Production Plan To Minimize Production Cost In Cv Una Surya Putra Mandiri

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Abstract*— Indonesia as the world's archipelagic country have Indonesia have almost 3,8 million hectares of coconut plant. That lead Indonesia to one of the biggest countries in exporting the coconut product. One of the products that has been exported is desiccated coconut. The interest of desiccated coconut is increasing in several countries. CV Una Surya Putra Mandiri is one of the that producing the desiccated coconut. This company use the principle of make to stock because of the raw material that was easy to be spoiled. Due to the uncertainty of the demand fluctuations, the company was struggling in producing the righty amount of product. So, the production of the company mostly get overproduction that cause the overstock in inventory while the production must go on. Based on the problem occur, this research has an objective to minimize the overproduction and backorder. In minimized the production cost, they are needing a production planning. In the other word, production planning will be determined the forecasting demand, the resource availability, and the schedule to fulfil the demand. The output in this research is finding the minimum production cost using the planned production to fulfil the demand

Keywords: Production Planning, Demand Forecasting, Rough Cut Capacity Planning, Scheduling, Uncontrolled Production

I. INTRODUCTION

A. Background

CV Una Surya Putra Mandiri (Unsypa) is one of the companies that contribute on exporting desiccated coconut. This company is an agricultural production company that sell processed coconut product. This company was found in 2011 and stared businesses as desiccated coconut manufacturing company for human consumption (DC for food) and for animal feed (DC for feed). CV Una Surya Putra Mandiri has sold their product overseas such as Japan, Korea, Europe, Brazil, Pakistan, China, and middle east. Since Indonesia is known as world's archipelagic country the distribution of the coconut is scattered in several island around Indonesia, the CV Una Surya Putra Mandiri manufacturing facilities are also spread throughout Indonesia close to coconut-producing areas.

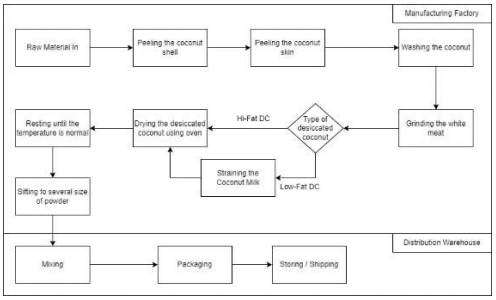

FIGURE 1
Production Flow of CV Una Surya Putra

The figure 2 shows the CV Una Surya Putra Mandiri production output and demand in 2021. The graphic shows the production output that is produce more than the demand needed. In other month, the production output is under the demand.

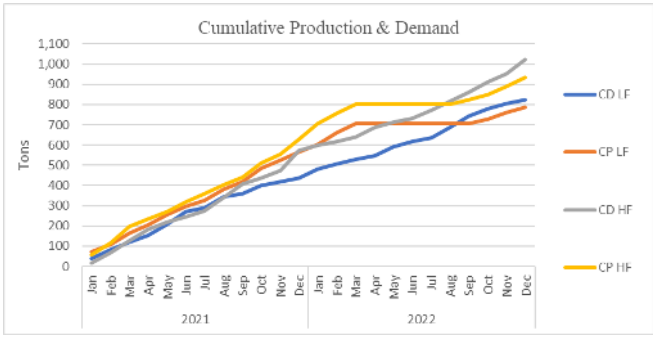

FIGURE 2
Cumulative Demand and Production Output 2021-2022

According to make to stock production, the production output will impact the inventory. The data of the end inventory for each month can be seen in figure 3.

FIGURE 3
Finished Good Stock in 2021

Due to the limitation on inventory warehouse, the company decided to stop the production in early 2022. The demand fluctuations are not predicted that make the production is uncontrolled. In the late of 2022 the demand for the product is increasing that make the production started again after several month. The preparation on production makes the demand is not fulfilled and backorder is occurred. Table 1. show the lateness of the shipment. In the fulfilment of the demand, the company use subcontracting to other company in the product to help the production on accomplishing the demand.

