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STUDY OF COMPANY REVENUE BASED ON PRODUCTION PLANNING CONFIGURATION USING GOAL PROGRAMMING METHOD

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Abstract

Production planning in company management is very important to manage. Production planning needs to consider various aspects. Starting from optimizing profits, minimizing production costs, maximizing the available resources. A Goal Programming Method is one method that can be used to optimize production planning, being able to solve problems to be optimal with more than one objective (multi-objective). UD. Lotus is a textile company, which aims to increase sales revenue, decrease production costs by maximizing regular work hours and optimize the use of available resources. The purpose of this study is to make an appropriate discussion to count the number of clothes produced and multiply the cost of production using the Goal Programming method. The results of the research determine the product combination optimization results from programming objectives increase more funds with the policies made by the company so far. The company's profit with a programming objective solution is exceed the company's profit target.

Keywords: Goal Programming, Multi Objectives, Production Planning

1. Introduction

Nowadays, the world of fashion is high in demand by the market. Therefore, many companies offer a variety of products and promote them as well as possible. This causes a high demand, so the company must meet these demands to dominate the market. UD. Lotus is required to meet the number of requests from consumers. therefore, the company strives to maximize existing production, to meet the number of consumer demand by making optimal production planning. In practice, a company's production planning does not only pay attention to consumer demand, but the company must also pay attention to other aspects, including consumers, available resources, and the manufacturing process.

So far UD. Lotus only orientates the production planning to fulfill the number of demands. This causes production planning to be less efficient. Overtime is done by the company to reach the amount of production. However, this overtime makes production costs at UD. Lotus increased, and the worker performance in carrying out its production is less than optimal. For this reason, companies need to maximize regular work hours so that overtime can be minimized or eliminated.

Goal Programming is a method that can optimize multiple goals (multi-objective). Goal programming is

the outcome of a linear programming model, the difference is in the final result. In Linear Programming, the final result defines the maximum or minimum value, whereas in Programming Goal the final result is something that has been agreed upon. Goal Programming tries to minimize the (total) deviation between the goals set and what can be achieved with a certain agreement.

2. Related works

Goal Programming have been used by many controlled system in industries. The application of programming system is explained in some other research, table 1 is some research which using Goal Programming.

Table 1. Application of Goal Programming In Previous Research

No.	Year and Place	Researhers	Research	Result
1.	America	(Qu, J. et al. 2019)	*A goal programming approach for balancing diet costs and feed water use under different environmental conditions*	The results of this model are based on the feeds, production level of model animals, and prices adopted, and these inputs can be easily modified. The proposed model provides a conceptual framework for the study and evaluation of irrigation water usage in the field of dairy production and a technique for potential use with other livestock systems.
2.	America	(Mcallister et al. 2000)	*Goal Programming Applications In Multidisciplinary Design Optimization*	The configurations from the traditional formulation to the bi-level goal programming formulations are the improved effectiveness and speed of the Undersea Vehicle Design

According to (Mcallister et al. 2000), from Research "Goal Programming Applications in Multidisciplinary Design Optimization", A goal programming is to extend multi-objective system-level analysis to the subsystem level. Goal programming is exceptionally well suited to these design problems because, through deviation variables, the approach automatically captures information about the relative attainment of goals. Therefore, the reported optimal solution can be constrained to a feasible design while incorporating secondary performance measures that are desirable but not required.

3. Methodology explanation and reasoning

Methodology of this research devided on several steps with the reasoning, these are the following steps:

3.1. System Observation

The existing system in this company still using own perception based on the demand from markets to determine production planning. This production planning leads to not achieve the revenue targets, incur more cost, because of the overtime, and the used of available resource id not optimized. A solution is needed to help stakeholders to make a decision for production planning.

3.2. Modelling Goal Programming

(Chowdary & Slomp, 2002), Production planning is a complicated task that requires cooperation among multiple functional units in any organization. In order to design an efficient production planning system, a good understanding of the environment in terms of customers, products and manufacturing processes is a must. Before forming the model, calculating the value of unknown parameters is needed, which the value will be used in the model later.

Table 2 shows the entity and performance measure which is need to be determined.

Table 2. Planning Production Performance Measures

Entity	Performance Measure
Consumer	Fulfill the Demand
Product	Volume of Production
Manufacturing Process	Revenue Cost Optimizing Resource

Table 3 shows the total raw material costs, used raw materials, demand, and available resource used for calculate the selling price. The total of raw material cost is a simple equation which raw material cost multiplied with raw material used per dozen.

Table 3. Type, Raw Material Cost, Demand, and Available Resources

Product	Product Name	Raw Material Used per Dozen (Kg)	Raw Material Cost	Total Raw Material Cost	Demand* (Dozen)	Available Resources (Kg)
X_1	Futsal Shirt	4	Rp 50,000	Rp 200,000	500	3700
X_2	Tracksuit	10	Rp 55,000	Rp 550,000		
X_3	Cotton Shirt	4.5	Rp 80,000	Rp 360,000		

*Demand is based from the last month order.

To calculate the selling price, company has a tern. The selling price is a simple equation which terms of the selling price multiplied by total raw material cost. The term and selling price is shown by table 4.

Table 4. Terms of Selling Price and Selling Price

Product	Product Name	terms of the selling price* (x 1.8)	Selling Price
X_1	Futsal Shirt	1.8	Rp360,000
X_2	Tracksuit		Rp990,000
X_3	Cotton Shirt		Rp648,000

*Terms is from the company policy.

To calculate the cost of production, company has a tern. The cost of ptroduction is a simple equation which terms multiplied by selling price. The term and cost f productin is shown by table 5.

