LONG-TERM CAPACITY PLANNING FOR CUPOLA FURNACE DIES CASTING MANUFACTURE USING ESTIMATION PRODUCT APPROACH

THESIS

Submitted to International Program Industrial Engineering in Partial Fulfillment of the Requirements for the degree of Bachelor of Industrial Engineering at Universitas Islam Indonesia

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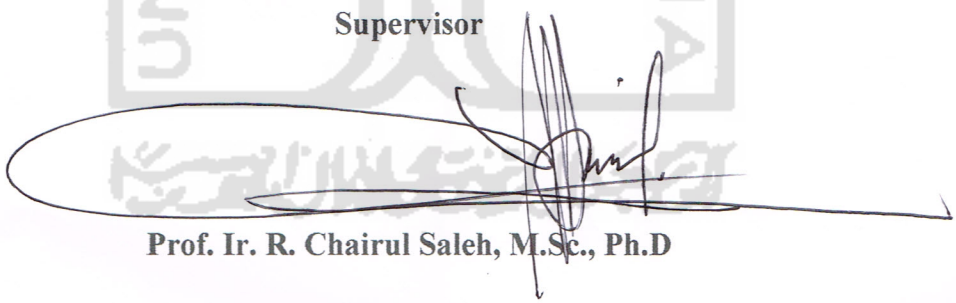

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In the name of Allah SWT, I declared that this research is conducts of my own crafts. All of the summaries study used have the source to be cited correctly, If in further my statement is proven to be at fault and violated the legal rules in writtings and intellectual copurights or proven plagiarsm. I am ready to give up back my graduate degree on Universitas Islam Indonesia.

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Miftah Aria Kusuma

ABSTRACT

Manage capacity planning is constantly facing the challenge of producing products while reducing cost. The challenge is to fit the demand with the order. Nowadays dies products are still being produced in homogenous market due to the complexity and high variance of the products. In such a production capacity planning is of vital importance as resources need to be cleverly managed in order to obtain a high utilization. However, with high demand all required process and estimation. The estimation cost of the products is used in order to determine the amount of capacity required to produce them. The better ~~can the~~ long-term capacity planning ~~to~~ will affect the operational. The process needs to determine the demand and the break-even point to get the alternatives. This research aims at revealing the connection between long term capacity planning and the estimated product cost in cupola furnace. A secondary is furthermore to find the best method to get the lowest cost and best quality for the subcontract that can fulfill the demand for long-term. The expected result to find the interest result is the break-even point approximately around 7.000 until 8.000 units. The profit with Rp39.440.000 and the product about 20.000 Kg and volume of the capacity is 40m^2.

Keyword: *Capacity Planning, Product Estimation, Production Planning & Controlling, Forecast, Decision Making.*

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CHAPTER I

INTRODUCTION

1.1 Background

Estimating manufacturing costs of a process ~~soon after research and development has commenced~~ can provide a good indication of the economic viability. Early estimation~~es~~ can be used to direct research efforts ~~to~~ for promising opportunities ~~for~~ of cost reduction, and allow businesses to ~~better~~ assign better resources to new products (Anderson, 2009) Although potentially compromised because some information may be missing, early estimation~~ses~~ are often sufficiently accurate to shed light on a product's long-term viability. Quick determination of the relative contribution of variable cost, fixed operating costs and capital depreciation of total product costs allows cost-reduction efforts to be focused on those cost components that are likely to be most significant. This case, capacity planning is one of the options to give reduction cost. Also as control, combining estimated cost and capacity planning for long term would solve one problem in manufacturing.

There ~~is~~ are ~~a~~ rich literature~~s~~ on optimal capacity investment and ~~an~~ extensive survey~~s~~ on the topic ~~has~~ have been provided ~~in~~. Several studies consider both ~~consider both~~ initial investments and optimal capacity adjustments overtime (Duenyas 2003). Therefore, investing in the optimum quantities and types of capacity at the beginning of a planning is crucial for profitability in the long run. Van Mieghem (1998) ~~stated~~ studied ~~that studies~~ optimal investment in dedicated and flexible capacities under uncertainly and showed~~s~~ how several problem parameters including investment cost demand uncertainties effect optimal investment decisions. The ability of a manufacturer to efficiently manage its capacity has a direct impact on the company's competitiveness and numerous of the market, especially for homogenous market. One of the approaches is product estimation which is break-even point.

Comment [MW1]: What is this? I mean the real meaning of this line?

Comment [MW2]: Iso double kata "consider"?

Metal manufacturing has many ways to produce metal. One of the production methods used for dies casting is cupola furnace. Cupola furnace is a continuous melting shaft furnace which has by its inherent design considerable advantages over batch type melters such as electric furnaces or rotary furnaces. A cupola can accept a wide range of raw materials including oily, wet and contaminated scrap. These materials are unsuitable for electric furnaces for safety reasons and because of the contamination their use is also often limited for metallurgical reasons. In cupola melting there is a degree of refining as the metal forms droplets during melting before collecting in the well. Many contaminants are lost or reduced in value in this process whereas when melting in electric furnaces or rotary furnaces whatever is in the charge material finishes up in the liquid.

One of the biggest problems faced by manufacturing is ~~that of~~how to matching supply to demand (Ji, Wang, & Hu, 2016). Very often, the metal manufacturer does not know how its server capacity ~~is~~ being used. The tendency of many metal manufactures ~~does not~~do not use product cost as consideration to manage~~ing~~ the capacity, and then cause decreasing amount of production. The case of cupola furnace which needs space for production, capacity planning for long-term would ensure that certain critical processes always have enough capacity to run effectively.

Wen., et al. (2016) defined that the capacity problems in the manufacturing caused by the uncertain demand and dynamic price of product that influence to profitability. The manufacturer faces problem in determining~~e~~ initial stock in the beginning of selling season and to allocate ~~and to allocate~~ the remaining quantity for the current and future sale in each period to maximize the profit. Nguyen & Wright (2015) said that the manufacturer needs to take consideration not only on how to customer will react~~s~~ with the product, but also whether ~~adequate~~ the capacity is adequate to fulfill the commitment.

~~According to~~ Creutznacher., et al. (2016) explained~~s~~ that to meet optimal production volumes and operation, ~~there is need~~it takes capacity management activity. A capacity planning management enables to identify underused capacity and opportunities for consolidation. It is able to reallocate~~s~~ capacity as necessary and

monitor the impact. Simply by doing this can save cost on previously wasted resources. Based on the problem above, it's possible to find the capacity planning based on cost estimation.

The complex procedure of cost estimation is currently views in the literature solely as means to early determine the cost of a product, even from the design phase. However, especially for metal manufacturing, this procedure could be proven as advantageous. Determininge the long-term capacity planning on homogenous market could find an interest to improve the operation of dies manufacturing.

1.2 Problem Formulation

This research will systematically correlate the parameter of availability with the cost which related to the time schedule maintenance by postponed time-based management. Related to the purpose, main research question addressed in this review are:

1. How to develop capacity planning to determine the capacity in cupola furnace dies manufacture?
2. What is the result that can be ~~shown~~ withdrawn as recommendation for further research to influence the cost estimation method on long term capacity planning ~~that~~ which can improve the operation of dies manufacture?

1.3 Research Objectives

Based on problem formulation above, this research is created to fulfill several obectives as mentioned below:

1. Able to develop capacity planning model through forecasting, decision-making, and Breakeven Point
2. To find the further research recommendation that could reveal interesting result to improve the operation of dies manufacture.

1.4 Research Limitation

Problem limitation is a limitation of problems to make a border in the research in order to keep the research inside the scope. Base on the background there are some scope to make the research focus,the scope as follows:

1. The research only focuses on cost estimation for long-term capacity planning in Metal manufacturing.
2. The research is conducted in Metal manufacturing in Indonesia.
3. The sample size of metal manufacturing that used by researcher only one company.

1.5 Research Benefit

It is expected that by conducting this research, some benefits can be earned:

1. Research methodology can be used to find the estimation cost for long-term capacity planning in Metal manufacturing.
2. Further research recommendation can be used for better future research.

1.6. Systematical of Thesis Writing

Furthermore, this thesis writing will be continued as follows:

CHAPTER I INTRODUCTION

This chapter contains the background of the problem, the formulation of the problem, research objectives, research benefits, limitation of problem and systematic writing.

CHAPTER II LITERATURE REVIEW

This chapter will be explaining the literature studies. Literature review is contains inductive and deductive study.

CHAPTER III RESEARCH METHODOLOGY

This chapter will be steps for conducting the research are applied as a references in order to keep focusing on the primarily goals, which are going to be archived. It w~~W~~ill explain~~be explaining~~ and summarize~~ies~~ the phases of the systematic literature review undertaken, the method and tools used to support every stage as well as the section of the article where these are addressed.

CHAPTER IV DATA COLLECTING AND PROCESSING

This chapter will ~~be explaining~~explain the analysis and synthesis in phase of systematic literature review. ~~Will be~~It will explain ~~ing how~~ the selection of method for synthesis and analysis~~, and~~ as well as~~how~~ the extraction data of paper.

CHAPTER V ANALYSIS

This chapter will ~~be~~ discuss ~~from~~ on the finding paper and literature, and also explain~~ing how~~ the sustainability~~le~~ in manufacturing~~e~~ industry.

CHAPTER VI CONCLUSION AND RECOMMENDATION

The final section will describe the overall conclusions from the results of study and the suggestion for the future research.

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CHAPTER II

LITERATURE REVIEW

2.1 Review on Previous Research

Nowadays, the highest efficiency in production is obtained by manufacturing the required quantity of a product, of the required quality, at the required time by the best methods (Nagare, 2007). Production Planning Inventory and Control (PPIC) is the course ~~to~~ that coordinates all manufacturing activities in a company. Bhat (2007) stated that production planning and control essentially consists of planning production in a manufacturing organization before actual production activities start and exercising control activities to ensure that the planned production is realized in terms of quantity, quality delivery schedule and cost of production. Production planning involves the organization of an overall manufacturing or operating system to produce product. In PPIC there is "planning" term, regarding to that, ~~also in~~ planning also refers ~~there is~~to capacity to be planned. Capacity planning is the maximum production rate of a facility or a firm. It is usually expressed as volume of output per period of time (Kurz, 2016). Capacity of the plant can be expressed as the rate of output viz, units per day, or per week, or per month, gallons per hour, labor. But for organization ~~whose~~ which product lines are more diverse, it is difficult to find a common unit of output (Hermant, 2007).