TABLE 1
Export Realization in 2022

Product	PO	Shipment Date	Lateness	Quantity (Kgs)
High-Fat	31-Aug-22	15-Oct-22	25 Days	25,000
Low-Fat	7-Sep-22	10-Oct-22	13 Days	23,000
High-Fat	17-Sep-22	29-Oct-22	22 Days	23,000
Low-Fat	20-Sep-22	29-Oct-22	19 Days	16,500
High-Fat	28-Sep-22	1-Nov-22	14 Days	18,000
Low-Fat	5-Oct-22	16-Nov-22	22 Days	16,000
High-Fat	8-Oct-22	9-Nov-22	12 Days	25,000
High-Fat	15-Oct-22	21-Nov-22	17 Days	26,500
Low-Fat	19-Oct-22	30-Nov-22	22 Days	20,065
Low-Fat	10-Nov-22	25-Dec-22	25 Days	26,000
High-Fat	15-Nov-22	15-Dec-22	10 Days	18,009
High-Fat	27-Nov-22	30-Dec-22	13 Days	24,000
High-Fat	1-Dec-22	unfulfilled	unfulfilled	25,635
High-Fat	10-Dec-22	unfulfilled	unfulfilled	18,000
High-Fat	21-Dec-22	unfulfilled	unfulfilled	25,000
Total				329,709

Beside the lateness and overstock, it is better to investigate the production floor. It is determined that the production floor has an idle machine. Table 2 show the idle time of the machine in normal day. The idle time show the in non-effectiveness of the production. Based on the production floor, it can be concluded that the machine might causes the lateness on the shipment. It can be concluded that the main problem is that they have uncontrolled production.

TABLE 2
Machine Idle Time

Machine	total working/day (minute)	Machine running	idle time (%)
Grinding the white meat	840	360	57.14%
Straining the Coconut Milk	840	440	47.62%
Drying using Oven	840	840	0.00%
Sifting	840	840	0.00%

B. Problem Definition

1. How forecasting demand affects the excessive inventory or backorder in producing desiccated coconut in CV Una Surya Putra Mandiri?
2. How rough-cut capacity planning reducing the cost and preventing backorder in CV Una Surya Putra Mandiri?
3. How scheduling machine optimize desiccated coconut production in CV Una Surya Putra Mandiri?

C. Purpose

1. Forecasting demand to prevent the overstock and backorder in CV Una Surya Putra Mandiri.
2. Rough-cut capacity planning to reducing production cost and prevent backorder in CV Una Surya Putra Mandiri.
3. Effect of machine scheduling to production in CV Una Surya Putra Mandiri.

D. Benefits

1. This research can provide the production planning in producing desiccated coconut to be implemented in CV. Una Surya Putra Mandiri.
2. This research can provide the implemented of production planning in facing excessive inventory or backorder problem in CV. Una Surya Putra Mandiri.

II. LITERATURE REVIEW

A. Production Planning

Production planning means determining what, when, and how the product needs to be produced. The aim of the production planning is to produce the product to meet the need without excessive inventory or backorder (Sule, 2008).

B. Aggregation Unit Process

According to Sipper & Bulfin (1998), in aggregate unit, the different unit can be arranged using same unit measurement such as time or money. The aggregate unit can be determined by multiplying the time or money for each product by the demand.

C. Time Series Forecast

Based on Kusmirandi et al. (2019), forecasting is needed for determining how many products are needed this will help the company to decide and preparing the future state. forecasting demand is highly needed for a complex and dynamics demand. There are 3 terms in forecasting based on each needed. There are short-term, mid-term, long term. When choosing the method, the information of the data is important. Qualitative method used when there is no previous data available. In the other hand, the method used when the data is available is quantitative data.

Time series forecast is the method of forecasting that observes the data sequentially (Hyndman & Athanasopoulos, 2018). According to Baroto (2002), In Determine the best forecasting method. There are several characteristics in finding the best forecasting method. One of the characteristics is the pattern of the trend. There are 4 types of patterns, such as trend pattern, seasonal pattern, cyclical pattern and random pattern.

Forecasting is always doubtful. Therefore, the forecasting needs to be compared to the actual demand. The forecasting need verification to verify that the forecasting can represent the actual demand. The out-of-control test can be obtained using Moving Range Chart (MRC) that will compare the actual data with the forecasted value (Kusmindari et al., 2019).

