Production Cost Analysis as Paint Production Planning References

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Abstract

PT. XYZ face a challenge in the form of high production cost, which leads to expensive product results and the inability to meet the market demand, which can cause a significant profit loss. This study aims to evaluate the production cost that can be arranged more efficiently, therefore, reducing the price of production and arranging an effective and efficient production planning to fulfil the market demand. The research method used to evaluate the production cost is the Activity-Based Cost Method. The methods used for production planning are Forecasting, Aggregate Planning and Master Production Scheduling methods. Based on the result of data processing, it is known from Activity-Based Cost calculation that one of the production costs that can be minimized is backorder cost with the final amount of Rp37.201.062. Moreover, the best forecasting method in production planning is the linear regression method. Thus from the proposed Aggregate Planning, it can be derived that the total production cost can be lowered up to Rp120.881.904.

Keywords
Activity-Based Cost, Forecasting, Aggregate Planning, Master Production Scheduling, Production Cost Analysis.

1. Introduction
Along with the increasing population in Indonesia, which is directly proportional to the increasing number of needs that must be met, it impacts increasing industrial growth in Indonesia to meet the needs of the Indonesian population. Industrial growth in Indonesia has a positive impact on where there are many opportunities for business people to start moving in the industrial field. One industry that is seeing an improvement is the paint industry. The improvement of the paint industry in Indonesia is inseparable from many other industries that require paint and the development of infrastructure, which is also increasingly active such as the construction of residential facilities, offices, roads, and others where the construction is not separated from the need for paint.

PT. XYZ, established in 2001, was initially engaged in the procurement of goods, especially sandblasting equipment, but seeing open opportunities was the reason for PT. XYZ to start developing its business by producing paint. Inefficiency and ineffectiveness at PT. XYZ can be seen from the high production costs of PT. XYZ, causing the price of paint products, especially Rincon Paint interior white wall paint, which is the main product of PT. XYZ is quite expensive. Production expenses from PT. XYZ comes from costs that should not need to be charged to the product's price, but to avoid any loss, these costs are charged to the product's price. Costs that should be avoided are overhead costs, but these costs cannot be avoided.

To achieve good planning in the form of accurate planning following the conditions and situations that exist in the

field need to be careful about selecting the most appropriate method at PT. XYZ so that the production process continuity can go according to plan and remain economical. Methods used in planning production include the Forecasting, Aggregate Planning method and applying the Master Production Scheduling (Table 1).

Table 1. Methods in Production Planning

Methods	Explanation	Advantages
Forecasting	The method used in planning to determine the number of goods to be produced is by predicting future events (Chopra, S., & Meindl, P., 2010)	Can predict the consumer demand in the future.
Aggregate Planning	The Aggregate Planning methodology is designed to translate demand forecasts into production plans for the company over a predetermined planning period (Nahmias, S., 2009)	Can plan specifically and what strategies need to be implemented.
Master Production Scheduling	It is a specific schedule of what must be made (number of finished products or items) and when it should be done.	Can schedule specifics in the production process.

In addition, increasing efficiency can be done by eliminating inefficient activities that occur in the production process. To eliminate inefficiencies in the production process, the concept of the Activity Based Costing method is used.

Krismiaji & Aryani, Y. (2011:110) said that Activity Based Costing is a system for determining the cost of activity-based products, Activity Based Costing can improve the accuracy of indirect cost allocation by linking each cost with the activity that causes the cost.

Meanwhile, Dunia, T. H., & Abdullah, W. (2012: 328) said that Activity Based Costing has several benefits such as helping to identify inefficiencies that occur in the production process, helping decision making well because cost calculations become more accurate, and another benefit is to help in cost control.

In essence with the existence of production planning, PT. XYZ in conducting production activities can regulate when and how much must be produced at the time of production so that production activities run effectively and efficiently ((Bertrand, 1992, Bertrand et al. 1990, Zhao et al. 2014).

In addition to this, efficiency improvements can be made by eliminating inefficient activities that occur in the production process. To eliminate inefficiencies in the production process, the concept of Activity Based Costing is used. Activity-Based Costing is more in line with the needs of PT. XYZ is because the Activity Based Costing method can be used to identify inefficiencies in the production process. Given the importance of inefficient cost evaluation and production planning in running company operations, the authors intend to research PT. XYZ who has difficulty in evaluating inefficient costs in making production planning to be more effective and efficient.

