Capacity Planning to Fulfill the Coal Demand in PT XYZ

Ilham Putra Pratama, Daryl Octovianus Chiok, Bachtiar H. Simamora
Management Department, BINUS Business School Undergraduate Program, Bina Nusantara University, Jakarta, Indonesia 11480
bsim@binus.ac.id

Abstract

Demand for coal in the world today continues to increase, one of which demands coal in Indonesia. The increase in demand for coal will certainly make some producers have to prepare their production capacity to meet the demand for coal, given that coal is currently also used as alternative fuel oil. One of the companies engaged in coal mining in Indonesia is PT. XYZ. The purpose of this study is for PT. XYZ can continue to meet the demand for coal, especially in the future. In this study, researchers used a capacity planning method that aims to meet the optimal production capacity and meet all the demand forecasts in the future. Before capacity planning, demand forecast forecasting is used as a basis for determining future production capacity requirements, forecasting using 5-year historical data starting from 2012 to 2016. Given the predicted demand that has been calculated, the company can find out the required capacity requirement In fulfilling all future requests. The addition of capacity has the cost of investment for the company, for that done the feasibility of investment analysis using a cost-benefit analysis approach. The results of this study indicate that the company needs to increase the production capacity from 13,497,624 tons/year to 18,338,040 tons/year to have optimal production capacity because the capacity can meet the demand of 18,204,390 tons/year in 2021. Investment cost. The addition of capacity is feasible because the results of the cost-benefit analysis show the NPV and ROI positive, profitability index and benefit-cost ratio above 1, and payback period under five years.

Keywords
Capacity Planning, Forecasting Method, Cost-Benefit Analysis, SPSS, Linear Regression Method.

1. Introduction
Mining in the country with natural resources, such as Indonesia, has now become a land that is eager to be exploited by various parties at home and abroad. One of which has been rife for the last few decades is coal, which has begun to be favored and sought by many large industries to become alternative energy as the issue of oil supply depletion and price comparison between the two is quite significant. This situation is read quite observant by local people who want to feel the benefits of the land where they stand, one by one the mining company began to stand up and begin serving domestic and foreign demands. The high market demand for coal products makes the companies currently moving in the coal mining industry must be able to produce products that are both quality and quantity. But besides that, the company is also required to be able to meet market demand promptly because if the company cannot meet market demands in terms of quality, quantity and time, then it is likely that the market will be disappointed with the company and find alternative other companies that can meet market desires (Nielsen et al. 2014, Paulus 2012, Shen et al. 2013, Thiruchelvam and Tookey 2011)

PT. XYZ is a coal mining contractor company located at Bakrie Tower 8th Floor Rasuna Epicentrum, Jl. Rasuna Said, South Jakarta 12940, and has been established in 1991. The problem faced by the company today is the increasing complaints from consumers caused by several requests that cannot be fulfilled by PT. XYZ. According to an interview conducted by Mr Yohannes Daniel Kristanto, a Cost Estimation Engineer, it was explained that the level of consumer complaints about the company continued to increase in recent years due to production delays due to drastic consumer demand. On the other hand, the company did not know how to move to predict sales in future periods, especially in the long term, so that the company could prepare the right production capacity planning, currently using forecasting based on assumptions. Also, the high demand for coal products makes the company indirectly have to pay more capital to produce coal. Until now, PT XYZ does not know yet what alternatives can be implemented by the company to meet production demands beyond the company's regular capability limits, making the company experience waste of costs and often get complaints because orders cannot be effectively fulfilled.

Based on the background above, the problem can be formulated as follows:

- What is the optimal production capacity that can be owned by the company to be able to meet future demand?

The objectives of this research are as follows:

- To find out how optimal the production capacity a company can have to be able to meet future demand.