D. Disaggregate Process

Disaggregate is the opposite of aggregate planning in which the disaggregate is used to break down the family item into a specific product. Aggregate units need to be disaggregated to allocate the resources (Nahmias & Olsen, 2015).

E. RCCP (Rough Cut Capacity Planning)

According to Kusmindari et al. (2019), BOLA is RCCP method that considered the detail time, such as standard time without considering the lead time. In the bill of labor approach there are two input data needed, namely bill of labor (list of the labor) and master production schedule. In calculating the BOLA, there are several steps, such as:

1. Make the MPS for each period.
2. Total manufacturing time that obtained from the labor list.
3. Calculate the capacity for each department.

F. CDS (Campbell, Dudek, and Smith) Scheduling

Campbell, Dudek, and Smith (CDS) algorithm is a heuristic algorithm that aiming on the makespan problem. CDS algorithm use Johnson's rules heuristically then determine several alternative scheduling that is compared each other until found the minimum makespan from the best alternative scheduling (Baker & Trietsch, 2019).

III. METHOD

The method is done starts with data collection stage. In this stage, the data will be gathered to be processed in the data processing stage. There are data required in data collection stage such as operational time data, demand data, capacity data, routing machine, processing time, and number of workers.

The second step as the main step is the data processing, the data that is already collected in the data collection is processed. The data processing has several steps such as calculating cycle time, do the aggregation process based on the cycle time, determining the optimal forecasting, do the disaggregation, that resulting the master production schedule. The master production schedule is verified by the RCCP to determine the capability of the available capacity to the capacity needed. If the master production schedule is not verified, the alternative to increasing the available capacity should be run. If the alternative is not working then the MPS no verified and need to change the MPS in the forecasting demand. In other hand, if the MPS is verified than the MPS is the result of the data processing. Then after the MPS is verified the last thing to do is production scheduling.

Last after data processing is analysis and conclusion of the research, in this stage the data that has been collected and processed is being analysed compared to the problem in identification stage. For data conclusion, the overall research is being concluded and giving the suggestion based on the research.

IV. RESULTS AND DISCUSSION

A. Aggregation Process

Since the product has a similarity with the only difference is the fat contain because of the coconut milk is not strained in making the high-fat desiccated coconut. Along with this similarity before forecasting the demand, it is recommended to do aggregation from desiccated coconut high fat and low fat to desiccated coconut for food. This aggregation will distribute the error of the forecast. In another hand, the aggregation unit process will minimize the error occur in one unit. The aggregation is done by multiplying the historical demand with the total standard time for each unit. The calculation can be seen below:

Aggregate high-fat in January 2021 = 17,785 × 8.45 = 150,321.34

Aggregate low-fat in January 2021 = 40,444 × 8.20 = 331,459.28

After knowing the aggregate of each unit, the result of each unit is summed up within the same period to become total aggregate.

Total aggregate in January 2021 = 150,321.34 + 331,459.28 = 481,780.62

Then, the aggregate unit will be divided with the total aggregate and multiply with 100 to determine the aggregation percentage.

Aggregation percentage of high-fat in January 2021 = 150,321.34/481,780.62 ×100%=31.20%

Aggregation percentage of low-fat in January 2021 = 331,459.28/481,780.62 ×100%=68.80%

The result of total aggregation percentage must be 100%. If the calculation is not 100% the calculation might have an error. Table 3 shows the result of aggregation process.

TABLE 3
Aggregation Result

Year	Month	Total Aggregate Unit
2021	JAN	481,780.61
	FEB	757,565.00
	MAR	835,899.89
	APR	713,157.64
	MAY	790,450.13
	JUN	729,850.75
	JUL	359,155.47
	AUG	1,043,352.15
	SEP	681,862.25
	OCT	577,705.59
	NOV	453,036.21
	DEC	997,958.51
2022	JAN	580,420.79
	FEB	382,573.07
	MAR	323,195.02
	APR	589,197.48
	MAY	580,973.28
	JUN	364,670.93
	JUL	494,441.96
	AUG	789,196.74
	SEP	821,607.03
	OCT	730,610.55
	NOV	568,149.32
	DEC	731,729.70

B. Forecasting 12 Period

Before doing the forecasting method, the initial step is determining the historical demand trend pattern. The pattern will determine the method that is suitable for forecasting. Figure 5 shows the aggregate demand in 2021 and 2022.

