yarn products

Based on data demand capacity in each month that is used for the profile steel production process, namely IWF-Flange, U- Chanal, L- Angels. In the month of January 2019 amounted to 250836.713 minutes, the month of February 2019 amounted to 225731.5425 minutes, the month of March 2019 amounted to 227445.987 minutes, the month of April 2019 amounted to 252745.392 minutes, the month of May 2019 amounted to 250129.18 minutes, the month of June 2019 amounted to 252705.67 minutes, the month of July 2019 amounted to 245774.25 minutes, in August 2019 amounting to 249450.19 minutes, the month of September 2019 amounted to 249345.23 minutes, the month of October 2019 amounting to 250606.27 minutes, the month of November 2019 amounted to 244933.83 minutes, the month of December 2019 amounted to 255647.22. The value of the demand capacity in each month is different depending on the order demand per month period that is different.

### 2. Company capacity for profile steel yarn products

Based on the data capacity of the company in each month that is used to process the production of steel profile that is the IWF-Flange, U-Chanal, L-Angels. In the month of January 2019 amounted to 298 080 minutes, the month of February 2019 amounted to 259 200 minutes, the month of March 2019 amounted to 298 080 minutes, the month of April 2019 amounted to 285 120 minutes , the month of May 2019 amounted to 298 080 minutes, the month of June 2019 amounted to 298 080 minutes, the month of July 2019 amounted to 285 120 minutes, in August 2019 amounted to 298 080 minutes , the month of September 2019 285 120 minutes, the month of October 2019 amounted to 298 080 minutes, the month of November 2019 amounted to 285 120 minutes , the month of December 2019 amounted to 298 080 min. The value of a company's capacity varies each month depending on the number of working days per month period.

### 3. Verify Capacity Demand with Capacity Company

On verification unit capacity provides information capacity demand and the capacity of the company within a minute per period of months, where the value of the capacity of the company is large compared with the capacity demand. So order requests can be fulfilled by the company and plan capacity demand that could in the received and processed on the floor production.

## 4. CONCLUSION

Determining the planning needs of the capacity of the company on product steel profile that is the IWF-Flange, U- Chanal , L-Angels by using the capacity of the machine that is used multiplied by the hours per shift at the time shifts per day multiplied by days of work per period by converting a planned production or MPS to the capacity to use the concept RCCP with methods capacity Planning Factors using Overall (CPOF) and then analyzing the capacity of the company meet the needs of capacity demand by calculating individual needs and can be concluded ability of companies to meet the needs of demand and can be processed on the floor production.

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