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Application Of The Goal Programming Method In Increasing Plate Production For Steel Ships

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ABSTRACT
PT. Gunawan Dianjaya Steel (GDS) is one company that produces steel plates in Indonesia. PT GDS was hot sheet steel factory (BLP) producing steel and steel in all sorts of different types and design of consumer conformed to order.A kind of steel produced by the blp hot sheet steel it is divided into the type form the coil and plate masing-masing form the quality of being domestic composed of different kinds, imports and CRM. Production planning basically there are three elements need to be considered, the consumers, products, and the manufacturing process.All three of these elements is a very complex to be faced by the company.This study attempts to determine the optimal combination that can reach the whole purpose of these elements of the company. Methods used in this research is goal programming, a method of optimize developed to solve the problems with the aim of more than one.The goal programming has the ability to achieve a number of goals or target. From the mathematical linear fomulasi until they reached the goal total production $x_1 + x_2 + x_3 = 10 + 75 + 65 = 140$ plate targetless 150 plate.Goal of a production = 10 plate that means 40 plate under production target of 50 plate goal products b = 75 plate that means in accordance with company production target.Goal production products c = 65 plate that means less than 15 a plat of 80 plate company production target.The product is the total second Rp.100.000 x_1 + Rp. 175.000 x_2 + Rp. 200.000 x_3 = Rp.100.000 (10) + Rp.175.000 (75) + Rp.200.000 (65) = Rp. 1.000.000,- + Rp.13.125.000,- + Rp.13.000.000,- = Rp. 27.125.000,-

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INTRODUCTION

PT. Gunawan Dianjaya Steel (GDS) is a company that produces steel plates in Indonesia. PT GDS was hot sheet steel factory (BLP) producing steel and steel in all kinds of different types and design of consumer conformed to order. A kind of steel produced by the blp hot sheet steel it is divided into the type form the coil and plate each form the quality of being domestic composed of different kinds, imports and CRM. Now the BLP in running production activities are in accordance with the market which numbers and colors according to the market, so as to cause there has often been a change in production plans. Has not done the PT. GDS material production planning well and planning, only on past experience, estimates

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(jusmendt) or an intuitive leap. As the market is difficult to unexpected and difficult in raw materials from other areas would bring causing problems, such as delays in fulfilling customer demand order requests so frequently lost in the event of an increase in demand efforts over time. Production planning is one of the important things in manufacturing concerns. Relating to planning determination of the volume of production, the timing, the utility capacity and equity. Management of companies should make a decision on the production to the proper obtained the cost will come to the minimum and maximum profit can be obtained. Planning production in general is undertaken by predictions based on the experience that happened in the past (Baroto, 2002).

The maximum advantage the required number of production planning with regard to what are on obstacles production system. The problems in planning production can be made as a model. The production of a company need in terms of maximizing the community production ripe. Relating to planning determination of the volume of production, the timing, the utilization of capacity, and even distribution of the burden. Production planning is generally carried out with assessment (marine based on past experience,) 2018.In this research will be done planning produced for the field of building plate of steel more planned in hope will be minimize problems that arise in factory PT. GDS. Company of plate would have to increase production in order to get the maximum maybe, for the time being shipyard is undergoing industrial production increase so that there is a chance for the company to meet the needs of shipyard industry yuliawati plate, e.(2018). Planning to achieve is a combination product, to meet a demand the forecasting through ship industry plate, production plant and companies will increase production plate commonly used to construct ships. This time to a plate that is often used in domestic shipyard industry vessel is plate 8 mm in thickness, 10 mm, and 12 mm and a measure of length 2,4 d meter

METHODS

The kind of research on this research is applied research using quantitative methods in PT. GDS. Applied research carried out relating to solving problems, kenyataan-kenyataan practical, the application of, and the development of knowledge produced by basic research in real life and merumuskannya problems. As for the procedure: research as follows:

1. Presentation theories
   Supporting presentation theories obtained from various a reliable source such as books, a journal of the internet, the text, a document that deals with the goal programming.
2. Decision variables Goal Programming.
   a) Objective function
      The objective function is a function of the decision variable that will be minimized or maximized. Another characteristic that mark's goal programming is the presence of deviation variables in the objective function that must be minimized.
      $$\sum_{i=1}^{m} d_i^- + d_i^+ \quad (1)$$
      It should be noted that in the GP model there are no decision variables found in the objective function. Researchers are still looking for, as the goal programming

model does, the unknown value of xj, but this will be done indirectly through minimizing negative and positive deviations from the RHS (Right Hand Side) value of the goal constraint.

b) Constraint function
The constraint function is a mathematical function that provides limits on the available resources that can be used. There are six different types of goal constraints. The purpose of each type of constraint is determined by its relationship to the objective function. The six types of constraints are presented in the following table. (Mulyono, 2007).