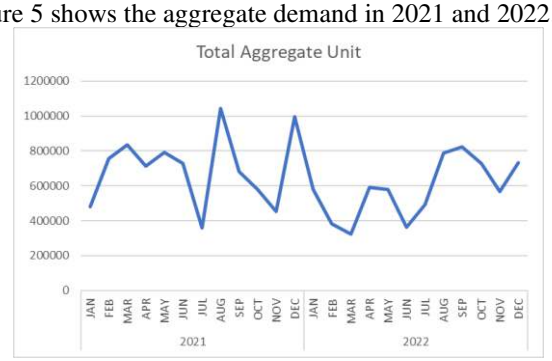

FIGURE 4
2021-2022 Demand Pattern

From the table above, it is known that the pattern is considered as a random pattern. For the random pattern it is suggested considering the ARIMA and exponential smoothing, that include holt's and winters method. The forecasting is done using IBM SPSS. IBM SPSS will compare the Exponential smoothing and ARIMA. The comparation will be choosing the minimum of RMSE, MAPE, and MAE. The following table shows the result of RMSE, MAPE, and MAE for ARIMA, Holt's and Winters method.

TABLE 4
Forecasting Method Error

	Holt's	Winter's	ARIMA
RMSE	205,577.26	128,066.23	194,917.81
MAPE	29.29	19.85	29.29
MAE	159,779.28	107,381.39	161,164.29

It has been determined that the chosen method for forecasting is winter's method. Result of forecasting in winter method shows in table 5.

TABLE 5
Forecasting Result

Year	Month	Forecasted aggregate
2023	JAN	357,399.04
	FEB	396,360.93
	MAR	405,832.25
	APR	477,453.84
	MAY	511,978.08
	JUN	373,516.42
	JUL	253,041.18
	AUG	742,502.73
	SEP	577,946.42
	OCT	480,352.02
	NOV	336,765.36
	DEC	690,994.25

Before continuing to disaggregation, the forecast method needs to be verified. The verification was done by using a moving range chart. The result of the moving range chart can be seen in picture 6 that shows it is verified. There isn't any graph that goes out of control based on the four out-of-control rules.

FIGURE 5
Out-of-control Verification

C. Disaggregation Process

The forecasted aggregation needs to be disaggregated to determine the demand for each type of product. The disaggregation used the method of percentage method. The percentage that was obtained in the aggregation process. The process can be done. by multiplying the result of total aggregate forecast with the percentage of the aggregate unit. The calculation can be seen below.

Aggregate high-Fat in January= 357,399.04 × 31.20% = 111,512.79

Aggregate low-Fat in January = 357,399.04 × 68.80% = 245,886.25

After knowing the aggregate of each unit. The aggregate each unit will be divided with their standard time.

Demand of high-fat in January = 111,512.79 / 8.45 = 13,193.44

Demand of low-fat in January = 245,886.25 / 8.20 = 30,002.55

The result of disaggregation can be seen in table 6.

TABLE 6
Disaggregation Result

YEAR	Month	Demand Forecast	
		High-Fat	Low-Fat
2023	JAN	13,193.44	30,002.55
	FEB	25,841.04	21,712.96
	MAR	29,843.89	18,740.43
	APR	36,048.84	21,080.32
	MAY	24,803.84	36,890.01
	JUN	13,318.84	31,839.83
	JUL	18,707.08	11,582.72
	AUG	48,356.69	40,727.79
	SEP	55,150.79	13,642.12
	OCT	24,362.43	33,486.29
	NOV	27,978.28	12,237.06
	DEC	68,567.76	13,598.89

D. Rough Cut Capacity Planning with Existing Capacity

Rough Cut Capacity Planning will be used to evaluate the forecasted demand is it possible or not to be produced. The demand will be evaluated by the capacity of the factory. If the demand is under capacity, then the demand is feasible. If all the demand has been feasible then the forecasted demand is considered as master production schedule. The method that will be used in RCCP for this research is bill of labor

approach. There are several data needed to be an input in RCCP such as efficiency, utilization, standard time, forecasted demand, number of worker and machine, workdays, and workhour.