Capacity planning is necessary when a manufacturer decides to increase~~s~~ their production or introduces new products into the market. Once capacity is being evaluated and a needed for ~~new expand facilities~~facilities expansion ~~is determined~~, decisions regarding facility location and process technology selection ~~are~~ have to ~~taken~~be taken. (Huang & Graves,) stated that in today's competitive economic environment, customers do not just prefer but demand manufacturers to provide ~~quality~~ qualified products in a timely fashion at competitive prices. To satisfy this

requirement, manufacturers need to plan necessary and sufficient capacity to meet market demands. However, capacity planning is a very challenging task for many reasons. For most industries, it is very difficult to accurately forecast the demand for new products. In an emerging industry, manufacturers devote substantial efforts to studying the applications and benefits of new technologies. However, when a technology is new, firms have little information on the commercial uptake of new products and, therefore, have poor forecasts of the product demand (Olhager., et al. 2001)

In manufacturing, capacity can be considered as uncertain due to factors such as unexpected breakdowns of unreliable machinery, unplanned maintenance of uncertain duration, rework of randomly defective items (Ciarallo., et al, 1994). Such uncertainties complicate production planning in that the output is not necessarily equal to the planned amount. The effect of uncertain capacities on production planning in serial system has investigated (Nguyen & Wright, 2015).

The importance of capacity planning has increased since many companies have reduced their inventories of finished goods to decrease unnecessary tied-up capital (Ji., et al., 2016). At the same time, these companies want to have the possibility to respond to fluctuations in demand (Linné & Ekhall, 2013). The fluctuations that previously were absorbed by the inventories have now been transferred upstream to the production sites. As a result of this transfer, high performance of the capacity planning is essential and problems have to be mitigated. Many companies believe in lean as an approach to improve processes and thereby gain competitive advantage. However, it is unclear if lean can be an approach to mitigate problems in a capacity planning process (Linné & Ekhall, 2013). With this background, the purpose of this thesis is to investigate how companies can apply lean principles in their capacity planning process. The rule of thumb is that changes in capacity are more limited on a short term compared to on a long term (Berry., et al. 1982) . This requires companies to plan capacity ahead and to have a higher focus on the challenges in the capacity planning. The trend of becoming lean and the focus on having minimal inventories have increased the importance of having available capacity in production (Vlachos., et al. 2007). The fluctuations that previously were

managed by inventories have been transferred upstream to production creating capacity imbalances. The different alternatives to manage capacity imbalances are related to costs (Bakke & Hellberg, 1993). The capacity planning per se is the second

and fifth step but the three other steps are necessary as input or as supporting steps. Which in Figure 2.1 (Linné & Ekhall, 2013).

Figure 2.1 Capacity Planning Cycle

Estimating is one of the most important functions of a successful project. Accurate estimates optimize good contracting as well as the process of calculating and analyzing all the costs that will enter into a particular job to arrive at a set total. The estimator is responsible for these estimates which serve to ensure the project will have a successful financial outcome and these estimates also influence the decisions made for budgeting and assist in clients' decisions for contractor selection (Barzandeh, 2011). Also, estimating has been interpreted differently by various industry professionals. Ben Arieh (2001, p 83) describes estimating as a process of predicting costs that are required for the completion of the work. "Cost estimating can be described as the technical process or function undertaken to assess and predict the total cost of executing an item(s) of work in a given time using all available project information and resources." Enshassi, et al. (2007, p 4) explained that estimating is an important step in the construction process as the reliability of its estimate accuracy — from conceptual to detailed stages — determines the success or failure of a project.

Similarly, Odusami & Onukwube (2008, p 1) explained that estimating cannot be a precise technical and analytical process, but to an extent, is a subjective process where estimators consider factors relevant to the successful completion of a project. Therefore, estimating in this sense is not based on the science of construction forecasting, but on the experience and decisions the estimator makes regarding factors that may influence the estimate when areas of uncertainty are evident. Furthermore, Odusami & Onukwube (2008, p 1) also described that estimating for construction projects as an estimatione of the market price that is made up ~~of~~ for quantities that may exist previously, currently, or even after the event under consideration.

Recently, numerous products being manufactured nowadays contains a high amount of parts that are produced through forming stamping of metal sheets during a pressing process. During this procedure, heavy duty dies are being ~~are being~~ used in several sequential steps with a purpose of gradually forming flat sheet of metal into a part that can be later assembled in the final product. Depending on the part they are producing, dies carry in size and could reach up to 60 tons in weight (Schuler, 1998). Dies are complex assemblies that usually consist ~~usually~~ of an external supporting structure and an internal construction. A typical Metal is split into an upper and a lower section. Therefore, the internal construction contains all the required components to sustain the part in the pressing process, to give it the required shape, safely remove the cutaway material and optionally attend to the edges of the part in certain stages of production (Eversheim., et al., 2000). The production layout ~~is affecting~~affects the complexity of the planning. The layout is dependent on the processes of a company (Tenhiälä, 2011). The processes might require a certain production layout to achieve a feasible and efficient production. The production layout determines the number of planning points (Olhager., et al. 2002). The concept of planning points means that a manufacturing resource or a set of manufacturing resources can be regarded as one entity from a planning point of view.

Good cost estimation has a direct bearing on the performance and effectiveness of a business enterprise because overestimation can result in loss of business and goodwill in the market, whereas underestimation may lead toward financial losses to the enterprise. Because of this sensitive and crucial role in an

organization, cost estimation has been a focal point for design and operational strategies and a key agenda for managerial policies and business decisions. As a result, a substantial and methods for producing accurate and consistent cost estimates not only to generate optimum design solutions but also to achieve the maximum customer satisfaction in terms of low-cost, high-quality, and in-time product delivery. The quality and accuracy of the financial information gathered about market changes and variables analysis of a project, will definitely lead to a sound and accurate investment decision. Pre-market analysis is a necessary and priority step before any application of breakeven point rules or even the visibility study in the first place, and that is due to many environmental effects (Alnasser., et al. 2014). Deshmukh & Bilolikar (2006) studied the feasibility of grid extension and distributed generation considerating biomass and diesel based generation options and BEP (break even point) based optimization suggested it as a cheaper option than grid extension.

Break-even point is a decisive tool for determining the capacity that a facility must have for profit. The purpose of breakeven analysis is to find a point, in units of currency and units, where cost equals profit (Apostu & Bendul., 2016). This point is called a breakeven point. Companies must operate above this level to achieve profit. Then to meet the demand, process planning takes critical role to realize a successful manufacturing strategy when it affects into success rate of manufacture as well as reliability and cost. ~~There is~~It is needed a work that presents an optimization method for manufacturing process planning in which reliability and cost are taken in consideration (Jiang., et al 2016). Journal of Bebeselea, Mihaela (2015) that research about connection between cost, productivity, profit, and efficiency show that those connections allows decision making in terms of efficiency with respect to the waiver of the manufacture of certain product. Through those situations, it will easily ensure the control amount of product which ~~are~~ is to be sold in order to get a certain predetermined benefit. Perfect m~~M~~arket competition ~~perfect~~ is a marketplace which ~~have~~ has a perfect mobility of available resources and completed by knowledge the best of the seller and buyer, so that the results from the interaction of the market price ~~is~~ are real from the interaction ~~between~~ among them. Only a few experienced competition is considered as perfect~~s~~ while the other sectors are not necessarily (Wen-Chun 2015).

Previously, there ~~is~~ was a research about capacity planning of remanufacturing in closed-loop supply chains (Apostu & Bendul, 2016). In that research, it is found that capacity planning of single product reverses supply chain for product recovery. The developed model allows the comprehensive description and analysis of the system operations taking amount capacity considerations in order to gave "green image" (Serrano & Sauer, 2013). The conclusions of the previous research ~~is~~ presented the development of a dynamic SD-based model for strategic remanufacturing and collection capacity planning of a single product reverse supply chain for product recovery. For reverse chains ~~ever increasing~~to increase environmental concerns, hence, the ~~impose~~ constant pressure on regulators for stricter policies and/or legislation is being imposed. The developed model allows the comprehensive description and analysis of the system operations (product flows and stocks) taking into account capacity considerations, alternative environmental protection policies involving a take-back obligation and a "green image" effect on product demand. First validated the SD simulator employing indirect structural tests and then proceeded with numerical investigation. The latter provides us with insights that can be employed in developing efficient capacity planning policies in a dynamic manner. Also they has further research about the long-term operation supply chain using total supply chain profit as the measure of performance. Previous and this research ~~has~~ have the similarity, in profit aspect also in long-term aspect using capacity considerations.

Based on literatures review and further research above (Marius & Julia, 2016) about capacity planning, there is a gap of each literature that could find a new problem. In short, long-term capacity planning using estimation approach on cupola furnace is not found yet.

2.2 Deductive Study

Deductive study is the theoretical basis for supporting the problem solving in the research. Inductive study was obtained from the journal and proceeding are published

periodically. While, deductive study was obtained from the study of textbooks related to the theory. In this chapter, there will be elaboration of the theory used.

2.2.1 Forecast

Forecasting (forecasting): is the art and science of predicting events that will occur with the use of historical data and project it into the future with some form of mathematical models. Forecasting required to perform certain methods and which method to use depends on the data and information that will be predictable and the objectives to be achieved. In practice, there are various methods of forecasting, among others. Forecasting based on the term:

a. ~~Forecasting s~~The Short-term forecasting (less than one year, ~~are~~ is generally less than three months: used to plan purchasing, work scheduling, the number of kindergarten, the level of production).
b. ~~Forecasting~~ The M~~m~~edium term forecasting (three months to three years: it is used for sales planning, production planning and budgeting and analyzing various operating plan).
c. ~~Forecasting t~~The long-term forecasting (three years or more, ~~are~~ is used to plan new products, capital budgeting, location of facilities, or expansion and research and development).