Based on the description above, the writer aims to research with the title "Analysis of Production Costs as a Reference for Production Planning Paint at PT. XYZ ". With this research, it is expected that the results of the research can be used as a basis for the development of production planning for companies to create effectiveness and efficiency in the production process so that it will indirectly increase the productivity of PT. XYZ.

2. Research Methods

The research method used is descriptive research. The time horizon or time dimension used is longitudinal. The Table 2 shows the research design that will be carried out for each research objective. The following table presents the research design more clearly (Table 2):

Table 2. Research Approach

Research Purpose	Research Type	Analysis Unit	Time Horizon
T-1	Descriptive	Paint Production Unit	Longitudinal

T-2	Descriptive	Paint Production Unit	Longitudinal
T-3	Descriptive	Paint Production Unit	Longitudinal
T-4	Descriptive	Paint Production Unit	Longitudinal
T-5	Descriptive	Paint Production Unit	Longitudinal

Information:
1) T-1: Knowing the calculation of Cost of Production with Activity Based Costing at PT. XYZ.
2) Q-2: Know the costs that can be eliminated in the production process.
3) Q-3: Know the predictions of consumer demand in 2017 and find out the most appropriate Forecasting method used to predict demand
4) Q-4: Know the best Aggregate Planning method used in production planning with efficient production costs.
5) Q-5: Know how to prepare the Master Production Scheduling that is most suitable for paint production at PT. XYZ.

3. Results and Discussions
3.1. Activity-Based Cost 2016
The following is a table of paint production costs for PT. XYZ in 2016 (Table 3):

Table 3. Paint Production Costs PT. XYZ 2016

No	Cost Type	Cost Total
1	Direct cost	
	Raw material	Rp524.029.500
	Direct Labor	Rp880.000.000
2	Indirect Costs	
	Packaging Fee	Rp99.880.000
	Electricity cost	Rp92.000.000
	Indirect Labor Costs	Rp220.000.000
	Building Maintenance Costs	Rp70.000.000
	Machine Maintenance Costs	Rp65.000.000
	Backorder fee	Rp110.808.000
	Shipping costs	Rp84.000.000
	Marketing Costs	Rp8.500.000
	Total	Rp2.154.217.500

The following details the costs of paint production of PT. XYZ in 2016:
1. Cost of Raw Materials
Every kilo of paint produced consists of 10 raw materials above with a total cost per kilo of Rp. 2,309. In 2016, PT. XYZ produces 227000 kg of paint to obtain the cost of raw materials amounting to Rp524,029,500.

2. Direct Labor Costs
Direct Labor Costs in the form of basic salary and benefits of 28 employees who work where the total cost of all employee salaries for one year is Rp.880,000,000. From the total salary of one year, we can take an average salary of 1 employee per month of Rp2,619,048. Apart from raw materials and direct labor costs included in the direct costs category, some costs can be classified as indirect costs. Indirect costs can be classified as Overhead costs because they do not include direct costs. The following data is the overhead costs used to carry out production activities in 2016 (Table 4).

Table 4. Paint Production Overhead Costs PT. XYZ 2016

No	Information	Amount
1	Packaging Fee	Rp99.880.000
2	Electricity cost	Rp92.000.000
3	Indirect Labor Costs	Rp220.000.000

4	Building Maintenance Costs	Rp70.000.000
5	Machine Maintenance Costs	Rp65.000.000
6	Backorder fee	Rp110.808.000
7	Shipping costs	Rp84.000.000
8	Marketing Costs	Rp8.500.000
	Total	Rp750.188.000

The following details the costs of Cat Production Overhead PT. XYZ in 2016:

1. Packaging Costs

The package costs Rp. 11,000 per 25 kg. The amount of paint production in 2016 was 22,700 kg, so if it was made 25 kg per package, then 9080 packages would be needed. So, the total cost of procuring packaging is IDR 99,880,000.

2. Electricity Costs

Electricity costs are incurred to support production activities such as starting machinery and providing lighting. One year producing 227,000 kg of paint costs Rp92,000,000 for electricity.