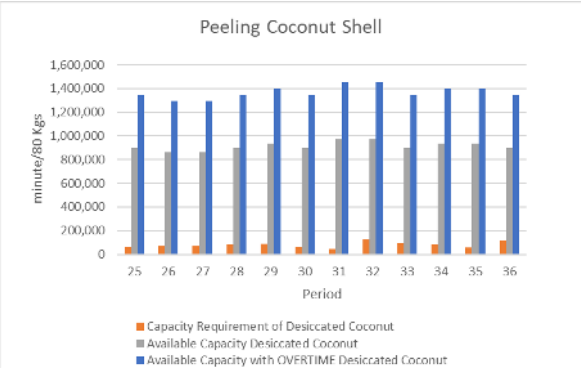

FIGURE 6
Peeling Coconut Shell RCCP

It is obtained that the graph of the capacity required, and capacity needed of each process. The picture 7 show that in the peeling coconut shell process the demand can be fulfil by the required capacity for each period. The orange is the required capacity to fulfil the demand. The grey color shows the available capacity and last the blue shows the available capacity with overtime. When the orange color is not higher than the available capacity with overtime that means the production doesn't need overtime. In other hand, when the require higher the available capacity with overtime than it need other action or alternative to fulfil the demand such as subcontract, alternate routing, or hiring. But, when the gap between required and available capacity is huge that shown in figure 7 the capacity can be reduced by doing several options such as layoff, reduce workhour, or reduce workday.

Table 7 shows the analysis of each workstation. The result shows all the required capacity is fulfilled with or without overtime. There is no need for additional action on the RCCP. which means the demand is possible to be produced. In the other hand the available capacity has a huge difference with the required capacity for each process like figure 7.

E. Existing Scheduling

CV. Una Surya Putra Mandiri doesn't have a fixed scheduling. In the other hand, they usually start producing with the low-fat product and with the high-fat and low-fat parallelly with the same amount each type. The production is done per 80kgs of each machine. After scheduled based on the production behavior, it is obtained that the existing schedule have a makespan of 1,016 minutes or almost 17 hours in a day for 20 job each type.

F. Proposed Scheduling Design.

The proposed scheduling design will process the new scheduling in producing the desiccated coconut low-fat and high-fat. In which, the objective of the scheduling design is reducing the makespan. The design consists of the purpose of the ideals amount of machine. Then determine the job for each month per day based on the forecasting result, do Campbell, Dudek, and smith, and last do mixed job models.

From the rough-cut capacity planning with existing capacity have a huge difference in several workstations. Unlike the worker capacity, the differences of machine can be reduced directly with only use several machines. The ideal amount of machine can be determined by using following step:

1. Determining the capacity available for 1 machine for each workstation. There is an assumption to the day available in determining the capacity available for 1 machine. The day will be assumed as 25 days for each month. The assumption came from the round of average of total workdays each period in 2023.
2. Then divide the average of required capacity each workstation with the available capacity with 1 machine. The ideal machine is obtained in Table 8.
3. Then do RCCP again. Table 9 show the RCCP result.

TABLE 7
RCCP with existing capacity feasibility analysis

Process name	25	26	27	28	29	30	31	32	33	34	35	36
Peeling Coconut Shell												
Peeling Coconut Skin												
Washing the Coconut												
Grinding the white meat												
Straining the Coconut Milk												
Drying using Oven												
Sifting												
Note												
		Feasible			Need Overtime					need action		

TABLE 8
Ideal Amount of Machine

Process name	**Available capacity (1 machine)**	**Average Required capacity**	**Ideal amount of machine**	**Ideal amont (roundup)**
Grinding the white meat	15,120.00	11,346.44	0.75	1
Straining the Coconut Milk	15,120.00	10,773.86	0.71	1
Drying using Oven	15,120.00	106,209.32	7.02	8
Sifting	17,955.00	41,600.00	2.32	3

TABLE 9
RCCP with ideal amount of capacity feasibility analysis

Process name	25	26	27	28	29	30	31	32	33	34	35	36
Grinding WM												
Straining the CM												
Drying using Oven												
Sifting												
Note												
		Feasible			Need Overtime					need action		

4. Calculating the gap between the average available capacity and requirement capacity is smaller showing that the ideal capacity is better. The gap can be reached by the average capacity minus the average required capacity. The better can be seen by the minimum gap. In the other hand, when the gap is negative means that the required capacity is not fulfilled. Table 10 shows the differences between existing and ideals capacity.