2.2.2 Break Even Point

BEP (Break Even Point) is a point where income from a business equal to the issued capital, there was no loss or gain. Break Even Point becomes an important ~~measure~~ measurement in the business. However, employers often interpret BEP with a turnover. Breakeven point and return on investment are two very different things. Breakeven Analysis can identify the minimum breakeven volumes when comparing projected costs and revenues. In the short–term capacity utilization: linear programming and computer simulations are very useful.

When a firm open a business, the firm must provide capital to rent space, buy equipment, or other needs. What is meant by return on investment is the profit earned from the business, all the capital that has been issued can eventually return. In financial terms this is called the ROI (Return on Investment). Unlike the ROI, when the firm run a business, surely will issue operational costs. There are two types of operating costs: fixed costs and variable costs (variable). Variable cost~~s~~ is the cost calculations ~~are~~ based on the sale of the business. Break even point analysis or cost volume profit analysis is often used in analyzing corporate finance. This model is trying to find and analyze the aspects of the relationship between the amount of investment and the large volume of rupiah required to achieve a certain level of profit.

In the enterprise, sales role that has been clearly named as "generating income" is the source of income formation. A firm wants the sale to cover the total costs consist of fixed costs and variable costs. Fixed cost ~~s are~~ is expenses that its amount is not affected by the volume of activity. Whether the company o~~O~~perating or not, these costs must be incurred, such as depreciation costs, rental costs, salary costs, and others. Conversely, the more volume the lower the activity or production cost per unit variable cost is the cost that its amount depends on the volume of activity. If there ~~is~~ are activities~~y~~ there must be ~~this~~ variable costs involved. The more the volume of activities~~y~~ the more variable costs will be. But the cost per unit is relatively the same. For example the cost of materials, direct labor wages, sales commissions, etc. Knowledge ~~of~~ on the costs is necessary ~~to~~ for carrying out ~~inisangat~~ break-even analysis.

Comment [MW3]: Welllaaaahhhh, ada Bahasa indonesinya nyelip

Break even means a state in which the company ~~does not~~ neither earns any profits nor loss position, meaning that all expenses incurred for the production activities that can be covered by income from sales. Total costs (fixed costs and variable costs) is equal to the total sales, so there is no profit and loss. The Break-even point formula is

$$BEP = \frac{Fixed\ cost}{Selling\ price - Variable\ cost} \ldots\ldots\ldots (1)$$

2.2.3 Capacity Planning

Capacity (capacity) is the result of the production (~~throughtphut~~throughput), or the number of units which can be held, received, stored, or manufactured by a facility within a certain time period. Capacity affects mostly to the fixed costs. Capacity ~~is~~ also determines whether the request can be met, or whether the existing facilities will be excessive. If the facility is too large, some facilities will ~~mengenggur~~ be idled and ~~there will be~~ additional fees will be charged to existing products or customers. If the facility is too small, the overall market or even customers will be lost. Therefore, the determination of the size of the facility is very decisive goal attainment of high utility rates and higher returns on investment

Comment [MW4]: Welahhh, Bahasa Indonesia lagi?

Capacity planning is the first step ~~when~~ for an organization to decide~~s to~~ for producinge more of a new or existing product. Once capacity is evaluated and a need for new or expanded facilities is determined, facility location and process technology activities will occur. Too much capacity would require ~~exploring ways~~exploration to reduce capacity, such as temporarily closing, selling, or consolidating that might involve relocation, combining of technologies, or a rearrangement of equipment and processes. Capacity planning normally involves the following activities:

a) Assessing existing capacity
b) Forecasting capacity needs
c) Identifying alternative ways to modify capacity
d) Evaluating financial, economic, and technological capacity alternatives
e) Selecting a capacity alternative most suited to achieve strategic mission

a. Assessing existing capacity & requirements

Assessing starts with measurement. There is no single measurement technique customized for such decisions, rather a blend of different approaches is utilized when necessary. As noted, there are two systems of measurements of system effectiveness: efficiency and utilization. Efficiency is the ratio of actual output to effective capacity and Utilization is the ratio of actual output to design capacity.

b. Forecasting capacity needs

Capacity requirements can be evaluated from two extreme perspectives – short term and long-term capacity needs:

a) Short-term Requirements: Managers often use forecasts of product demand to estimate the short-term workload that the facility must handle. By looking ahead up to 12 months, managers anticipate output requirements for different products or services. Then they compare requirements with existing capacity and detect when adjustments are necessary.
b) Long-term Requirements: Long-term capacity requirements are more difficult to determine as future demand and technologies are uncertain.

Forecasting five or ten years ahead is a risky and difficult task. Important questions include what products and services will the firm produce then for today's product may not even exist in the future. Obviously, long-term capacity requirements are dependent on marketing plans, product development, and the life cycle of products. Changes in process technology must also be anticipated. Even if products remain unchanged, methods for generating them may change dramatically. Capacity planning thus must involve forecasts of technology as well as product demand.

The capacity is limiting the ability of a production unit to produce in a given time, and is usually expressed in terms of output (output) per unit time. Understanding this capacity should be viewed from three perspectives to be ~~more~~ clear, namely:

Comment [MW5]: Clearer bukan more clear

a) Capacity Design: Indicates maximum output under ideal conditions where no product is damaged or defective, only for routine maintenance.
b) Effective Capacity: Indicates the maximum output at the level of specific operations.

After existing and future capacity requirements are assessed, alternative ways of modifying capacity either short-term or long term must be identified. Short-term responses to capacity modification include the Table 2.1 as follows:

Table 2.1 Temporary Capacity Changes

Type	Actions
Inventories	Stockpile of finished goods should be built during slack periods to meet later demand.
Backlogs	During peak demand periods, willing customers may be requested to wait some time before receiving their product. Their orders may be filed and be fulfilled after the peak demand period.
Employment levels	Additional employees be hired or be laid-off as demand for output increases or decreases.
Work force utilization	Employees may be asked to work overtime during peaks and can be allowed to work fewer hours during slack demand periods.
Employee training	Instead of having employees specialized in one task, each of them should be trained in several tasks. Then as skill requirement changes employees be rotated among different tasks. This is an alternative to hiring and layoffs for getting needed skills.
Process design	Job contents may be changed at each workstation to increase productivity. Work methods analysis and redesign of jobs are suggested there.
Subcontracting	During peak periods, temporarily another firm might be hired to make the product or some of its components.
Maintenance	Routine preventive maintenance programs on facilities and equipment be

Type	Actions
	discontinued temporarily so that during peak periods the facility can be operated when it would otherwise be idle.

In general, the effective capacity is lower than the design capacity. Effective capacity is often lower than the design capacity for the existing facilities may have been designed for previous versions of the product or a different product mix than is now being produced.

Sustained benefits derived from the establishment of competitive advantage, not only of good financial returns on a particular process. Capacity decisions must be integrated into the organization's mission and strategy. Investments are not made as an expense in itself, but as part of an integrated plan that could put the company in an advantageous position. Additional strategy considerations as tight integration between strategy and investment, there are four things that must be considered, namely:

a) Accurate demand forecasting

   Accurate forecasting is the culmination of forecasting capacity. Whatever type of new products, its prospects and the life cycle of existing products to be determined. Management must know the products that will be added and the product will be reduced, as well as the desired volume.

b) Understanding the technology and capacity enhancement

   Number of early ~~padasaat~~ alternative may be large, but so determined volume production, technology decision also determined by analysis of the cost, applied resource ~~use~~, quality and reliability. A review ~~like this~~will typically reduce~~s~~ the existing technological alternatives become fewer. Technology can determine the increasinge in capacity. Operations manager holds responsibility for technology and capacity building.

   Comment [MW6]: Confusing line, please re phrase

c) Finding the optimum operating level (volume)

Determination ofe the technology and capacity often determines the optimal size of the facility, most businesses have optimal size, not least the discovery of a new business model.

d) Made for change

In a rapidly changing world, change is inevitable. Therefore, the operations manager creates flexibility in equipment and facilities. They He evaluates the sensitivity of the decision to test some revenue projections on both sides of the upper and lower risks

2.2.4 Decision Making

Decision-making is an important element in the operational management. To take or makemeet a successful capacity planning decisions to on the demand with uncertainty, it would require a decision tree. Thus, a decision tree was developed to help managers to make a series of events that involve uncertainties. The decision tree (decision tree) is a graphical display indicating the decision process of alternative decisions, natural conditions and opportunities, and rewards for each combination of alternative decisions and natural conditions.

The criteria most often used criteria to analyze the decision tree is EMV (Expected Monetary Value). EMV is an estimated value for the money. One initial step of this analysis is to describe the decision tree and set the financial consequences of all results for a particular problem.
The formula of EMV is:

$$\text{EMV} = \sum_{i=1}^{n} Pi \times Ii \ \ldots\ldots\ldots (2)$$

P = Probability
I = Impact

Analyzing thee problems by using a decision tree includes five steps; defining the problem, drawing a decision tree, determininge opportunities for natural

conditions, estimating return for each combination of alternative decisions and natural conditions that may, and solving the problem by counting the EMV for each point in the natural condition. This is ~~done~~ conducted by doing it back to front, or backward, which is to start from the right side of the tree continues to point towards a decision on his left. Toward those explanations from previous research and deductive study, the relationships between forecasting, BEP and EMV is that the forecasting and BEP are using to how to take the action from the result of forecasting and BEP.

CHAPTER III

RESEARCH METHODOLOGY

In this chapter, the steps for conducting the research are applied as a reference in order to keep focusing on the primarily goals, which are going to be achieved

3.1 Location and Object of Research

This research was conducted in CV Bonjor Jaya that focused will be on the dies casting steel Manufacture. Steel is one of industries, which rapidly grow in Indonesia. The market is wider as the needed of society that must to use this product because of the component is the main or primary use for industrial process. However, the business processes in dies casting ~~is resulting~~influenced by the economic, environmental and social aspect and ~~those~~ others that could impact to the company's circumstances. By ~~following to~~ those reasons, the research will measure the long-term capacity planning with product estimation approach to get ~~what~~ appropriate capacity ~~should the company have and~~for the company and what decisions should be taken to change the long-term capacity ~~for long term~~.