Table 5. Terms of the Cost and Cost of Production

Product	Product Name	Selling Price	Terms Of The Cost* (x 15%)	Cost of Production
X_1	Futsal Shirt	Rp 360,000	15%	Rp 54,000
X_2	Tracksuit	Rp 990,000		Rp148,500
X_3	Cotton Shirt	Rp 648,000		Rp 97,200

*Terms is from the company policy.

This company is targeting the cost of production is below 65.000.000 and the total revenue is above 300.000.000 with the maximum of productions is 500 pcs per month because the labor limitations. Table 6 shows the number of productions, revenue, and cost of production.

Table 6. Number of Production, Total Revenue, and Total Cost of Production

Product	Product Name	Number of Production	Revenue	Cost of Production
X_1	Futsal Shirt	150	Rp 54,000,000	Rp 54,000
X_2	Tracksuit	150	Rp 148,500,000	Rp148,500
X_3	Cotton Shirt	200	Rp 129,600,000	Rp 97,200
Total		500	Rp 332,100,000.00	Rp 49,815,000.00

3.3. Modelling Goal Programming

The formulation of goal programming model is the determination of the optimal product combination. The decision variable is the number of each type of product to be made. The number of each type of product are X_1 = Futsal Shirt, X_2 = Tracksuit, and X_3 = Cotton Shirt.

The objectives to be achieved by UD. Lotus in sequence is fulfill product demand, maximize sales revenue, minimize production costs, optimize the available resources. The following formulation model according from (Anis & Nandiroh, 2007) to achieve the goals of UD. Lotus is as follows:

1. Objective is to maximize the volume of production to fulfill demand :

$$X_i + d_i^- - d_i^+ = P_i \quad \text{... (1)}$$

Where :

X_i = number of products i produced P_i = demand of product i d_i^- = the value of the deviation is below Pi d_i^+ = the value of the deviation above Pi the value of d_i^- and d_i^+ need to be minimized, then the function of Z will be :

$$\text{Min } Z = \Sigma (d_i^- - d_i^+) \quad \text{...(2)}$$

2. Determine the function of constraints on the use of raw materials and the availability of raw materials

Determination of the constraint function for the use of raw materials and the availability of raw materials is obtained from the number of raw materials used in and the number of available raw materials

$$R_1 + R_2 + R_3 \leq 3700 \quad \text{...(3)}$$

Where :

R_i = number of raw material used per dozen

3. The value of production constraints

As mentioned previous, the demand is an estimate of previous month's demand, due to the absence of demand archiving every month. Constraints on the amount of production are assumptions from research. That the production is at least 50 per type per month and maximum total production is 500 per month.

$$X_1 \geq 50 \quad \text{...(4)}$$

$$X_2 \geq 50 \quad \text{...(5)}$$

$$X_3 \geq 50 \quad \text{...(6)}$$

$$X_1 + X_2 + X_3 \leq 500 \quad \text{...(7)}$$

4. Objective is to maximize the revenue, then the function of Z will be :

$$\text{Max } Z = \sum_{i=1}^{m} Si\ Xi \quad \text{...(8)}$$

Where :

S_i = selling price per unit of

product i X_i = number of products i

produced m = types of products

From the equation (8) company wants to maximize the revenue, sales revenue can be achieved if product sales can be maximized. these are the following functions to maximize revenue :

$$\text{Max } Z = 360.000X_1 + 990.000X_2 + 648.000X_3 \quad \text{...(9)}$$

5. Objective is to minimize the cost, then the function of Z will be :

$$\text{Min } Z = \sum_{i=1}^{m} Ci\ Xi \quad \text{...(10)}$$

Where :

C_i = selling price per unit of product i X_i

= number of products i produced m

= types of products

From the equation (10) company wants to minimize cost of production, minimizing the cost of production can be achieved if cost of production is below the target. These are the following functions to maximize revenue:

$$\text{Min } Z = 54.000X_1 + 148.500X_2 + 97.200X_3 \quad \text{...(11)}$$

4. Validation and Result

The validation is comparing between optimized result from this research with the target of company. This result is done by running solver in excel, these following tables are the result of the maximizing, revenue, minimizing cost, and fulfill the demand.

Table 7. Comparison Between the Optimized Solution Number of Production and Previous Production

Goal Number of Productions	Optimized Solution	Previous Production	Company Target
Futsal Shirt	75	150	≤ 500 Pcs / Month
Tracksuit	250	150	
Cotton Shirt	175	200	
Total	500	500	

With using the optimized solution from number of productions, that make the revenue increased. This following table show the comparison from the optimized solution with previous production.

Table 8. Comparison Between the Optimized Solution and Previous Production of each Goals

Goal	Optimized Solution	previous Production	Company Target
Maximize Gross Profit	Rp 387,900,000	Rp 332,100,000	-
Minimizing cost	Rp 58,185,000	Rp 49,815,000	Rp 65.000.000
Total Revenue	Rp 329,715,000	Rp 282,285,000	Rp 300.000.000

From the data table can be analyzed there is the difference between the optimized solution with the previous production. The total revenue from previous production is Rp 282,285,000, this is 5.9% lower than the company target. However, the result from the optimized solution shows Rp 329,715,000 which 9.9% higher from the company target. Even though the cost of optimized solution is 12.9% higher from previous production this cost is still below the company's target.

5. Conclusion

The result of this study is to reduce the stake holders subjectivity in configurating a number of production. The validation from the result of goal programming has 9.9% higher value from the company target. Although the value of the cost from the optimized solution is higher than the previous production, stakeholder should take this configuration from optimized solution because the total revenue is exceed the company target.

6. References

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