TABLE 10
Gap Between Existing and Ideal Capacity

Process name	Average capacity existing	Average capacity Ideal	Average Required capacity	Gap Existing	Gap Ideal
GWM	76,860	15,372	11,346	65,514	4,026
SCM	46,116	15,372	10,774	35,342	4,598
DO	153,720	122,976	106,209	47,511	16,767
S	54,763	54,763	41,600	13,163	13,163
Average				40,382	9,638
Nearest to 0					9,638

The gap differences show that the existing machine has more overcapacity than the ideal. Overcapacity may cause overproduction and overstock. The proposed capacity not only reduces all the causes of the overcapacity but also makes the required and available capacity is more balance and reducing machine operational cost.

The determining job for each month will be converting the amount of forecasted quantity become order job. The job obtained from the forecast is divided by lot size. The job will be distributed for each day so the job will be divided with the amount of workday. The amount of job each day is rounded. The lot size of the job came from the oven process that has a longest processing time and which the process needs to be done in 80 Kgs. Table 11 shows the job/day for each month.

TABLE 11
Converting Demand to Job/Day

Period	Demand HF	Demand LF	Job HF/Day	Job LF/Day
25	13,193	30,003	7	16
26	25,841	21,713	14	12
27	29,844	18,740	16	10
28	36,049	21,080	19	11
29	24,804	36,890	12	18
30	13,319	31,840	7	16
31	18,707	11,583	9	6
32	48,357	40,728	23	19
33	55,151	13,642	28	7
34	24,362	33,486	12	17
35	27,978	12,237	14	6
36	68,568	13,599	35	7

In production the desiccated coconut, it known that the job for each month is different. Therefore, the routing process time need to be multiplied by the amount of job each period to fulfil the demand. Table 12 show the routing process in to fulfil the demand in January.

TABLE 12
Routing Machine in Time (January)

Job	Operation			
	1	2	3	4
HF	113.51	0.00	132.82	138.73
LF	259.46	246.36	303.58	317.09

Job sequencing using Campbell, Dudek, and Smith (CDS) have several steps such as:

1. Define K as an iteration.

CDS method use minimum K in each job as a decision whether the job going first or last. Each K consists of M1 and M2 that came from following calculation. Since the machine used to produce desiccated coconut needs only 4 machines. So, it can be concluded that the iteration and result of calculation as table 13.

TABLE 13
K-iteration in January

Job	K=1		K=2		K=3	
	M1	M2	M1	M2	M1	M2
HF	113.51	138.73	113.51	271.54	246.33	271.54
LF	259.46	317.09	505.82	620.67	809.41	867.04

2. Sequencing the Job

Sequencing the job is done each iteration by finding the minimum processing time. If the minimum processing time is obtained in M1 then the job will be determined as the first job. In the other hand, if the minimum processing time obtain in M2 than the job will be determine as the last job and the chosen job will be out of the table than do that until all job has been arranged. Do the same thing for each iteration. From table 13 it is known that the alternative sequence of each iteration is HF-LF.

3. Simulate the sequence.

Simulating the sequence will determine the makespan of the process. The simulation will use forward scheduling. The makespan of low-fat and high-fat in January is 1300.61 minutes.

Besides calculating the CDS in a period by multiplying the routing with the total job. There is another way to schedule the machine in January by determining the lot sizing. The lot sizing can minimize the make span of the CDS scheduling. Therefore, the lot size will be using oven machine.

The lot size will be using the oven machine capacity because the machine needs to be processed as the machine maximum capacity. If the oven machine produces less than 80kgs then the machine will have a waste in producing. The capacity of the oven machine is 80 kgs. So, the lot size is 80kgs. In the other hand, the routing will be separated rather than multiply with the job. Table 14 shows the routing machine with the lot sizing.