The research was conducted at dies casting manufacturing~~e~~ which applies typology of production MTO, MTS & ETO. Assessment process has done with Mini-tab software, while Microsoft Excel is used for the financial and managerial aspect.

The result of economic aspect would determine the capacity planning. Development of the capacity planning will be elaborated in paragraph below. The object of this study is to conduct assessment of capacity planning using the development of product estimation, forecast demand and decision making. As it has been elaborated in Chapter 1, capacity planning is one of updating issues to be developed in the industrial field. The measurement on this aspect will benefit to comprehend the extent of capacity planning performance in the real industry.

3.2 Planning and Research Tool

The topic that will be discussed in this research is the long-term capacity planning in dies casting manufacturing with product estimation approach. From the general course production planning and controlling, focus on capacity planning with product. The type of production industry is metal manufacturing. ~~For the~~P ~~p~~roduct estimation uses the financial report which includes all activities~~y~~ and cost. The aspects which will be analyzed are economic aspect and. The economical aspect will be assessed by using Mini-tab and Excel with the parameters of Reliability, Cost, and Assets Management. Following the economical aspect, ~~to find the~~ demand could be identified is by forecasting, ~~and~~ then ~~compare~~ the product and demand will be compared ~~to make~~for decision making that reveals the result of capacity planning. The final result is to find the best alternative~~s~~ which has~~ve~~ the fit number of demand and product estimation.

Comment [MW7]: And opo?

The result will ~~be~~ consider ~~of~~ long capacity planning with product cost estimation. Then the capacity planning would give a decision making to improve~~ment of the~~ capacity in the company. ~~Also~~ It also will show the ability to increase the operation and production planning. In addition, the sub issue of the attribute of Mini tab and Ms. Excel that will be improved is forecasting and product estimation. The whole process of the knowledge based on development has been elaborated in the K-Chart development at Figure 3.1~~-~~:

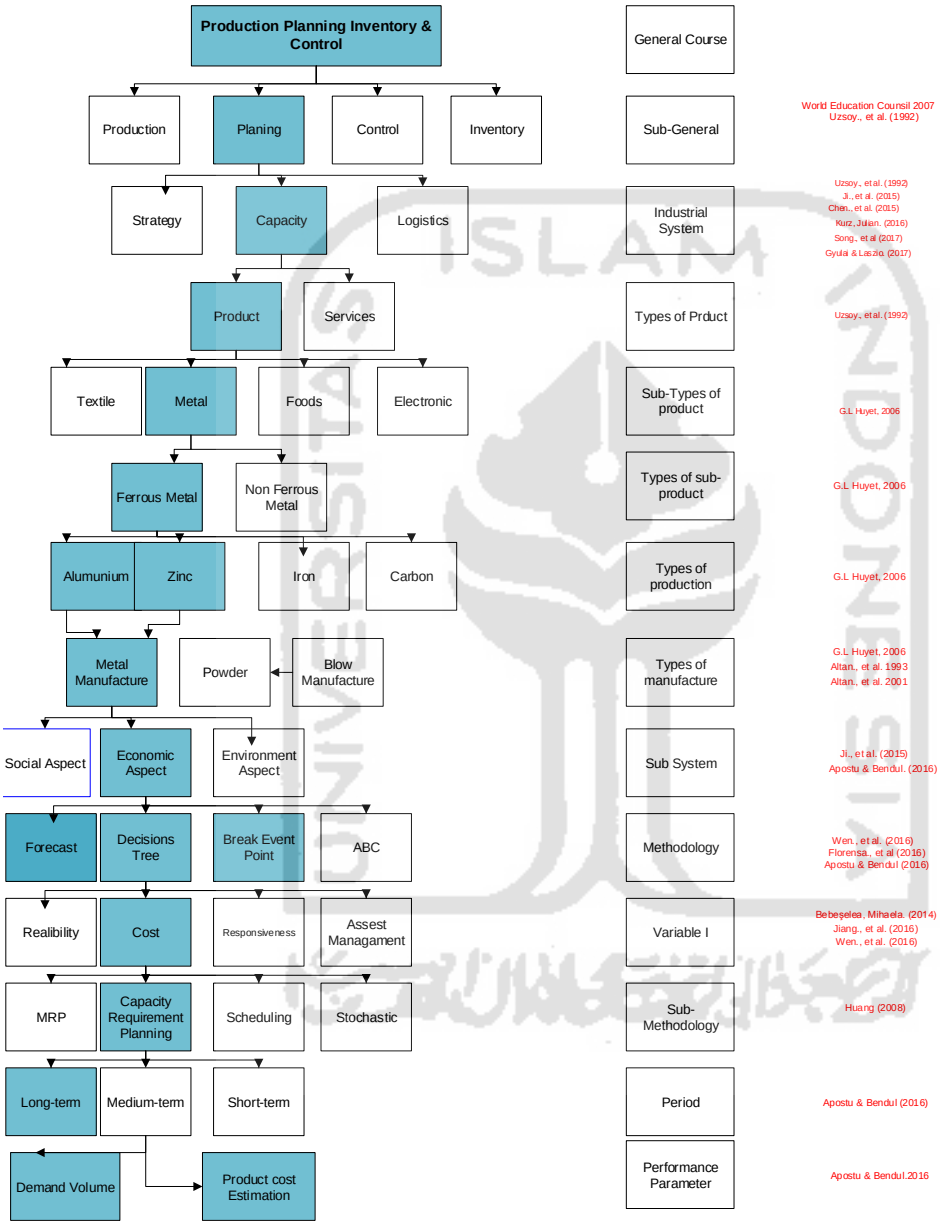

Figure 3.1 K-Chart development

3.3 Conceptual Model

The study will assess result of capacity planning for long-term using estimation cost to get the demand volume and product cost estimation in Metal manufacturing. The proposed framework consists of the improvement method in this study use capacity planning. Based on the result of methodology it us long-term for the capacity. The long term considerations relate to overall level of capacity, such as trends and cycles.

The bidding process in Metal manufacturing taken places about seven months and even up to year in advance of the actual production, depending on the scale of the products. In this case, mMetal manufacturering ~~would have~~ has to determine the cost of the offered dies ~~offered~~ for production in order to place their bid. Break event point and Decision Tree can fulfill the consideration of capacity planning as a design. Other consideration is resource availability, accuracy of long-range forecast, capacity cushion and changes in competitive environment. When break event point is in the same amount as total cost and already forecasted for long-range. After getting the cost, capacity planning can be applied ~~after get~~as the price per unit, quantity, fixed cost, variable cost are obtained. In this case the quantity is unknown. Third, identify and analyze the sources of capacity that meet these needs. Then, it is selected from ~~among~~ alternative sources of capacity. In short, the steps are finding the cost estimation for the product, ~~then~~ makinge the capacity planning design and, choosinge the best alternatives. The result is the alternatives ~~that get~~to get the cheapest one. The framework is illustrated in figure 3.2 below:

Comment [MW8]: Berapa year?

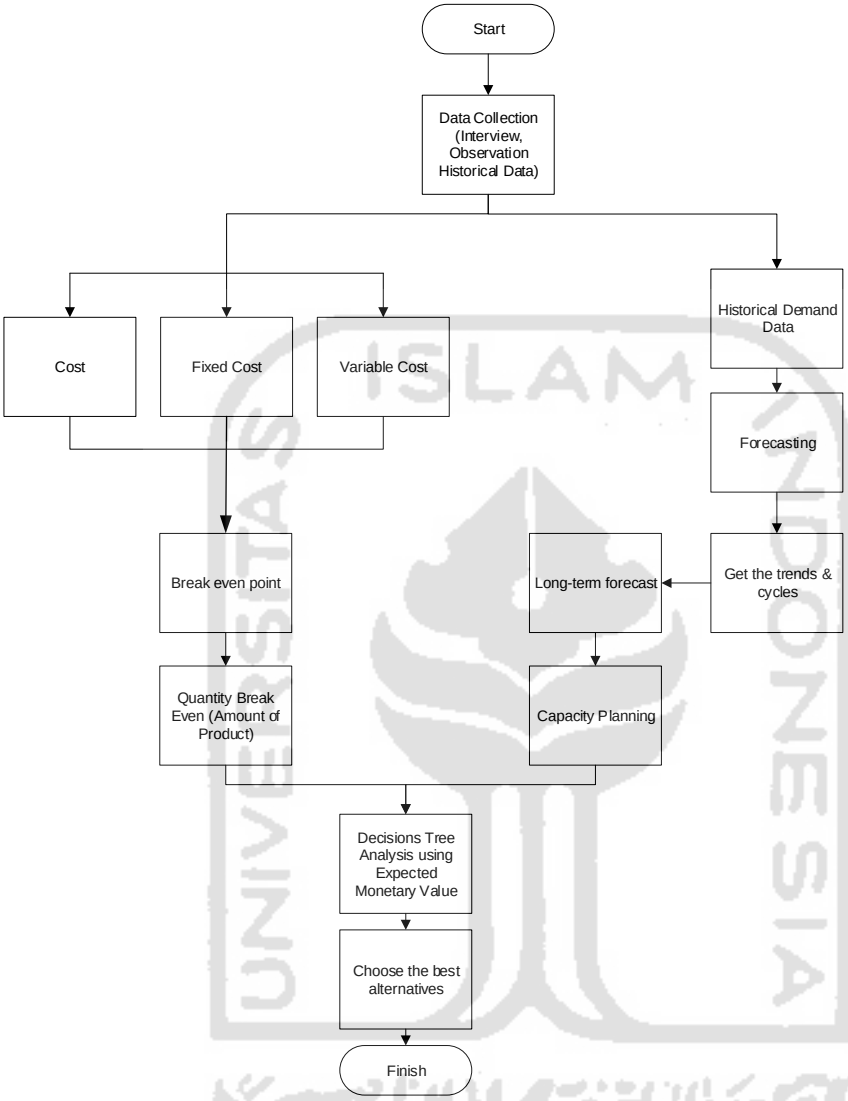

Figure 3.2 Conceptual Model of Research

3.4 Data Collection

3.4.1 Primary Data

The primary data are divided into several kinds of data that are needed for fulfilling the goal of the research. The primary data contain the result of interview as well as the result of historical data, ~~—~~which have been developed and distributed to the respondents

A. Interview Result

The interview is proposed to generate the information which cannot be acquired by direct observation as well as the historical data. The interview consists of several questions to understand the condition of the company.