3. Indirect Labor Costs

Direct labor costs are incurred to pay supervisors who conduct production monitoring activities. The supervisor is required to conduct inspections of workers carrying out production activities. Costs incurred for indirect labor amounted to Rp.220,000,000.

4. Building Maintenance Costs

Building maintenance costs are costs incurred every year to maintain building quality. These costs are usually incurred regularly every year. The budget spent for each year is Rp. 70,000,000.

5. Machine Maintenance Costs

Machine maintenance costs are costs incurred every year to maintain the quality of the machine. These costs are usually incurred routinely every year, where the budget spent for each year is Rp. 65,000,000.

6. Backorder Fee

Backorder costs arise due to production failures that cannot meet demand. In 2016, PT. XYZ failed to meet the paint demand of 24000 kg. When making a backorder, the price of 1 Kg of raw material is Rp. 4617, so the total cost of doing a backorder is Rp110,808,000.

7. Shipping costs

Shipping costs are costs incurred in sending production to consumers. Costs incurred in 2016 amounted to Rp.84,000,000. Usually, shipping costs can change depending on the number of products sold.

8. Marketing Costs

Marketing costs are costs incurred to carry out promotional activities or introduce goods. Costs incurred in the amount of Rp.8,500,000.

9. Cost Pool 2016

Based on the Cost Pool cost data above, it can be seen that the largest cost is used, namely for indirect labor costs and backorder costs. Indirect labor costs are incurred to pay for the costs of supervisors who supervise the production.

The supervisor is required to conduct inspections of workers carrying out production activities. While backorder costs exist due to the company's failure to meet consumer demand due to the absence of product availability. Of the two costs, the company wants to reduce or eliminate these costs to reduce the cost of production so that it can sell products with greater profits or lower prices.

3.2 2016 Production Cost

The following Table 5 is the cost of production in 2016:

Table 5. Calculation of Cost of Production in 2016

Information	Amount
Raw Material Costs	Rp524.029.500
Direct labor costs	Rp880.000.000
Company Overhead Costs	Rp750.188.000
Product Cost	Rp2.154.217.500
Product Kg	227.000

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Product Cost / Kg	Rp9.490

The calculation of the cost of paint production in 2016 amounted to Rp9,490. The company has a target so that the cost of production in 2017 can be lower than in 2016. Therefore, production planning is needed to make the cost of production in 2017 lower than in 2016.

3.3 Forecasting

In the initial stage of production planning the first step is to make demand forecasting in 2017. This forecast is intended as an initial reference for how much each month the company produces paint. From the request and pattern data on the demand graph, forecasting is done using QM for Windows software using five methods, namely:
1. Linear Regression Method
2. Exponential Smoothing with Trend Method
3. Exponential Smoothing Method
4. Weighted Moving Average Method
5. Moving Average Method

From the five methods, a comparison of MAD, MSE and MAPE values will be made from the calculation results. MAD, MSE and MAPE values will be used as a basis for assessing which methods are best used for demand forecasting in the 2017 period. Forecasting methods that produce MAD, MSE and MAPE values from the smallest Forecasting calculations, the Forecasting results will be made as demand data in 2017. Following Forecasting Method Comparison:

Table 6. Comparison of Forecasting Methods

Method	MAD	MSE	MAPE
Linear Regression	4627,62	26064590	27,546%
Exponential Smoothing with Trend	5311,54	39693630	31,812%
Exponential Smoothing	5195,08	37157190	29,292%
Weighted Moving Average	5644,44	44357780	37,451%
Moving Average	6000	53850000	37,745%

Based on the MAD, MSE and MAPE values obtained from the Forecasting calculation of the Linear Regression (Table 6), Exponential Smoothing with Trend, Exponential Smoothing, Weighted Moving Average and Moving Average methods, the Linear Regression method with the smallest MAD, MSE and MAPE values obtained 4627.62, MSE amounted to 26064590 and MAPE value of 27.546%, so it was decided to use the Linear Regression method as a method for calculating demand in 2017.