Table 1. Types of Goal Constraints

Constraint fungction	Deviation Variable	Possible deviation	Determine the desired RHS value
$aijxj + d_i^- = b_i$	d_i^-	Negative	$= b_i$
$aijxj - d_i^+ = b_i$	d_i^+	Positive	$= b_i$
$aijxj + d_i^- - d_i^+ = b_i$	d_i^-	Neg and pos	b_i or plus
$aijxj + d_i^- - d_i^+ = b_i$	d_i^-	Neg and pos	b_i or minus
$aijxj + d_i^- - d_i^+ = b_i$	d_i^- and d_i^+	Neg and pos	$= b_i$
$aijxj - d_i^+ = b_i$	d_i^+	Tidak Ada	$= b_i$

3. Data processing formula for Goal Programming problems
The data used in this research is secondary data obtained from PT GDS. The data required in this research includes:
   a) Sales data at PT GDS
   b) Production costs of ship steel plates
   c) Price of each type of plate at each thickness
   d) Processing time
   e) The amount of raw materials required for one product production

The model formulation to achieve the above objectives is divided into two categories of functions, namely target functions and constraint functions:

1) The goal is to maximize production to meet sales quotas

$$x_i + d_i^- + d_1^+ = Pi \quad (2)$$

Where
x_i : Number of products produced
Pi : Product sales level i
d_i^- : Deviation value below Pi
d_1^+ : Deviation value above Pi

2) The goal is to maximize profits

$$\sum_{i=1}^{m} u_i x_i + d_i^- - d_i^+ = PK \quad (3)$$

ui : Profit per unit of product
xi : Number of products produced
m : Number of product types
PK : Profit Projection

4. Data processing

The data that has been obtained is then processed using the help of LINDO software. The use of software is expected to provide the best output without any errors such as when using the manual method. Then the results obtained will be analyzed to explain the picture of the output results.

5. Result

After the data processing results are obtained and analyzed, conclusions can be drawn for the problems that occur at PT GDS.

RESULTS AND DISCUSSION

Data collection

The problem that occurs with PT GDS is that the company only relies on the belief that optimal income can be obtained by only relying on fulfilling market demand or it could be said that the company only has one goal, namely fulfilling market demand. So to solve problems using the Goal Programming method, a number of data related to the problem are needed. The data obtained is as follows:

a. The profit from Plate A with a thickness of 12mm is IDR. 100,000,-
b. The profit from Plate B with a thickness of 10mm is IDR. 175,000,-
c. The profit from Plate C with a thickness of 8 mm is IDR. 200,000,-
d. Each product goes through a production and testing process
e. The monthly working hour capacity in the production section is 192 hours.
f. The monthly working hour capacity in the testing section is 240 hours.
g. Each plate A requires 3 hours of processing in the production section and 2.5 hours in the refining section.
h. Each B plate requires 2 hours of processing in the production section and 2 hours in the refining section.
i. Each C plate requires 1.75 hours of processing in the production section and 1 hour in the refining section.

Data processing

Assuming that the PT DGS plate company has a goal, namely maximizing profits from production results, the optimum product combination is as follows:

Decision variables are decomposed into

X_1= Number of A plates produced per month

x_2= Number of B plates produced per month

x_3= number of C plates produced per month

So it is obtained

$Z = 100\ x_1 + 175\ x_2 + 200\ x_3$

Dengan fungsi kendala

With constraint function

$3\ x_1 + 2\ x_2 + x_3 = 192$ (4)

$2{,}5\ x_1 + 2\ x_2 + x_3 \leq 240$ (5)

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The production goal for both plates is 150 plates. If it is defined that d_1^+ is the goal above the target and d1- is the goal below the target $x_1 + x_2 + x_3$ as total production then the third constraint is obtained.

Third obstacle

$x_1 + x_2 + x_3 - d_1^+ + d_2^- = 150$ (6)

If the goal exceeds the target, then d_1^+ will be positive and d_1^- will be 0. If the total production is 120 plates or $x_1 + x_2 = 120$ then d1+ = 10 and $d1^- = 0$ so $x_1^+ + x_2^- - d_1^+ + d_1^- = 160-10+ 0 = 150$ and vice versa, in the same way constraints can also be created for the other two goals, namely:

$x_1 + d_2^- = 50$ (7)

$x_2 + d_3^- = 75$ (8)

$x_3 + d_4^- = 80$ (9)