B. Historical Data Result

The Historical data is developed to obtain the information of the last production. The historical data is assessed by the data from manager in the company. This assessment is proposed to ~~result~~ yield the historical to fulfill the step in forecasting.

3.4.2 Secondary Data

The secondary data have already provided by the company, so those can be directly acquired. They presented in the form of the historical data that will be used to conduct the performance assessment by using Break event point, decisions tree analysis~~ze~~ and ~~forecasting~~ long-range forecasting. There are also the data about production flow as well as the detail of the production process, for instance, the precedence activity and also the processing time. That data will be implemented to the performance improvement, so the target might be achieved by the company.

3.5 Tools of Analysis

This research ~~is using~~uses several tools in order to conduct the data processing, which are mentioned as follows:

1. **Microsoft Excel®**

   This tool is mostly used for the calculation of the ~~forecasting~~ long range forecasting, break event point and capacity planning assessment. The formula ~~which is~~ used is basic formula that is provided by this software.

2. **Minitab**

   The tool is used to build a simulation based on the improvement result that used to get decisions tree analysis method.

CHAPTER IV

DATA COLLECTING AND PROCESSING

This chapter will elaborate the collection of the data as well the processing of the data. The data collection is divided into the primary as well as the secondary. Data accumulation is~~are~~ derived from direct observation and historical data provided by the company. The data processing will be developed based on the methodology which has been built in the previous chapter.

4.1 Observation

The research was conducted at CV Bonjor Jaya, which applies production type of MTO, MTS and ETO. To obtain the performance assessment the following observation is conducted. This is kind of the initial step to get the data which is needed to be processed based on the methodology that has been developed. Based on the observation, several data are obtained. Those data are divided into primary data and also the secondary data. The primary data are acquired by the questionnaire and the interview. Then, the secondary data has been provided by the company. These data are in the form of historical data that in the further will be processed for the assessment as well as the performance improvement.

4.4.1 Primary Data

There are three data collecting method used in this research. Those methods mentioned as follows:

A. Interview

Data collection by direct questioning on problems that associated with the production planning inside the company. The objects of interview are the experts CV Bonjor Jaya Steel Manufacture. According the interview, the researcher can get the information

about the problem that occurs on capacity and the aspect that influence the capacity in CV Bonjor Jaya Steel Manufacture.

B. Direct observation

Activity of direct observation ~~are~~ is used to collect data about activity based cost and process in the company. Besides ~~that~~, ~~from~~ direct observation also can be used in order to get the flow of material during production, systematically production process, and ~~also~~ the real condition of production layout. Then, the researcher also got business process from the flow of material.

C. Historical Data

The historical data are used to collect data about ~~forecast~~ the sales forecasting and trend of the company. Historical data also used for determining the break-even point. The data ~~got~~ are obtained from the company's daily report ~~in the company~~. Those data ~~such as~~include historical demand, historical price, and cost component data. The detail ~~has~~ will be shown on appendix.

4.4.2 Secondary Data

The secondary data ~~is~~ are already provided by the company, so those can be directly acquired. Here, the secondary data ~~is~~ are presented in the form of the historical data that ~~in~~ further will be used to conduct the performance assessment by using Minitab and Ms. Excel. There are also the data about production flow as well as the detail of the production process, for instance, the precedence activity and also the processing time. That data will be implemented to the performance improvement, so the target might be achieved by the company.

4.4.3 Data of Production Process

The production processes that implemented in the company are Make-to-Order, Make-to-Stock and Engineer-to-Order. The step of getting the capacity planning will be described below:

4.4.4 Forecast Historical Data

Forecasting is the prediction process ~~prediction~~ of the future based on historical data. Forecast is used to know the demand of production. The smallest percentage is the most accurate one. In t~~T~~his case, researcher would compare 3 methods time series method that consists of winter's method, trend analysis and exponential smoothing. The graph of forecasting shows variables, ~~there are~~which are actual, fits, forecast and 95% PI. ~~Another~~ Other contents are α , MAPE, MAD, MSD. Actual is the data based on actual history data. Fits is the data on optimal number ad 95% PI is the 95% prediction interval, which represents a range of likely values for a single new observation. The α is used ~~for~~ to determine the margin of error and MAPE is the percentage of error. The figure below shows the winter method plot for demand:

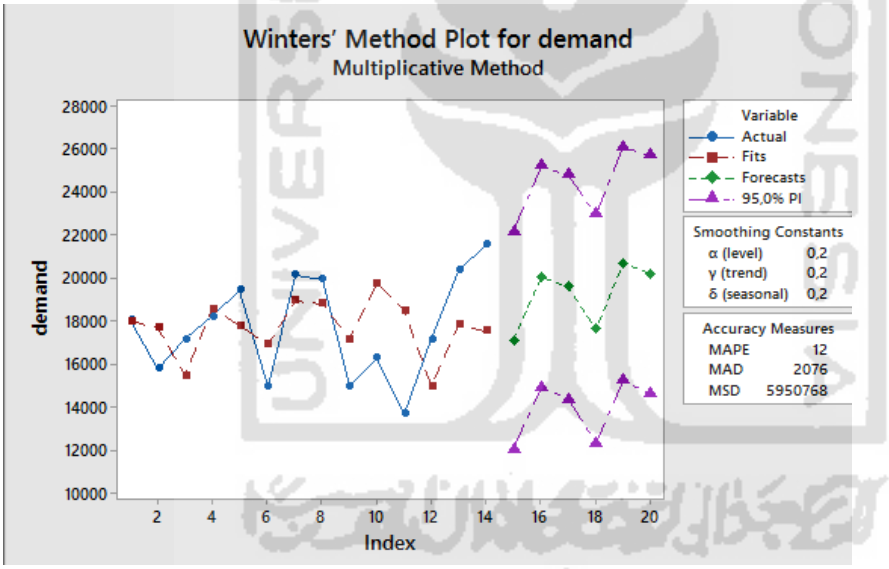

Figure 4.1 Winters' Method

Winter method shows that the forecasting for the next 6 months has 1.2% with the demand of 19.566,9 kg. There are 3 variables in Figure 4.1 which consist~~s~~ of actual data, forecasting data and fits data show~~s~~ that the ~~demand~~ actual data dominant demands are higher than the fits data. The next forecasting method is trend analysis method:

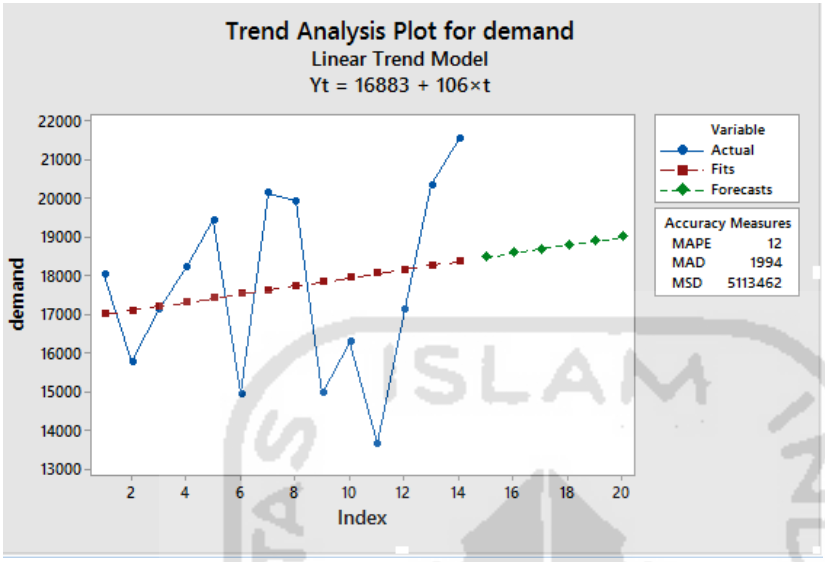

Figure 4.2 Trend Analysis Method

Winter method shows that the forecast for the next 6 months has 1.2% with the demand 18.688,2 kg. There are 3 variables in Figure 4.2 which consists of actual data, forecast data and fits data shows the demand actual data dominant higher than the fits data and the fits data is stable increasing.

Comment [MW9]: Perbaikan sda

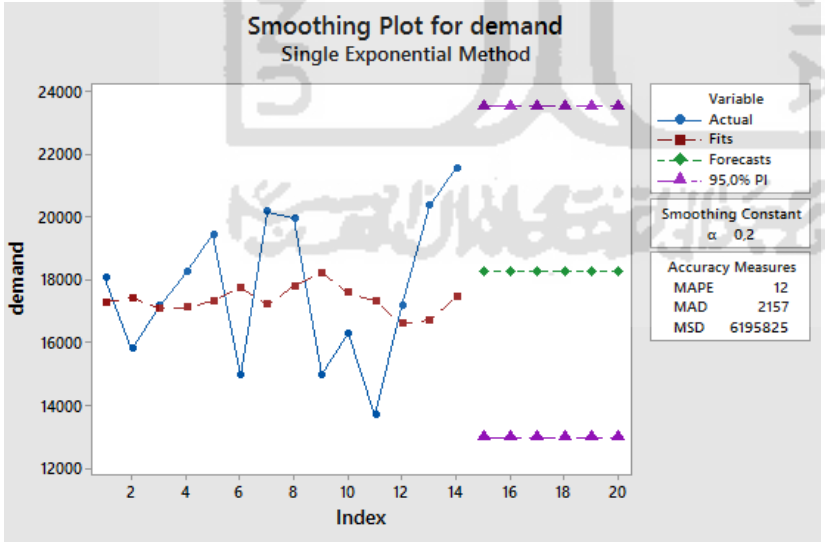

Figure 4.3 Smoothing Plot Method

Smoothing plot method shows that the forecast for the next 6 months has 1.2% with the demand 18.242,6 kg. There are 3 variables in Figure 4.1 which consists of actual data, forecast data and fits data shows the demand actual data dominant higher than the fits data, but the fits data is smoothly decreased. The historical data ~~that~~ are used for forecasting ~~use~~ to determine the demands of its company. Then the result ~~from~~ of forecasting can predict the demand for product's cost and will be processed by using Break-Even Point method.