According to Kumar and Suresh (2009), Capacity Planning is a plan undertaken to maintain future growth and development plans, market trends, sales forecasting, and others. According to Heizer and Render (2009) in his book states that capacity is the number of units that can be accommodated, received, stored, or made by a facility within a period. According to Chase et al. (2005), capacity is the ability to accommodate, receive, store, or accommodate. Capacity is often seen as the amount of output a system can achieve over a certain period. Based on the above theories, it can be concluded that capacity planning is the process of deciding the production capacity requirements of a company to meet the changing demands of each product.

2. Research Method

The type of research used is descriptive quantitative research. According to Sugiyono (2007), descriptive research is research conducted to determine the value of independent variables, either one or more variables without making comparisons, or connecting with other variables. Descriptive research can be done quantitatively by using mathematical calculations.

The research design is a blueprint of the collection, measurement, and analysis of data based on questions from the study (Sekaran, 2014). A research design can be described as a plan that describes how, when and where data will be collected and analyzed. The design of this research study is shown as follows in Table 1:

Table 1. Research Design

Purpose	**Research Design**		
	Research Type	**Analysis Unit**	**Time**
T-1	Descriptive	Organization	*Cross-Sectional*

Information:
Q-1: To find out how much optimal production capacity the company can have to be able to meet future demand.

Data collection techniques used by researchers are:
• Research is done by visiting the places that are the object of research. The activities carried out are as follows:
• Researchers collect data needed for research, by conducting interviews.

To analyze the problems that occur at PT XYZ using the capacity planning method. The following data analysis techniques are used in this study:

2.1 Forecasting Linear Regression

It is one of the statistical analysis techniques used to describe the relationship between one response variable with one or more explanatory variables. The use of this method is based on existing variables, and that will affect the results of forecasting. The things that need to be known before forecasting using the regression method are knowing in advance knowing conditions such as:

a. Past information
b. Existing information can be made in the form of data (quantified)
c. It is assumed that existing data patterns from past data will be sustainable in the future.

The data in the field are:
a. Seasonal
b. Horizontal (Stationary)
c. Cycle (Cyclical)
d. Trend

In compiling forecasts, 2 types of analysis can be used, namely:
1. Time series analysis, is an analysis of the variable sought with the time variable.

2. Cross Section Analysis or causal (Causal method), is an analysis of variables sought with independent or influential variables.

There are two approaches for forecasting using time series analysis with a simple regression method, namely:
1. Time series analysis for simple linear regression
2. Series analysis for simple non-linear regression
To explain the relationship between these two methods mathematical notation like:
Y = F (x)

Where:
Y = Dependent variable (variable sought)
X = Independent variable (the variable that affects it)
Simple regression notation using linear regression (straight line) can be used as follows:
Y = α + bx
Where a and b are parameters that must be sought. To find the value of a, you can use the formula:
a = Y - bx
then the value of b can be found by the formula:
b =

2.2 Capacity Planning

The results of the demand forecast will be used as a basis for determining future capacity needs (Ceryan and Koren 2009). Capacity planning is used to modify the amount of production capacity that will be adjusted to the needs of production capacity.
Capacity planning is carried out by means of (Aarabi and Hasanian 2014):
1. Forecasting requests
2. Determine capacity requirements
3. Determine alternative choices in changing capacity
4. Evaluate each choice
5. Decision making with the best alternative

3. Result and Discussion

3.1 Linear Regression Method

Based on the results of SPSS processing, where the value of beta (b) is 851,394.4 while the value of (a) or constant is 9,690,450. So, it can be concluded there are no differences or incorrect calculations when using manual calculations or with SPSS tools.

Regression equation with manual calculations or with SPSS in Table 2:

Table 2. Linear Regression

Years	Ddemand
2017	14.798.814
2018	15.650.208
2019	16.501.602
2020	17.352.996
2021	18.204.390

3.2 Capacity Planning Method

In accordance with the planning implications described earlier, after calculating forecasting, it will determine how much capacity is needed in order to meet these future requests. Forecasting results will be used as a reference to determine the capacity needs in the future. Then a comparison of the company's production capacity with the capacity needs will be made (Table 3).