3.4 Aggregate Planning

Aggregate planning data processing aims to determine the best Aggregate Planning method with the most efficient production costs. In production planning, aggregate planning can find out whether, in production with the maximum capacity, the company has met consumer demand or not. If the maximum production capacity has been reached and demand is still not fulfilled, then an alternative plan is needed to meet the demand.

PT. XYZ owns three solutions, where the first solution is to subcontract with other companies but to maintain the quality of paint products PT. XYZ rejected the Aggregate Planning plan by using subcontracts. The second solution is to use a backorder that has been the choice of PT. XYZ but the backorder that was made by PT. XYZ in 2016 cost a lot of money and was classified as the highest cost of overhead. Therefore, it is necessary to have a backorder solution companion if PT. XYZ cannot meet consumer demand. The third solution that becomes an option is overtime. The use of overtime can be a solution because of overtime PT. XYZ can increase the maximum production capacity. With the availability of three solutions to maximize aggregate planning for 2017, an aggregate planning method is determined by using a mixed strategy and additional constraints. Application of mix strategy and additional constraints at PT. XYZ uses a combination of backorder that has been used by PT. XYZ with combined overtime to reduce the number of backorders to maximize existing workers and reduce the costs incurred to do a backorder. However, applying overtime, in addition to reducing backorder costs, can also cause new overhead costs, namely overtime costs. Therefore, it is necessary to have an appropriate mix between the number of products produced with

a backorder and the number of products produced with overtime. The following Table 7 is Aggregate Planning for 2017:

Table 7. Aggregate Planning

Period	Forecast Net Demand	Number of Working Days	Number of Units Produced (Kg) per Worker	Production	Number of Unit Produce /worker (Overtime = 0,8)/hour	Overtime Need	Overtime	Production (Overtime)	Backorder
Jan-17	19712	24	540	15120	54	4	3	4536	56
Feb-17	19835	24	540	15120	54	4	3	4536	179
Mar-17	19957	23	517,5	14490	51,75	4	3	4347	1120
Apr-17	20079	23	517,5	14490	51,75	4	3	4347	1242
May-17	20202	23	517,5	14490	51,75	4	3	4347	1365
Jun-17	20324	20	450	12600	45	7	6	7560	164
Jul-17	20446	20	450	12600	45	7	6	7560	286
Aug-17	20569	24	540	15120	54	4	3	4536	913
Sep-17	20691	24	540	15120	54	4	3	4536	1035
Oct-17	20814	25	562,5	15750	56,25	4	3	4725	339
Nov-17	20936	25	562,5	15750	56,25	4	3	4725	461
Dec-17	21058	20	450	12600	45	7	6	7560	898
Total									8057

After calculating the Aggregate Planning, the amount of capacity that cannot be fulfilled has been obtained so that the need to do backorder and overtime. Costs that must be incurred to do a backorder of Rp. 4617 per Kg and the number of backorders required as much as 8057 Kg, the total required backorder fee of Rp. 37,201,062. The cost incurred for overtime for one hour is Rp.83,265. In 2017 based on the planned aggregate planning, the total overtime needed is 1005 hours, consisting of the monthly overtime times multiplied by the number of working days in that month. From the calculation of overtime, it can be seen that the amount that must be spent on overtime costs becomes Rp.83,680,842. From the total costs incurred for backorder and overtime, the total production cost incurred amounted to Rp120,881,904.

3.5 Master Production Scheduling
Calculation of Master Production Scheduling uses forecasting data. The purpose of preparing the Master Production Scheduling is used as scheduling of paint production of PT. XYZ has a building capacity that can store 2500 Kg of safety stock. If PT. XYZ wants to impose a stock policy so it can use the calculation of the Master Production Scheduling as a reference. The following Table 8 is the calculation of the Master Production Scheduling:

Table 8. Master Production Scheduling

Lead Time:				1			Safety Stock:			2500		
On Hand:				0			Demand Time Fences:			9		
Lot Size:				250			Planning Time Fences:			3		
Period (Month)	Past Due	1	2	3	4	5	6	7	8	9	10	11	12
Forecast		19712	19835	19957	20079	20202	20324	20446	20569	20691	20814	20936	21058
Project Available Balance	0	2538	2703	2747	2667	2716	2642	2695	2626	2685	2622	2686	2628
Available to Promise	0	2538	2703	2747	2667	2716	2642	2695	2626	2685	2622	2686	2628
Master Scheduled		22250	20000	20000	20000	20250	20250	20500	20500	20750	20750	21000	21000