When determining the objective function in goal programming, the objective function only includes deviation variables with minimum criteria. In the case of increasing production at the plate production factory, the company management set a total production target of 150 plates. In the solution the deviation variable is $d_1^+ + d_1^-$ Therefore, the two deviation variables are included in the objective function. Furthermore, management wants a minimum target for product A of 50 plates. The deviation variable is d_2^-, which is calculating the target goal for product A. Apart from that, management also wants a minimum target for product B of 75 plates. The deviation variable is d_3^-,namely calculating the target goal for product B, finally product C is 80 plates. The deviation variable is d_3^-, namely calculating the target goal for product B. Thus, the objective function of the company's problem is the minimum complete goal programming is as follows:

$Z = d_5^+ + d_5^- + d_6^+ + d_6^- + d_1^+ + d_1^- + d_2^- + d_3^- + d_4^-$ with obstacles

$3 x_1 + 2 x_2 + 1,75 x_3 d_5^+ + d_5^- = 192$ (1)

$2,5 x_1 + 2 x_2 + x_3 - d_6^+ + d_6^- = 240$ (2)

$x_1 + x_2 + x_3 - d_1^+ + d_1^- = 150$ (3)

$x_1 + d_2^- = 50$ (4)

$x_2 + d_3^- = 75$ (5)

$x_3 + d_4^- = 80$ (6)

The mathematical formulation model that has been carried out is then written on the LINDO software board so that an optimal solution is found.

INPUT

MIN DA5 + DB5 + DA6 + DB6 + DA1 + DB1 + DB2 + DB3 + DB4

SUBJECT TO

2) - DA5 + DB5 + 3X1 + 2X2 + 1.75X3 = 192

3) - DA6 + DB6 + 2.5X1 + 2X2 + X3 = 240

4) - DA1 + DB1 + X1 + X2 + X3 = 150

5) DB2 + X1 = 50

6) DB3 + X2 = 75

7) DB4 + X3 = 80

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END
OUTPUT
LP OPTIMUM FOUND AT STEP 5
OBJECTIVE FUNCTION VALUE
1) 156.7500

VARIABLE	VALUE	REDUCED COST
DA5	101.750000	0.000000
DB5	0.000000	2.000000
DA6	0.000000	1.833333
DB6	0.000000	0.166667
DA1	0.000000	0.916667
DB1	0.000000	1.083333
DB2	40.000000	0.000000
DB3	0.000000	0.583333
DB4	15.000000	0.000000
X1	10.000000	0.000000
X2	75.000000	0.000000
X3	65.000000	0.000000

ROW	SLACK OR RPLUS	DUAL PRICES
2)	0.000000	1.000000
3)	0.000000	-0.833333
4)	0.000000	0.083333
5)	0.000000	-1.000000
6)	0.000000	-0.416667
7)	0.000000	-1.000000

NO. ITERATIONS= 5

The objective function value shown by the LINDO program output is Rp. 156,750,000. This value is the minimum total cost based on the raw materials for making the three types of plates, where x1 = 10,000,000, x2 = 75,000,000, x3 = 65,000,000. The value of Reduced Cost is very meaningful if the decision variable concerned is 0 (zero), because the function of Reduced Cost is to show how much the cost per unit of a variable can be reduced so that the optimal solution obtained from the variable is positive. Based on the output above, the value of the decision variable is zero, so the Reduced Cost is also zero.

The objective function value shown by the LINDO program output is IDR. 156,750,000. This value is the total minimum cost based on the raw materials for making the three types of plates, where x_1 = 10,000,000, x_2 = 75,000,000, x_3 = 65,000,000. The value of Reduced Cost is very meaningful if the decision variable in question has a value of 0 (zero), because the function of Reduced Cost is to show how much the cost per unit of a variable can be reduced so that the optimal solution obtained from that variable is positive. Based on the output above, none of the decision variable values have a value of zero, so Reduced Cost also has a value of zero.

From the Software Output, the result is $x_1 = 10$; $x_2 = 75$; $x_3 = 65$ then add up. Total production goal $x_1 + x_2 + x_3 = 10 + 75 + 65 = 140$ plates below the target of 150 plates. Product

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A production goal = 10 plates, which means 40 plates below the target of 50 plates. Product B production goal = 75 plates, which means it is in line with the production target. Product production goal C = 65 plates, which means less than 15 plates of the 80 plate production target. So the total profit for both products is IDR 100,000 x_1 + IDR. 175,000 x_2 + Rp. 200,000 x_3 = IDR 100,000 (10) + IDR 175,000 (75) + IDR 200,000 (65) = IDR. 1,000,000,- + Rp.13,125,000,- + Rp.13,000,000,- = Rp. 27,125,000,-

CONCLUSION

The total profit obtained per month is IDR. 27,125,000,- .The total profit can be used as a parameter for running production to get maximum profit. This research can be further developed into research with a larger scope, such as analyzing profit forecasting for a company starting from raw materials and profits for each month in the following year.

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