Comment [MW10]: Sda perbaikannya

A. Estimation Product Assesment (Break-even Point)

Break-even Point (BEP) is the production level where total revenues equals total expenses. In other words, the break-even point is where a company produces the same amount of revenues ~~as~~ with expenses either during a manufacturing process or an accounting period. Break even method should use estimation product assumptions for calculated the units and total profit. The assumptions consist of fixed cost, variable cost, number of units and unit price. Fixed cost is the cost that does not change with an increase or decrease in the amount of goods or services produced or sold. Variable cost is the opposite of fixed cost, are also the sum of marginal costs over all units produced.

Table 4.1 Break-Even Point Assumption

Fixed Cost Assumption	**Rp28.600.000**
Variable Cost Assumption	**Rp5.250**
Unit Price	**Rp9.000**

The break-even point assumption based on the company data, the fixed cost is Rp28.600, then the variable cost is Rp5.250, and the unit price Rp9.000. After the basic data ~~is~~ are fullfiled, the process of BEP ~~shows~~ will show the revenue, total cost and total profit based on the units that sold.

Table 4.2 Break-Even Point Data

Units	Revenue	Fixed Costs	Variable Costs	Total Costs	Total Profit
0	Rp 0	Rp 28,600,000	Rp 0	Rp 28,600,000	Rp 28,600,000
1000	Rp 9,000,000	Rp 28,600,000	Rp 5,250,000	Rp 33,850,000	Rp 24,850,000
2000	Rp 18,000,000	Rp 28,600,000	Rp 10,500,000	Rp 39,100,000	Rp 21,100,000
3000	Rp 27,000,000	Rp 28,600,000	Rp 15,750,000	Rp 44,350,000	Rp 17,350,000
4000	Rp 36,000,000	Rp 28,600,000	Rp 21,000,000	Rp 49,600,000	Rp 13,600,000
5000	Rp 45,000,000	Rp 28,600,000	Rp 26,250,000	Rp 54,850,000	Rp 9,850,000
6000	Rp 54,000,000	Rp 28,600,000	Rp 31,500,000	Rp 60,100,000	Rp 6,100,000
7000	Rp 63,000,000	Rp 28,600,000	Rp 36,750,000	Rp 65,350,000	Rp 2,350,000
7626	Rp 68,643,000	Rp 28,600,000	Rp 40,041,750	Rp 68,641,750	Rp 0
8000	Rp 72,000,000	Rp 28,600,000	Rp 42,000,000	Rp 70,600,000	Rp 1,400,000
10000	Rp 90,000,000	Rp 28,600,000	Rp 52,500,000	Rp 81,100,000	Rp 8,900,000
11000	Rp 99,000,000	Rp 28,600,000	Rp 57,750,000	Rp 86,350,000	Rp 12,650,000
19567	Rp 176,103,000	Rp 28,600,000	Rp 102,726,750	Rp 131,326,750	Rp 44,776,250
21545	Rp 193.905.000	Rp 28,600,000	Rp 113,111,250	Rp 141,711,250	Rp 52,193,750

Table 4.2 shows products from 0 to 21545.000 products, and the break-even point is approximately between 7.000 and 8.000 units. Also shown in figure 4.3 is the graph of BEP ~~gives~~ that provides the point of the even.

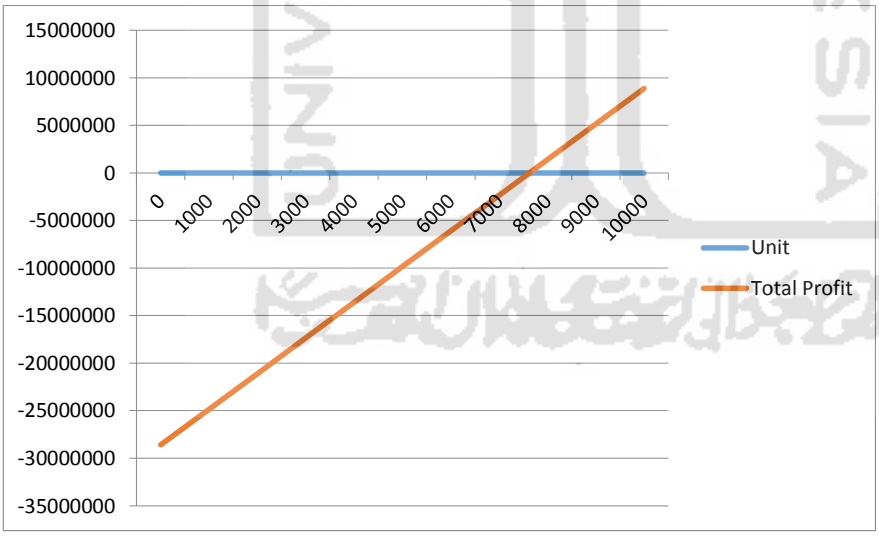

Figure 4.4 Break-Even Point Graph

After showing the point where the profit became 0 or even point. The exact number output that must be exceeded are shown below:

$$BEP = \frac{Fixed\ cost}{Selling\ price - Variable\ cost}$$

$$= \frac{Rp28.600.000}{Rp9.000 - Rp5.250}$$

$$= 7.626{,}67\ kg$$

Where,

Fixed cost = Average total of all fixed resources from operational cost in 1year (The data has shown on appendix)

Selling Price = Production cost + Margin Company

Variable cost = Average total of all variable resources from operational cost in 1 year (The data has shown on appendix)

It shows that the break-even point for the product is 7.626,67 kg. The result from break-even point will used as consideration in decision making.

B. Decision Making

The decision making is the ~~thought~~ thinking process of selecting a logical choice from the available options. When trying to make a good decision, a person must ~~weigh~~ consider the positives and negatives sides of each option, and consider all the alternatives. The Decision-making method ~~using~~applies ~~-~~ Expected Monetary Value (EMV) for the specified is the weighted average payoff. There would be 3 criteria for the payoff, the first is large ~~with~~ which suits the actual condition that has 21545 kg products and~~,~~ profit Rp 52,193,750~~, and~~ then medium ~~with~~ which suits the forecasting result that has 19567 product and~~,~~ profit Rp44.776.250, later is ~~and~~ small ~~for~~ that suits with the ~~Break-even~~Break-even point, which ~~-~~has 7627 products, Rp 0 profit. All losses is the fixed cost or production and the result of 3 criteria will be shown ~~below~~ as follows:

Comment [MW11]: I don't understand the composition of the line, please re-phrase

Comment [MW12]: Ndak nyambung dengan kata selanjutna je...

Table 4.3 Expected Monetary Value

	Profit	Lost	Max product
Besar	Rp 52,193,750	Rp -141,711,250	21545
Sedang	Rp 44,776,250	Rp -131,326,750	19657
Kecil	Rp 0	Rp -68,641,750	1627
ά	0.4	0.6	

The table above shows the profit and loss for large capacity, medium capacity and small capacity. The result shows that there are ~~contain~~ probability of alternatives, which are~~if~~ profit ~~has~~ of 40% and loss ~~has~~ of 60%. The probability would be used for determine the pay off. The probability is taken from the owner ~~from the data taken~~of the data.

The EMV table proceeds the formula to choose the alternatives and choose the highest for the decision. The result is described ~~figure on~~ Table 4.4 as follows

Table 4.4 Expected Value Result

EMV Alternatives	
EMV Large Capacity	-64,149,250
EMV Medium Capacity	-60,885,550
EMV Small Capacity	-41,185,050

The result shows that small capacity has the highest value or profit with Rp. -41.185.050 and the product about 7627 Kg . If all metal manufacturing companies us~~e~~ing those capacities planning for long-term, the loss ~~of many metal manufacturing~~ could be solved.

Based on the analysis above, it shows that there is a connection between product estimation and capacity planning. Capacity planning, in this case, for ~~is~~ long-term could be found if the demand on long-term also found. As ~~a~~ homogenous markets with the limit capacity, there is a chance that ~~what~~ they would reveal a sub contract. Sub contract is a contract between a party to an original contract ~~and~~ with a third party ~~one~~ to provide all or ~~a~~ specified parts of the work. Sub contract has several

disadvantages such labor cost and hard to ensures ~~of~~ the quality of product. ~~It also has impact for the~~ The size of the companies, whether they are small or large, provided certain impacts~~small and large enterprise~~. Costumer would choose the biggest one rather than small one, and then the small enterprise would be the sub contract. This research could decrease the sub contract, also could give an accurate result for company to determine the capacity itself. Another hand, the cost and productivity are efficient due to capacity and demands are not far away from the production offering.

CHAPTER V

ANALYSIS

In this chapter, the problem formulation of this research that was determineds earlier will be discussed in this chapter. Furthermore, the result which obtained from data processing will be discussed as follows:

One of the biggest problems faced by metal manufacturing is that ofto matching supply to demand. Very often, the metal manufacturer does not know how its server capacity is being used. The tendency of many metal manufacturers does not use product cost as consider managing the capacity, and then cause decreasing amount of production. The case of cupola furnace which needs space for production, capacity planning for long-term would ensure that certain critical processes always have enough capacity to run effectively.