The preparation of the Master Production Scheduling begins with knowing the value needed in the Master Production Scheduling table. The first value that must be filled is the amount of lead time or time required for the available item, which is one day. The second value to be filled is the amount of on-hand or inventory available at the end of the period. At the end of 2016, the amount of inventory available was not available, so the on-hand value was 0. On hand value 0 causes the value of the project available balance and value available to promise to be the same because

the amount of goods in the previous period is 0, so the past due value in the project available balance and the value of the available to promise are both 0. The value of the project available balance is obtained from the calculation of the Past Due or the value of the project available balance in the previous period added by the Master Schedule reduced with the forecast. Whereas the available to promise value is obtained from the Past Due calculation or the available to promise value is added to the Master Schedule minus the Forecast. From the method of calculating the same project available balance and available to promise, so if the value in the previous period is the same in this calculation, it is 0, then the value of the project available balance and the available to promise value will be the same.

3.6 Activity-Based Cost 2017
The following is a Table 9 of paint production costs for PT. XYZ in 2017:

Table 9. Paint Production Costs PT. XYZ 2017

No	Cost Type	Cost Total
1	Direct cost	
	Raw material	Rp564.710.833
	Direct Labor	Rp880.000.000
2	Indirect Costs	
	Packaging Fee	Rp107.633.860
	Electricity cost	Rp99.142.122
	Indirect Labor Costs	Rp220.000.000
	Building Maintenance Costs	Rp70.000.000
	Machine Maintenance Costs	Rp65.000.000
	Overtime fee	Rp83.680.842
	Backorder fee	Rp37.201.062
	Shipping costs	Rp90.521.068
	Marketing Costs	Rp8.500.000
	Total	Rp2.226.389.788

The following details the costs of paint production of PT. XYZ in 2017:
1. Cost of Raw Materials
Every kilo of paint produced consists of 10 raw materials above with a total cost per kilo of Rp. 2,309. In 2016, PT. XYZ produced 244,622 kg of paint to obtain the cost of raw materials amounting to Rp564,710,833.
2. Direct Labor Costs
Direct Labor Costs in the form of basic salaries and loans from 28 employees who work where the total cost of all employee salaries for one year is Rp.880,000,000. From the total salary of one year, we can take an average salary of 1 employee per month of Rp2,619,048. In addition to the cost of raw materials and direct labor costs included in the direct costs category, some costs can be classified as indirect costs. Indirect costs can be classified as Overhead costs because they do not include direct costs. The following data is the overhead costs used to carry out production activities in 2017.

The following details the costs of Cat Production Overhead PT. XYZ in 2016:
1. Packaging Costs
Packaging fees of IDR 11,000 per 25 kg. The amount of paint production in 2017 was 244,622 kg, so if it were made 25 kg per package, 9,785 packages would be needed. So, the total cost of procuring packaging is Rp.107,633,860.

2. Electricity Costs
Electricity costs are incurred to support production activities such as starting machinery and providing lighting. Costs incurred during one year in producing 244,622 kg of paint cost Rp99,142,122 for electricity.

3. Indirect Labor Costs
Direct labor costs are incurred to pay supervisors who conduct production monitoring activities. The supervisor is required to conduct inspections of workers carrying out production activities. Costs incurred for indirect labor

amounted to Rp.220,000,000.

4. Building Maintenance Costs

Building maintenance costs are costs incurred every year to maintain the quality of the building. These costs are usually incurred routinely every year. The budget spent for each year is Rp. 70,000,000.

5. Machine maintenance cost

Machine maintenance costs are costs incurred every year to maintain the quality of the machine. These costs are usually incurred regularly every year. The budget spent for each year is Rp. 65,000,000.

6. Overtime Cost

The cost incurred for overtime for one hour is Rp.83,265. In 2017 based on the planned aggregate planning, the total overtime needed is 1005 hours, consisting of the monthly overtime times multiplied by the number of working days in that month. From the calculation of overtime, it can be seen that the amount that must be spent on overtime costs becomes Rp.83,680,842.