TABLE 14
Routing Machine Time with Lot Size (January)

Job	Operation			
	1	2	3	4
HF1	16.22	0.00	18.97	19.82
HF2	16.22	0.00	18.97	19.82
HF3	16.22	0.00	18.97	19.82
HF4	16.22	0.00	18.97	19.82
HF5	16.22	0.00	18.97	19.82
HF6	16.22	0.00	18.97	19.82
HF7	16.22	0.00	18.97	19.82
LF1	16.22	15.40	18.97	19.82
LF2	16.22	15.40	18.97	19.82
LF3	16.22	15.40	18.97	19.82
LF4	16.22	15.40	18.97	19.82
LF5	16.22	15.40	18.97	19.82
LF6	16.22	15.40	18.97	19.82
LF7	16.22	15.40	18.97	19.82
LF8	16.22	15.40	18.97	19.82
LF9	16.22	15.40	18.97	19.82
LF10	16.22	15.40	18.97	19.82
LF11	16.22	15.40	18.97	19.82
LF12	16.22	15.40	18.97	19.82
LF13	16.22	15.40	18.97	19.82
LF14	16.22	15.40	18.97	19.82
LF15	16.22	15.40	18.97	19.82
LF16	16.22	15.40	18.97	19.82

After knowing the routing machine, then do the CDS steps. The CDS steps same as the previous CDS calculation. First determine the iteration. Table IV.28 show the iteration in CDS after lot sizing.

TABLE 15
K-iteration in January with Lot Size

Job	K=1		K=2		K=3	
	M1	M2	M1	M2	M1	M2
HF1	16.22	19.82	16.22	38.79	35.19	38.79
HF2	16.22	19.82	16.22	38.79	35.19	38.79
HF3	16.22	19.82	16.22	38.79	35.19	38.79
HF4	16.22	19.82	16.22	38.79	35.19	38.79
HF5	16.22	19.82	16.22	38.79	35.19	38.79
HF6	16.22	19.82	16.22	38.79	35.19	38.79
HF7	16.22	19.82	16.22	38.79	35.19	38.79
LF1	16.22	19.82	31.61	38.79	50.59	54.19
LF2	16.22	19.82	31.61	38.79	50.59	54.19
LF3	16.22	19.82	31.61	38.79	50.59	54.19

TABLE 16
K-iteration in January with Lot Size (continue)

Job	K=1		K=2		K=3	
	M1	M2	M1	M2	M1	M2
LF4	16.22	19.82	31.61	38.79	50.59	54.19
LF5	16.22	19.82	31.61	38.79	50.59	54.19
LF6	16.22	19.82	31.61	38.79	50.59	54.19
LF7	16.22	19.82	31.61	38.79	50.59	54.19
LF8	16.22	19.82	31.61	38.79	50.59	54.19
LF9	16.22	19.82	31.61	38.79	50.59	54.19
LF10	16.22	19.82	31.61	38.79	50.59	54.19
LF11	16.22	19.82	31.61	38.79	50.59	54.19
LF12	16.22	19.82	31.61	38.79	50.59	54.19
LF13	16.22	19.82	31.61	38.79	50.59	54.19
LF14	16.22	19.82	31.61	38.79	50.59	54.19
LF15	16.22	19.82	31.61	38.79	50.59	54.19
LF16	16.22	19.82	31.61	38.79	50.59	54.19

It is known that the CDS sequence is HF1-HF2-HF3-HF4-HF6-HF7-LF1-LF2-LF3-LF4-LF5-LF6-LF7-LF8-LF9-F10-LF11-LF12-LF13-LF14-LF15-LF16 for January then after doing forward scheduling, time obtain after do CDS using oven capacity as lot size is 518.48 minutes.

G. Cost Analysis

Cost Analysis will contain the existing machine cost with the existing production output and the ideal amount of machine cost with the proposed production. The comparison will determine whether the cost is reduced or not. Table 16 shows the result of existing and proposed cost.