Table 3. Capacity Planning

Year	Demand Forecast	Current Production Capacity	Lack of capacity	Adding machine	Capacity increased	Capacity Total	Capacity available
2017	14.798.814	13.497.624	-1.301.190	1	2.420.208	15.917.832	1.119.018
2018	15.650.208	13.497.624	-2.152.584	-	2.420.208	15.917.832	267.624
2019	16.501.602	13.497.624	-3.003.978	1	4.840.416	18.338.040	1.836.438
2020	17.352.996	13.497.624	-3.855.372	-	4.840.416	18.338.040	985.044
2021	18.204.390	13.497.624	-4.706.766	-	4.840.416	18.338.040	133.650
Total	**82.508.010**	**67.488.120**	**-15.019.890**	**2**	**19.361.664**	**86.849.784**	**4.341.774**

From the above Table 3, it is seen that PT XYZ is predicted to experience a shortage of production capacity from the Coal Crusher machine of 15,019,890 tons over the next five years. Therefore, it is necessary to add two sets of machines that will increase production capacity by 19,361,664 tons over five years. The addition is needed in 2017 as many as 1 set of machines, and 1 set of machines in 2019.

Table 4. Capacity Planning

Year	Demand Forecast	Current Production Capacity	Lack of capacity	Adding machine	Capacity increased	Capacity Total	Capacity available
2017	14.798.814	15.724.800	-	-	-	15.724.800	925.986
2018	15.650.208	15.724.800	-	-	-	15.724.800	74.592
2019	16.501.602	15.724.800	-776.802	1	1.310.400	17.035.200	533.598
2020	17.352.996	15.724.800	-1.628.196	1	2.620.800	18.345.600	992.604
2021	18.204.390	15.724.800	-2.479.590	-	2.620.800	18.345.600	141.210
Total	**82.508.010**	**78.624.000**	**-4.884.588**	**2**	**6.552.000**	**85.176.000**	**2.667.990**

From the above Table 4, it appears that PT XYZ is predicted to experience shortages in the carrying capacity of the Excavator engine of 4,884,588 tons over the next five years. Therefore, it is necessary to add two sets of machines that will increase production capacity by 6,552,000 tons for five years. The addition is needed in 2019 for 1 set of machines and 1 set of machines in 2020.

Table 5. Capacity Planning

Year	Demand Forecast	Current Production Capacity	Lack of capacity	Adding machine	Capacity increased	Capacity Total	Capacity available
2017	14.798.814	16.511.040	-	-	-	16.511.040	1.712.226
2018	15.650.208	16.511.040	-	-	-	16.511.040	860.832
2019	16.501.602	16.511.040	-	-	-	16.511.040	9.438
2020	17.352.996	16.511.040	-841.956	4	1.048.320	17.559.360	206.364
2021	18.204.390	16.511.040	-1.693.350	3	1.834.560	18.345.600	141.210
Total	**82.508.010**	**82.555.200**	**-2.535.306**	**7**	**2.882.880**	**85.438.080**	**2.930.070**

From the Table 5, it appears that PT XYZ is predicted to experience shortages of the carrying capacity of the 2,535,306 ton Dump Truck engine over the next five years. Therefore, it is necessary to add two sets of machines that will increase production capacity by 6,552,000 tons for five years. These additions are needed in 2020 as many as four dump trucks and three dump trucks in 2021.

