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Production planning and control in the Diki Ceramic home industry

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ABSTRACT

Diki Ceramics is an industry that produces pottery with its address at Pagerjurang RT 02 RW 04, Melikan, Wedi, Klaten, Central Java using the main ingredients of black soil and red soil. Companies often cannot estimate the right amount of production to meet market demand. The company expects that there will be no shortage of products which will result in lost opportunities to sell products, but also does not expect that there will be excess products which will result in increased inventory costs. The method used as the optimal solution to determine the amount of pottery production is the dynamic programming method. Variable production planning decisions are taken based on the activities in the factory, namely production activities and raw material procurement activities. The target to be achieved from this research is to determine the optimal level of production in order to get maximum profit by using the dynamic programming method. The total optimal production cost obtained by dynamic programming is IDR 86,500,000, while the company's total actual production cost in 2021 is IDR 181,501,984. From the comparison results, the research method provides cost savings of Rp. 95,001,984.

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1. Introduction

In the industrial world, every company improves the quality of its management in order to survive in the competition by improving the continuity of production in order to meet consumer demand in a timely manner and at the most efficient production costs. This is happening because business competition is getting tougher and more difficult due to the increasing number of companies that are superior in building a business.

Production planning is a very important area in making decisions at the company's strategic level, especially in manufacturing companies. Production planning as a tactical plan that aims to provide decisions based on the resources owned by the company in meeting the demand for the products produced (Nasution, 1999). Every company, there are various limitations and problems that must be faced. One of them is to determine the optimal production planning. This is an obstacle that must be overcome by the company so that production is maintained smoothly, so with the existence of various obstacles in the form of these problems, it requires management to develop an optimal production plan so that the amount of production that benefits the company is obtained. To obtain an optimal production plan, production planning plays an important role because it includes the processing of facilities, equipment, resources and manpower for an operational activity.

One of the right methods to complete production planning is to use the dynamic programming method. Based on planning research by victor (2009) and Petra (2007) have applied this method. Dynamic programming is a collection of mathematical programming techniques used for decision making which consists of many stages (*multistage*). A *multistage* decision-making problem is separated into a series of problems (or sub-problems) that are sequential and interconnected (Subagyo, 1984). The main objective of this model is to make it easier to solve optimization problems that have certain characteristics. The basic idea of this dynamic program is to divide the problem into smaller parts to make it easier to solve. (Dimyati, 2004).

Dynamic programming has the advantage of being an optimization approach that diverts a complex problem into a series of simple problems which have the main characteristics as stages of the optimization procedure. Therefore, it is important to carry out research on pottery production planning at Diki Keramik, with the hope that the results of this study can be used as consideration or alternatives in achieving optimal production.

Diki Keramik is an industry that produces pottery which is located at Pagerjurang RT 02 RW 04, Melikan, Wedi, Klaten, Central Java using the main ingredients of black earth and red earth. The pottery produced has been distributed to various areas including Karawang and Purwakarta. Each production can reach 2000 units . The large number of pottery industries that have developed with intense competition requires Diki Keramik to be able to produce pottery according to demand . Diki Keramik itself implements a *make to order system* , which in its implementation Diki Keramik experiences several obstacles, one of which is related to determining the number of products that must be produced in each period. So far, Diki Keramik has had ineffective production planning, as often excess product produced (*stock out*) and shortage of products (*over stock*).

The number of requests for pottery products every month in the period January - December 20 21 which experienced fluctuations. Under these conditions, Diki Keramik needs to carry out a strategic production plan to provide decisions in meeting product demand and costs incurred for production activities so that the costs used are as minimum as possible. This can be achieved by using the production planning dynamic programming method. So this research really needs to be done on pottery production planning at Diki Keramik with the aim that the results of this research can be used as an alternative material to achieve optimal production. This study aims to carry out production planning for the next period, namely the period from January to December 2021 . In research - research on the application of the dynamic programming method in production planning gives better results than the system implemented by the company. It is evident from the savings obtained by Diki Keramik with this method resulting in production cost savings of IDR 95,001,984.