TABLE 17
Result of Cost Calculating

Proposed		Existing	
Name	Cost	Name	Cost
Raw Material	IDR 3,315,442,000	Raw Material	IDR 3,725,300,128
Machine cost	IDR 1,149,369,804	Machine cost	IDR 1,142,443,999
Inventory cost	IDR 47,502,000	Inventory cost	IDR -
Backorder penalty	IDR 164,854,500	Backorder penalty	IDR 30,012,728
Total	IDR 5,577,168,304	**Total**	IDR 4,897,756,856

It is known that the proposed cost has a cheaper cost than the existing. Means the production planning is considered better than the existing planning.

V. CONCLUSION

This research for CV Una Surya Putra Mandiri comes to an end. The problem has been formulated that the main problem of the company is uncontrolled production. Therefore, this research discusses production planning to satisfy the problem that occurs in the company. The result of the research said that the first thing to implement is forecasting the demand as a decision variable to amount of production

each month. It is resulting that the forecasting can satisfy the overstock in the company. The error is decreasing around 2% in MAPE calculation. The overstock also not occur in proposed design.

Besides the forecasting, we should know the forecasting feasibility by doing RCCP. The result of RCCP said that the forecasting is feasible to be produced. In the other hand, the existing capacity is higher than the required capacity. Therefore, the capacity of production needs to be reduced or the sales of the product need to be increased. In this research, the machine capacity will be determined because the machine capacity will not impact the human factor. The ideal number of machines that is being reduced can lower the cost of operation from IDR 5,577,168,304 to IDR 4,897,756,856.

After determining the ideal number of machines, the schedule of the machine needs to be determined. The existing scheduling from the company has some idle that make the machine is not working. Beside the idled machine is reduced, the scheduling also obtaining the shorter makespan in producing desiccated coconut. The result of scheduling makes the makespan shorter and the idle time is zero. This came to a conclusion that the research provided the lower operational cost with the better production.

REFERENSI

[1] Anil Kumar, S., & Suresh, N. (2008). Production and Operations Management : With Skill Development, Caselets and Cases.

[2] Baroto, T. (2002). PERENCANAAN DAN PENGENDALIAN PRODUKSI.

[3] Chapman, S. N. (2006). The fundamentals of production planning and control. Pearson/Prentice Hall.

[4] Groover, M. P. (2016). Automation, production systems, and computer-integrated manufacturing.

[5] Heizer, J., Render, B., & Munson, C. (2016). Operations management : sustainability and supply chain management (Twelfth Edition).

[6] Hyndman, R. J., & Athanasopoulos, G. (2018). Forecasting: Principles and Practice.

[7] International Coconut Community. (2022). The Cocommunity : Monthly Newsletter of the International Coconut Community. 52 No. 10. https://www.apccsec.org/

[8] IOP Conference Series: Earth and Environmental Science Export performance and competitiveness of Indonesian coconut oil and desiccated coconut. (n.d.). https://doi.org/10.1088/1755-1315/892/1/012072

[9] Jacobs, R. F., Berry, W. L., Whybark, C. D., & Vollmann, T. E. (2011). Manufacturing Planning and Control for Supply Chain Management.

[10] Kusmindari, Ch. D., Alfian Achmad, & Hardini Septa. (2019). Production Planning and Inventory Control.

[11] Nahmias, S., & Olsen, T. (2015). Production And Operations Analysis.

[12] Sahat, S. F. (2017). Export News Indonesia : Indonesian Various Coconut Products. http://djpen.kemendag.go.id

[13] Sinulingga, S. F. (2009). Perencanaan & Pengendalian Produksi.

[14] Sipper, D., & Bulfin, R. L. (1998). Production : planning, control, and integration. McGraw-Hill International ed.

[15] Stevenson, W. J. (2012). Operations management. McGraw-Hill/Irwin.

[16] Sule, D. R. (2008). Production planning and industrial scheduling: examples, case studies and applications.

[17] Sutalaksana, I. Z., Anggawisastra, R., & Tjakraatamadja, J. H. (1979). Teknik Tata Cara Kerja. Penerbit ITB.

Wignjosoebroto, S. (2000). Ergonomi, Studi gerak dan Waktu. Surabaya. Guna Widya.