This research was taken from one of metal manufacturing in the homogenous market and perfect competition market. Based on the measurement above in order to find the interest result, the first step is to find the demand by forecasting. After that, 3 methods forecasting using trend analysis are applied, winter's and single exponential the smallest percentage is the smoothing exponential with 1.2% that has demand about 19567 kg. After the demand has determined, the break-even point or the minimum product to gain profit should be found by employing Break-Even Point method. The result of break-even point is 7.626,7 kg. Another word, after the company got to order more than 7.627,7 kg the company could gain profit. WhileWhen the minimum numbers of products already was knownidentified, it's it is possible to have alternatives for building the capacity and the actual production is resulted as 21545 Kg. The alternatives of expected monetary value divided into 3 alternatives which are large capacity, medium capacity, and small capacity. The highest profit from 3 alternatives is resumed from small capacity with that resulted Rp. -41185050 and thewith total amount of products about 7627 Kg products.

Comment [MW13]: I try to understand this line and improve it by my own interpretation, please check

Comment [MW14]: Please re phrase

After the integration is conducted, the process of capacity planning using product estimation approach shows the interest that could have ability to improve the operation. As a homogenous market with the limit capacity, there is a chance what would reveal a sub contract. Sub contract is a contract between a party to an original contract ~~and~~ with a third party ~~one~~ to provide all or ~~a~~ specified parts of the work. Sub contract has several disadvantages such labor cost and ~~ensures~~ uncertainty on~~of~~ the quality of products. It also has impact both for the small and large enterprise~~.~~, as the c~~C~~ostumer would choose the bigger enterprises ~~st one~~ rather than the small ones. To overcome this, ~~,~~ ~~and then~~ the small enterprise would be the sub contract. This research could decrease the sub contract, also could give an accurate result for company to determine its own ~~the~~ capacity ~~itself.~~ . ~~Another hand~~On other hand, the cost and productivity ~~are~~ will be more efficient due to capacity and demands are not far away from the production.

CHAPTER VI

CONCLUSION AND RECOMMENDATION

The last chapter will elaborate the conclusion of the research as well as the recommendations which can be developed for the further research.

6.1. Conclusion

Based on the result of the discussion and referring to the objectives of the research, there are several ~~results~~outcomes which can be concluded as follows:

a. The development of capacity planning by using BEP is initially calculated from the demand ~~for~~ of the company, ~~and~~ then ~~find~~ the BEP is will be calculated to ~~know~~recognize the minimum numbers of product to gain profit, ~~and then~~later it will be continued ~~to~~ with the decision tree. The result shows actual condition that has 21545 kg, ~~then~~ while demand has 19567 kg and the BEP has 7.626,7 kg with no profit. The best a~~A~~lternative is indicated by small capacity with Rp. -41185050 and the product about 7627 Kg

b. The further research on long term capacity planning could reveal interesting result to improve the operation of dies manufacturinge ~~is~~ as a homogenous market with the limit capacity, there is a chance what would reveal a sub contract. Sub contract has disadvantages such labor cost and ensures of the quality product. The further research is to find the best method to get the lowest cost and best quality for the subcontract that can fulfill the demand.

Comment [MW15]: Samakan dengan perbaikan sebelumnya ya Miftah, kalimatnya yang sama

6.2 Recommendation

The whole assessment and improvement processes have been conducted. Based on the process of research, it can be suggested several things that might become the

contribution for the future research. Firstly, related to the framework, the estimation product and forecast method still can be developed to obtain the future condition by using more method. Secondly, the estimation product calculation could include the condition of each company, for example: ~~use~~ big company with large amount of financial or small one with the same method. Thirdly, there is no direct or indirect factor that could have ability to affect numerous companies of die manufacturing, for instance the fixed cost, unit price or maximum production. ~~Lastly, by using this method there appear sub contract.~~ Finally, by ~~Find~~finding the capacity planning ~~about how much the availability of~~on sub contracts ~~for~~ of the company.

Comment [MW16]: What are you talking about actually Miftah…miftah…hmmmm. I prefer to omit it

Comment [MW17]: Semoga interpretasiku dari kalimat ini adalah benar, dicek lagi ya…

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APPENDIX

Outcome						Income				
No	Activities	Amount (kg)	Price (Rp)	Total (Rp)		No	Activities	Amount (kg)	Price (Rp)	Total (Rp)
1	Meals/Food			500,000		1	H.Bambang	3,300	9,000	29,700,000
2	Bata api & Sement			500,000		2	Quartindo	800	9,000	7,200,000
3	Reparation			200,000		3	Wijaya	600	9,000	5,400,000
4	Baja cor	20,030	5,250	105,157,500		4	MK Surabaya	3,000	9,000	27,000,000
5	Brongkal/Briket			-		5	Agung Tehnik	10,061	9,000	90,549,000
6	coces	1,610	9,500	15,295,000		6	Paten	265	4,500	1,192,500
7	Tenaga cor			2,740,000						
8	Tenaga Press			4,340,000						
9	Tenaga Tapel			3,300,000						
10	Transport cost			200,000						
11	Delivery cost			100,000						
12	Electricity cost			500,000						
13	Resin			150,000						
14	Labor cost			795,000						
15	Others cost									
	TOTAL	21,640		IDR 133,777,500.00		Total		18,026		161,041,500

Outcome						Income				
No	Activities	Amount (kg)	Price (Rp)	Total (Rp)		No	Activities	Amount (kg)	Price (Rp)	Total (Rp)
1	Meals/Food			500,000		1	Semesta	2,300	9,000	20,700,000
2	Bata api & Sement			500,000		2	Wijaya	2,500	9,000	22,500,000
3	Reparation			200,000		3	Kreasi	300	9,000	2,700,000
4	Baja cor	17,525	5,250	92,006,250		4	MK Surabaya	3,000	9,000	27,000,000
5	Brongkal/Briket			-		5	Agung Tehnik	6,254	9,000	56,286,000
6	coces	1,410	9,500	13,395,000		6	Paten	1,418	4,500	6,381,000
7	Tenaga cor			2,273,000						
8	Tenaga Press			3,930,000						
9	Tenaga Tapel			-						
10	Transport cost			200,000						
11	Delivery cost			100,000						
12	Electricity cost			500,000						
13	Resin			150,000						
14	Labor cost			510,000						
15	Others cost			400,000						
	TOTAL	18,935		IDR 114,664,250		Total		15,772		IDR 135,567,000

Outcome						Income				
No	Activities	Amount (kg)	Price (Rp)	Total (Rp)		No	Activities	Amount (kg)	Price (Rp)	Total (Rp)
1	Meals/Food			500,000		1	Koperasi BJ	5,910	9,000	53,190,000
2	Bata api & Sement			500,000		2	MK Surabaya	3,000	9,000	27,000,000
3	Reparation			200,000		3	Wijaya	1,700	9,000	15,300,000
4	Baja cor	19,015	5,250	99,828,750		4	Kreasi	800	9,000	7,200,000
5	Brongkal/Briket			-		5	Agung Tehnik	3,524	9,000	31,716,000
6	coces	1,580	9,000	14,220,000		6	Paten	2,198	4,500	9,891,000
7	Tenaga cor			2,672,000						
8	Tenaga Press			3,325,000						
9	Tenaga Tapel			-						
10	Transport cost			200,000						
11	Delivery cost			100,000						
12	Electricity cost			500,000						
13	Resin			150,000						
14	Labor cost			690,000						
15	Others cost			400,000						
	TOTAL	20,595		IDR 123,285,750		Total		17,132		IDR 144,297,000

Outcome						Income				
No	Activities	Amount (kg)	Price (Rp)	Total (Rp)		No	Activities	Amount (kg)	Price (Rp)	Total (Rp)
1	Meals/Food			500,000		1	Koperasi BJ	3,977	9,000	35,793,000
2	Bata api & Sement			500,000		2	M bambang	820	9,000	7,380,000
3	Reparation			200,000		3	Wijaya	3,500	9,000	31,500,000
4	Baja cor	20,190	5,250	105,997,500		4	Kreasi	800	9,000	7,200,000
5	Brongkal/Briket			-		5	Wijaya	1,300	9,000	11,700,000
6	coces	1,440	9,000	12,960,000		6	Paten	610	4,500	2,745,000
7	Tenaga cor			2,874,700		7	Agung Tehnik	7,213	9,000	64,917,000
8	Tenaga Press			4,198,800						
9	Tenaga Tapel			2,460,000						
10	Transport cost			200,000						
11	Delivery cost			100,000						
12	Electricity cost			500,000						
13	Resin			150,000						
14	Labor cost			590,000						
15	Others cost			400,000						
	TOTAL	21,630		IDR 131,631,000		Total		18,220		IDR 161,235,000

Outcome						Income				
No	Activities	Amount (k	Price (Rp)	Total (Rp)		No	Activities	Amount (k	Price (Rp)	Total (Rp)
1	Meals/Food			500,000		1	Koperasi E	1,449	9,000	13,041,000
2	Bata api & Sement			500,000		2	M bambar	3,200	9,000	28,800,000
3	Reparation			200,000		3	Wijaya	3,750	9,000	33,750,000
4	Baja cor	20,190	5,250	105,997,500		4	Kreasi	8,920	9,000	80,280,000
5	Brongkal/Briket			-		5	Wijaya	0	9,000	0
6	coces	1,440	9,000	12,960,000		6	Paten	839	4,500	3,775,500
7	Tenaga cor			2,874,700		7	Agung Teh	1,276	9,000	11,484,000
8	Tenaga Press			4,198,800						
9	Tenaga Tapel			2,460,000						
10	Transport cost			200,000						
11	Delivery cost			100,000						
12	Electricity cost			500,000						
13	Resin			150,000						
14	Labor cost			590,000						
15	Others cost			400,000						
	TOTAL	21,630		IDR 131,631,000		Total		19,434		IDR 171,130,500