2. Research Method

This research was conducted at Diki Keramik which is located at Pagerjurang RT 02 RW 04, Melikan, Wedi, Klaten, Central Java. In the process of this research, the data taken were secondary data which were obtained through collecting data from the industry concerned, literature results, and related agencies. The data obtained are sales volume, production capacity, warehouse capacity, production costs and storage costs. The data processing procedures using the dynamic programming method. After calculating and determining the amount of production and the optimal amount of inventory using the dynamic programming method, the step is to do a problem-solving analysis. Analysis is carried out to see what the optimum production quantity must be produced by taking into account the amount of inventory, determining the production schedule using the dynamic programming method will be able to minimize costs .

3. Results and Discussions

The demand for Diki Keramik pottery products for 1 year can be seen in Table 1. Table 1 shows the number of product requests per month during that period. Data processing includes calculating labor wages, calculating total production costs, saving costs and then determining optimal production using dynamic programming.

Table 1. Demand for Pottery Products

Month	Pottery Demand (Unit)
January	2000
February	2500
March	2200
April	3200
May	4000
June	3500
July	2900
August	2500
September	3400
October	2100
November	3700
December	2600
TOTAL	34600

3.1 Calculation of labor wages

From interviews conducted by the owner of Diki Keramik , this business has a total of 4 employees with working hours of 8 hours/per day. Companies can add working hours with the costs that have been described in the following table:

a. If production only uses regular time, then what is produced is:

Table 2. Energy Cost at Regular Time

Information	Amount	Unit
Hours/Day	8	O'clock
Number of employees	4	Person
Production amount	65	Day
Kindergarten fees	IDR 57,692	/Day
Total Kindergarten Fee	IDR 230,768	/Day
Production cost	IDR 3,550.28	

b. If the company adds overtime, the resulting costs:

Table 3. Overtime Labor Costs

Information	Amount	Unit
Number of employees	4	person
Production amount	32	units
Kindergarten OT fees	IDR 7,211.5	/O'clock
Overall OT Kindergarten Fee	IDR 28,846	/Day
Production cost	IDR 901.44	/O'clock

3.2 Calculation of production costs with storage costs

Calculation of production costs is obtained by increasing the total cost of raw materials used and the cost of labor used in the period. The calculation of production costs is listed in the following table:

Table 4. Production Costs

Month	Material (IDR)
January	5,000,000
February	6,250,000
March	5,500,000
April	8,000,000
May	10,000,000
June	8,750,000
July	7,250,000
August	6,250,000
September	8,500,000
October	5,250,000
November	9,250,000
December	6,500,000
TOTAL	86,500,000

From Table 4 it can be seen that to produce 34,600 pottery products requires a cost of IDR 86,500,000 so it can be said that the raw materials for making 1 unit of pottery products are IDR 86,500,000 / 34,600 = IDR 2 . 500. That way it can be said that the production cost for regular time per unit is IDR 2,500 + IDR 3 . 550 , 28 = IDR 6 . 060.28 while for production costs using over time per unit is IDR 2,500 + IDR 901 .44 = IDR 3,401.44 . The calculation of actual production costs is as follows:

Table 5. Total Production Costs

Month	Household Fee (Rp)	OT fee (Rp)	Total Cost (Rp)
January	IDR 12,120,560.00	IDR -	IDR 12,120,560
February	IDR 12,120,560.00	IDR 1,700,720.00	IDR 13,821,280
March	IDR 12,120,560.00	IDR 680,288.00	IDR 12,800,848
April	IDR 12,120,560.00	IDR 4,081,728.00	IDR 16,202,288
May	IDR 12,120,560.00	IDR 6,802,880.00	IDR 18,923,440
June	IDR 12,120,560.00	IDR 5,102,160.00	IDR 17,222,720
July	IDR 12,120,560.00	IDR 3,061,296.00	IDR 15,181,856

August	IDR 12,120,560.00	IDR 1,700,720.00	IDR 13,821,280
September	IDR 12,120,560.00	IDR 4,762,016.00	IDR 16,882,576
October	IDR 12,120,560.00	IDR 340,144.00	IDR 12,460,704
November	IDR 12,120,560.00	IDR 5,782,448.00	IDR 17,903,008
December	IDR 12,120,560.00	IDR 2,040,864.00	IDR 14,161,424
TOTAL			IDR 181,501,984