By investing in additional coal production capacity, PT XYZ can handle the problem that previously occurred, namely the level of demand that is above the level of production capacity. Because of this additional production capacity, PT

XYZ can handle market demand and can also reach a wider market share. Besides, through the Cost-Benefit Analysis calculation analysis can be seen the feasibility of investing in the addition of coal production machines is as follows:

Table 6. Cost-Benefit Analysis

Method	Criteria	Result	Calculation result	Result
Net Present Value	Positive	Accepted	IDR 1.707.113.208.471	Accepted
	Negative	Rejected		
Return On Investment	Positive	Accepted	340.59%	Accepted
	Negative	Rejected		
Profitability Index	> 1	Accepted	27.2019	Accepted
	< 1	Rejected		
Benefit / Cost ratio	Ratio > 1	Accepted	1.17647	Accepted
	Ratio <1	Rejected		
Payback Period	< 5 Year	Accepted	4 months 1 days	Accepted

Based on the Table 6, it can be seen that investment in adding coal production capacity through the addition of machinery is feasible. These results also show that adding machines in the specified year has been able to meet all future requests. The investment value also shows a positive NPV, so which shows that the addition of these machines makes the company's production capacity optimal.

4. Conclusion and Suggestion

4.1 Conclusion

Conclusions based on the results of capacity planning analysis, it was found that to have optimal production capacity, the company needed additional production capacity because the company's current production capacity could not meet future demand. The addition of production capacity is done through the addition of machines. The addition of machines consists of adding two units of coal crusher in the year, adding two units of excavators and seven units of dump trucks, so the company can have a production capacity of 18,338,040 tons/year to meet all future requests are 18,204,390 tons/year in 2021.

4.2 Suggestion

A. Suggestions for PT. XYZ
The following is a suggestion for PT. XYZ:
1. Companies are advised to apply the demand forecasting method with a linear regression method for the next period (2018 and beyond) so that they can know the surge in demand and can control the movement of demand so that the forecast results can be more accurate.
2. PT. XYZ, it is recommended to increase production capacity by increasing the number of machines following the results of existing calculations, thus PT. XYZ can fulfill all consumer demands.

B. For further researchers
For further researchers, can use other forecasting methods (not using Excel and SPSS tools) by conducting moving averages or exponential smoothing so that they do not project trends like researchers do now.

References

Aarabi, M. and Hasanian, S., Capacity planning and control, *International Journal of Scientific & Engineering Research*, 975-984, 2014.
Ceryan, O. and Koren, Y., Manufacturing capacity planning strategies. *Department of Mechanical Engineering*, 403-406, 2009.
Chase, R. B., Jacobs, F. R., and Aquilano, N. J., *Operations Management For competitive advantage*, 9th Edition, McGraw-Hill, New York, 2005.
Heizer, J. R., *Manajemen Operasi Buku 1,* 9th Edition*,* Salemba 4, Jakarta, 2009.
Kumar, S. A., and Suresh, N., *Operation Management*, New Age International (P) Ltd. Publisher, New Delhi, 2009.

Nielsen IE, Banaeian N, Gollinska P, Mobli H, and Omid M., Green Supplier Selection Criteria: From a Literature Review to a Flexible Framework for Determination of Suitable Criteria. Journal Logistics Operations, Supply Chain Management and Sustainability.Part I, pp 79, 2014.

Paulus, M. The Economics of International Markets [disertation]. Cologne (DE): Cologne University 2012.

Sugiyono. *Metode Penelitian Kuantitatif Kualitatif dan R&D*, Bandung, Alfabeta, 2007.

Shen, L., Muduli, K., and Barve,A. Developing a Sustainable Development Framework in the Context of Mining Industries: AHP Approach. Journal of Resources Policy. vol 46, pp. 15-26, 2013.

Thiruchelvam S, and Tookey JE. Evolving Trends of Supplier Selection Criteria and Methods. International Journal of Automotive and Mechanical Engineering. vol. 4, pp. 437-454, 2011.

Biographies

Ilham Putra Pratama and Daryl Octovianus Chiok are students of Management Department, BINUS Business School Undergraduate Program, Bina Nusantara University.

Bachtiar Simamora is a Senior Lecturer at Management Department, BINUS Business School, Bina Nusantara University.