Outcome						Income				
No	Activities	Amount (kg)	Price (Rp)	Total (Rp)		No	Activities	Amount (k	Price (Rp)	Total (Rp)
1	Meals/Food			500,000		1	Koperasi BJ	2,300	9,000	20,700,000
2	Bata api & Sement			500,000		2	M bambang	1,400	9,000	12,600,000
3	Reparation			200,000		3	Wijaya	1,400	9,000	12,600,000
4	Baja cor	16,640	5,250	87,360,000		4	Kreasi	8,846	9,000	79,614,000
5	Brongkal/Briket			-		5	Wijaya	0	9,000	0
6	coces	1,160	9,000	10,440,000		6	Paten	980	4,500	4,410,000
7	Tenaga cor			2,843,000		7	Agung Tehnik	0	9,000	0
8	Tenaga Press			4,259,000						
9	Tenaga Tapel			3,900,000						
10	Transport cost			200,000						
11	Delivery cost			100,000						
12	Electricity cost			500,000						
13	Resin			150,000						
14	Labor cost			535,000						
15	Others cost			400,000						
	TOTAL	17,800		IDR 111,887,000		Total		14,926		IDR 129,924,000

Outcome						Income				
No	Activities	Amount (kg)	Price (Rp)	Total (Rp)		No	Activities	Amount (k	Price (Rp)	Total (Rp)
1	Meals/Food			500,000		1	Koperasi BJ	1,700	9,000	15,300,000
2	Bata api & Sement			500,000		2	M bambang	800	9,000	7,200,000
3	Reparation			200,000		3	Wijaya	3,000	9,000	27,000,000
4	Baja cor	22,380	5,250	117,495,000		4	Kreasi	2,250	9,000	20,250,000
5	Brongkal/Briket			-		5	Wijaya	11,477	9,000	103,293,000
6	coces	1,760	9,000	15,840,000		6	Paten	915	4,500	4,117,500
7	Tenaga cor			3,149,400		7	Agung Tehnik	0	9,000	0
8	Tenaga Press			5,947,770						
9	Tenaga Tapel			-						
10	Transport cost			200,000						
11	Delivery cost			100,000						
12	Electricity cost			500,000						
13	Resin			150,000						
14	Labor cost			675,000						
15	Others cost			400,000						
	TOTAL	24,140		IDR 145,657,170		Total		20,142		IDR 177,160,500

Outcome						Income				
No	Activities	Amount (kg)	Price (Rp)	Total (Rp)		No	Activities	Amount (k	Price (Rp)	Total (Rp)
1	Meals/Food			500,000		1	Koperasi BJ	2,200	9,000	19,800,000
2	Bata api & Sement			500,000		2	M bambang	3,000	9,000	27,000,000
3	Reparation			200,000		3	Wijaya	2,500	9,000	22,500,000
4	Baja cor	20,665	5,250	108,491,250		4	Kreasi	2,700	9,000	24,300,000
5	Brongkal/Briket			-		5	Wijaya	8,288	9,000	74,592,000
6	coces	1,685	9,000	15,165,000		6	Paten	1,250	4,500	5,625,000
7	Tenaga cor			2,956,000		7	Agung Tehnik	0	9,000	0
8	Tenaga Press			5,680,000						
9	Tenaga Tapel			3,300,000						
10	Transport cost			200,000						
11	Delivery cost			100,000						
12	Electricity cost			500,000						
13	Resin			150,000						
14	Labor cost			590,000						
15	Others cost			400,000						
	TOTAL	22,350		IDR 138,732,250		Total		19,938		IDR 173,817,000

Outcome						Income				
No	Activities	Amount (kg)	Price (Rp)	Total (Rp)		No	Activities	Amount (k	Price (Rp)	Total (Rp)
1	Meals/Food			500,000		1	Koperasi E	3,810	9,000	34,290,000
2	Bata api & Sement			500,000		2	M bambar	2,500	9,000	22,500,000
3	Reparation			200,000		3	Wijaya	3,500	9,000	31,500,000
4	Baja cor	16,615	5,250	87,228,750		4	Kreasi	4,448	9,000	40,032,000
5	Brongkal/Briket			-		5	Wijaya	0	9,000	0
6	coces	1,360	9,000	12,240,000		6	Paten	694	4,500	3,123,000
7	Tenaga cor			2,340,000		7	Agung Teh	0	9,000	0
8	Tenaga Press			4,554,000						
9	Tenaga Tapel			-						
10	Transport cost			200,000						
11	Delivery cost			100,000						
12	Electricity cost			500,000						
13	Resin			150,000						
14	Labor cost			625,000						
15	Others cost			400,000						
	TOTAL	17,975		IDR 109,537,750		Total		14,952		IDR 131,445,000

Outcome						Income				
No	Activities	Amount (k	Price (Rp)	Total (Rp)		No	Activities	Amount (k	Price (Rp)	Total (Rp)
1	Meals/Food			500,000		1	Koperasi BJ	4,026	9,000	36,234,000
2	Bata api & Sement			500,000		2	M bambang	2,090	9,000	18,810,000
3	Reparation			200,000		3	Wijaya	1,300	9,000	11,700,000
4	Baja cor	18,085	5,250	94,946,250		4	Kreasi	2,800	9,000	25,200,000
5	Brongkal/Briket			-		5	Wijaya	4,866	9,000	43,794,000
6	coces	1,380	9,000	12,420,000		6	Paten	1,195	4,500	5,377,500
7	Tenaga cor			2,557,000		7	Agung Tehnik	0	9,000	0
8	Tenaga Press			4,873,000						
9	Tenaga Tapel			-						
10	Transport cost			200,000						
11	Delivery cost			100,000						
12	Electricity cost			500,000						
13	Resin			150,000						
14	Labor cost			575,000						
15	Others cost			400,000						
	TOTAL	19,465		IDR 117,921,250		Total		16,277		IDR 141,115,500

Outcome						Income				
No	Activities	Amount (kg)	Price (Rp)	Total (Rp)		No	Activities	Amount (k	Price (Rp)	Total (Rp)
1	Meals/Food			500,000		1	Koperasi BJ	3,792	9,000	34,128,000
2	Bata api & Sement			500,000		2	M bambang	2,000	9,000	18,000,000
3	Reparation			200,000		3	Wijaya	2,500	9,000	22,500,000
4	Baja cor	15,185	5,250	79,721,250		4	Kreasi	4,459	9,000	40,131,000
5	Brongkal/Briket			-		5	Wijaya	0	9,000	0
6	coces	1,170	9,000	10,530,000		6	Paten	914	4,500	4,113,000
7	Tenaga cor			2,139,000		7	Agung Tehnik	0	9,000	0
8	Tenaga Press			4,863,000						
9	Tenaga Tapel			-						
10	Transport cost			200,000						
11	Delivery cost			100,000						
12	Electricity cost			500,000						
13	Resin			150,000						
14	Labor cost			515,000						
15	Others cost			400,000						
	TOTAL	16,355		IDR 100,318,250			Total		13,665	IDR 118,872,000

Outcome						Income				
No	Activities	Amount (kg)	Price (Rp)	Total (Rp)		No	Activities	Amount (k	Price (Rp)	Total (Rp)
1	Meals/Food			500,000		1	Koperasi BJ	4,500	9,000	40,500,000
2	Bata api & Sement			500,000		2	M bambang	1,800	9,000	16,200,000
3	Reparation			200,000		3	Wijaya	2,300	9,000	20,700,000
4	Baja cor	19,100	5,250	100,275,000		4	Kreasi	1,800	9,000	16,200,000
5	Brongkal/Briket			-		5	Wijaya	5,452	9,000	49,068,000
6	coces	1,410	9,000	12,690,000		6	Paten	1,287	4,500	5,791,500
7	Tenaga cor			2,733,000		7	Agung Tehnik	0	9,000	0
8	Tenaga Press			5,636,500						
9	Tenaga Tapel			-						
10	Transport cost			200,000						
11	Delivery cost			100,000						
12	Electricity cost			500,000						
13	Resin			150,000						
14	Labor cost			570,000						
15	Others cost			400,000						
	TOTAL	20,510		IDR 124,454,500			Total	17,139		IDR 148,459,500

Outcome						Income				
No	Activities	Amount (k	Price (Rp)	Total (Rp)		No	Activities	Amount (k	Price (Rp)	Total (Rp)
1	Meals/Food			500,000		1	Koperasi BJ	3,000	9,000	27,000,000
2	Bata api & Sement			500,000		2	M bambang	2,300	9,000	20,700,000
3	Reparation			200,000		3	Wijaya	500	9,000	4,500,000
4	Baja cor	21,505	5,250	112,901,250		4	Kreasi	2,000	9,000	18,000,000
5	Brongkal/Briket			-		5	Wijaya	12,252	9,000	110,268,000
6	coces	1,570	9,000	14,130,000		6	Paten	300	4,500	1,350,000
7	Tenaga cor			3,025,650		7	Agung Tehnik	0	9,000	0
8	Tenaga Press			6,101,300						
9	Tenaga Tapel			-						
10	Transport cost			200,000						
11	Delivery cost			100,000						
12	Electricity cost			500,000						
13	Resin			150,000						
14	Labor cost			690,000						
15	Others cost			400,000						
	TOTAL	23,075		IDR 139,398,200		Total		20,352		IDR 181,818,000

Outcome						Income				
No	Activities	Amount (k	Price (Rp)	Total (Rp)		No	Activities	Amount (k	Price (Rp)	Total (Rp)
1	Meals/Food			500,000		1	Koperasi E	2,800	9,000	25,200,000
2	Bata api & Sement			500,000		2	M bambar	1,300	9,000	11,700,000
3	Reparation			200,000		3	Wijaya	800	9,000	7,200,000
4	Baja cor	25,540	5,250	134,085,000		4	Kreasi	2,700	9,000	24,300,000
5	Brongkal/Briket			-		5	Wijaya	13,010	9,000	117,090,000
6	coces	1,830	9,000	16,470,000		6	Paten	935	4,500	4,207,500
7	Tenaga cor			3,370,000		7	Agung Teh	0	9,000	0
8	Tenaga Press			6,750,000						
9	Tenaga Tapel			-						
10	Transport cost			200,000						
11	Delivery cost			100,000						
12	Electricity cost			500,000						
13	Resin			150,000						
14	Labor cost			670,000						
15	Others cost			400,000						
	TOTAL	27,370		IDR 163,895,000		Total		21,545		IDR 189,697,500