Based on the assumption that the saving cost incurred by Diki Keramik is 1% per unit , it can be calculated using the formula. Holding cost per unit per month = production cost per unit x percentage cost, and the result is 5,245 / month

3.3 Production planning with dynamic program

This production planning uses a dynamic programming method with forward recursion where the calculation starts from the 1st stage of the move progress to stage 12. The planning period is 1 year with a period of 1 month , so there are 12 stages of implementation starting from January to December 20 21 . The most optimal amount of production will be obtained based on the total minimum production costs contained in each of the production policies that have been prepared. With the cost of this calculation repeating up to stage 12, namely December 2021.

3.4 Production plan using dynamic programming

Calculation of production planning using a dynamic system can be seen in Table 6 below:

Table 6. Production Plan with dynamic program

Month	production	0	1000	2000	3000
January	2000	IDR 5,000,000	IDR 10,245,000	IDR 15,490,000	IDR 20,735,000
February	2500	IDR 6,250,000	IDR 11,495,000	IDR 16,740,000	IDR 21,985,000
March	2200	IDR 5,500,000	IDR 10,745,000	IDR 15,990,000	IDR 21,235,000
April	3200	IDR 8,000,000	IDR 13,245,000	IDR 18,490,000	IDR 23,735,000
May	4000	IDR 10,000,000	IDR 15,245,000	IDR 20,490,000	IDR 25,735,000
June	3500	IDR 8,750,000	IDR 13,995,000	IDR 19,240,000	IDR 24,485,000
July	2900	IDR 7,250,000	IDR 12,495,000	IDR 17,740,000	IDR 22,985,000
August	2500	IDR 6,250,000	IDR 11,495,000	IDR 16,740,000	IDR 21,985,000
September	3400	IDR 8,500,000	IDR 13,745,000	IDR 18,990,000	IDR 24,235,000
October	2100	IDR 5,250,000	IDR 10,495,000	IDR 15,740,000	IDR 20,985,000
November	3700	IDR 9,250,000	IDR 14,495,000	IDR 19,740,000	IDR 24,985,000
December	2600	IDR 6,500,000	IDR 11,745,000	IDR 16,990,000	IDR 22,235,000

After calculating using the dynamic program, it can be seen that the production plan for each period is production with a minimum cost and will produce an optimal solution at all stages of the scheduling.

Table 7. Comparison of actual production costs with dynamic programs

Month	Total Actual Cost	Minimum Fee
January	IDR 12,120,560	IDR 5,000,000
February	IDR 13,821,280	IDR 6,250,000
March	IDR 12,800,848	IDR 5,500,000
April	IDR 16,202,288	IDR 8,000,000
May	IDR 18,923,440	IDR 10,000,000
June	IDR 17,222,720	IDR 8,750,000
July	IDR 15,181,856	IDR 7,250,000
August	IDR 13,821,280	IDR 6,250,000
September	IDR 16,882,576	IDR 8,500,000
October	IDR 12,460,704	IDR 5,250,000
November	IDR 17,903,008	IDR 9,250,000
December	IDR 14,161,424	IDR 6,500,000
Total	IDR 181,501,984	IDR 86,500,000

The table above shows a comparison between actual production costs and production costs using a dynamic system every month. From the table it is also seen that the total production cost by using dynamic programming can save production costs . Based on the calculations above, if Diki Keramik applies the dynamic program method, Diki Keramik can save production costs of IDR 95,001,984 . This is influenced by the large

amount of production, where in the calculation there is a large amount of overtime production which increases production costs.

4. Conclusion

In calculating the actual production costs for the period January 20 2 1 to December 20 21 the actual costs incurred by Diki Keramik amounted to IDR 181 . 501 . 984 . Based on the application of the dynamic program method in production planning, production costs incurred Rp 86 . 500 . 000 . Based on the calculations above, if Diki Keramik applies the dynamic programming method, can save production costs of IDR 95,001,984. This difference is influenced by the large amount of production, where in the company's calculations there is a large amount of overtime production which increases production costs while in production planning using a dynamic program demand can be met using overtime or using initial inventory, so there is no increase in production costs.

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