7. Backorder cost

Backorder costs arise due to production failures that cannot meet demand. In 2017, PT. XYZ requires a back order of 8057 Kg. The price of 1 kg of raw materials when making a backorder is Rp. 4617, so the total backorder cost is Rp. 37,201,062.

8. Shipping cost

Shipping costs in the form of shipping costs of production to consumers. Costs incurred in 2017 amounted to Rp90,521,068. Shipping costs usually change depending on how many products are sold.

9. Marketing cost

Marketing costs are costs incurred to carry out promotional activities or introduce goods. Costs incurred in the amount of Rp.8,500,000.

10. Cost Pool 2017

Using the cost pool, we can determine the costs incurred in each activity. At the unit level activity, the packaging and electricity costs can be seen with a total cost of Rp.107,633,860 and Rp99,142,122. At the batch level activity, the indirect labor costs and overtime costs can be seen with a total cost of Rp. 220,000,000 and Rp. 83,680,842. The product level activity can be known backorder, shipping, and marketing with a total cost of Rp37,201,062, Rp90,521,068 and Rp8,500,000.

11. Production Cost 2017

The following Table 10 is the cost of production:

Table 10. Calculation of Cost of Production 2017

Information	Amount
Raw Material Costs	Rp564.710.833
Direct labor costs	Rp880.000.000
Company Overhead Costs	Rp781.678.955
Product Cost	Rp2.226.389.788
Product Kg	244.622
Product Cost / Kg	Rp9.101

The cost of production is obtained from the total cost of raw material costs of Rp564,710,833, then added to the total costs incurred for labor costs of Rp880,000,000, then added to the company's overhead costs of Rp781,678,955 then the product cost will be obtained. The cost of the product can be made as to the price of the product per kg, where the paint product can be sold per kg. The cost of the product, which amounts to Rp.2,226,389,788 divided by the total number of products produced, which amounted to 244,622Kg will get the cost of production / Kg of Rp9,101. Compared with the cost of production/kg in 2016, which amounted to IDR 9,490, the cost of production/kg in 2017

is cheaper. There is a difference of IDR 389. When calculated from the difference in the cost of production / Kg, so when multiplied by the number of products in 2017, there is an efficiency of Rp95,063,412.

4. Conclusions & Suggestions
4.1. Conclusions
The following conclusions are proposed in this study:

1. Calculation of costs in production activities can be divided into total costs and overhead costs, in addition to all costs incurred can be divided by how many products are produced and the cost of production will be found / kg. The cost of production/kg in 2017 is IDR 9,101 lower than in 2016, IDR 9,490.

2. Costs that can be eliminated from the production process are costs in the form of overhead. Overhead costs that can be reduced are backorder costs because production planning has been done to minimize backorder costs to Rp37,201,062.

3. The Linear Regression method is the best and most optimal forecasting method for companies to predict future consumer demand. This is because the MAD value of 4627,623, MSE of 26064590 and MAPE value of 27.546% are the smallest MAD, MSE and MAPE values compared to other forecasting methods.

4. In Aggregate Planning, the most optimal method for minimizing the total production costs of a company is the Mixed Aggregate (Overtime and Backorder) method, where the Overtime method prioritizes maximizing labor equal to the Backorder method so that combining the two methods will produce a total cost amounting to Rp120,881,904 consisting of a Backorder fee of Rp37,201,062 and an Overtime of Rp83,680,842.

5. The best Master Production Scheduling to be applied in paint production is to use a table that illustrates the paint production schedule.

4.2. Suggestions
The following suggestions are made in this study:

1. PT. XYZ is recommended to use the Activity Based Costing System Method to calculate the cost of production to more clearly see the cost or expenditure according to the activity causing the cost.
2. PT. XYZ must be able to determine which costs can be eliminated or streamlined, and if eliminated, these costs do not disrupt production
3. PT. XYZ should use the Forecasting method to predict demand in the coming period to do production planning in advance.
4. PT. XYZ should use the Aggregate Planning method that can be adapted to the company's state in conducting production planning.
5. Scheduling using Master Production Scheduling can help PT. XYZ in arranging production scheduling.

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