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Planning of Optimal Raw Materials Inventory Using the Marcov Chain Method

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ABSTRACT

Inventory is an important issue to control. Both finished goods and raw material inventories are the same with ingredient raw for the production process . no seldom our find problem where company no To do good control in management inventory that results in needs customer no fulfilled. Ray Traso Jaya is company that manufactures and sells paving block products , bataco , riol concrete and pits wind where in the production process experience disturbance in carry out the production process caused level management supply ingredient raw sand and cement that are not optimal as a result company difficulty for Fulfill needs customers who are fluctuating . Formulas problem in study this is " How " determine supply ingredient raw materials and costs supply ingredient optimal raw material at Sinar Traso Jaya?". Study this aim for determine supply ingredient optimal raw material and cost supply ingredient optimal raw . Method analysis used in research this is method Analysis Calculation With Markov Chain. Where is the result study this company can adapt costs required at the time level booking with ingredient fluctuating standard with notice stock ingredient available raw. That is if ingredient raw sand initial 0 or stock empty on level ordering 170.638 kg the optimal cost is at Rp. 1300,000 , if ingredient cement raw 0 or stock empty on level booking as much as 57,617 kg with the optimal cost is IDR 1,300,000.

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1. INTRODUCTION

Background

Problem Supply is important problem for controlled. Well supply goods so nor ingredient raw for process production . In many case , many shop or company no To do good control in management inventory that results in needs customer no fulfilled . Management supply is something method control supplies to get To do right order that is with optimal cost .

Ray Traso Jaya is company that manufactures and sells paving block products , bataco , riol concrete and pits wind. Which becomes object study I that is ingredient raw from the resulting product Ray Traso Jaya is ingredient raw main paving block. The company 's production process need two ingredient raw main namely cement and sand , as well as ingredient addition such as water and rock ash .

Sinar Company Traso Jaya experienced disturbance in carry out the production process caused level management supply ingredient non optimal standard as a result company difficulty for Fulfill needs

customers who are volatile, Ray company traso jaya this must capable control supply ingredient raw for streamline the production process . Available supplies must could Fulfill Request consumers.

Excess inventory could cause loss for company because the amount of invested capital , increasing cost storage, presence drop quality, and damage or lose. Temporary that, lack supplies can also hinder smoothness production. Lack of production result in no fulfillment Request consumer so that cause lost market confidence and loss profit.

Use Markov Chain method in study this discuss about planning and control production in maximizing profit . Cost production , cost storage , cost shortage and price combined selling with supply give decision in produce profit. So with help method markov chain, can resolve problem inventory and management supply so that drawn results processing optimal inventory as well as suitable profit.

Formulas Problem

From the problem above , then formula the problem that becomes center attention to writing Duty bachelor this is " How " determine supply ingredient optimal standard and how method determine cost supply ingredient raw in Sinar Traso Jaya?"

Destination Study

As for the goals you want achieved from study this is

1. Determine supply ingredient optimal raw .
2. Determine cost supply ingredient optimal raw .

Benefit Study

As for the benefits obtained from study this are :

1. the company can determine cost supply ingredient optimal raw .
2. This research is expected to contribute thinking in order to broaden the insight and knowledge of thinking in a alternative solving problem at a time ingredient consideration for control problem management supply ingredient paving block raw .

B. Company Overview

Company history

Ray Traso Jaya is standing since 25 years ago, founded by Mr Jonni, which is located on Guarantee Ginting Street, KM.7.5, Kwala Supplies district, Medan Johor, Medan City, North Sumatra 20142.

Ray Traso Jaya sells results production in the form of paving blocks, bricks, concrete rolls and holes wind . Ingredient raw the manufacture of paving blocks consists of on sand that has level good hardness and Portland cement as a binding material as well as water mixture .

Scope Business Field

Ray area Traso Jaya covering an area of 60 mx 50 m with a production capacity of 6,000 units/day. Ingredient raw paving block making obtained from area binjai and belawan.

Organization and Management

Organization basically is the place or receptacle where people gather together, work together by rational and systematic, planned, organized , guided and controlled , in utilise source resources (money, materials, machines, methods, environment), infrastructure , data and so on are used by efficient and effective for reach destination organization. Organization can also be defined as structure distribution work and relationship structure work Among group of holders cooperating position by certain for together reach destination certain.

Structure Company Organization

Structure organization is description about distribution Duty as well as not quite enough answer to individual nor part certain from organization . Structure organization Ray Traso Jaya is *line structure* because leader generally is owner from company that alone . All decision both strategic nor operational will taken by the owner himself.

Structure organization Ray Traso Jaya can seen in figure 1

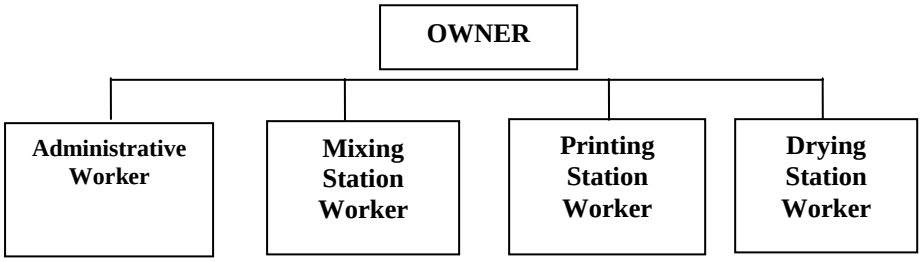


Figure 1. Structure Organization Ray Traso Jaya

Description Duties and Responsibilities

Distribution duties and responsibilities Reply to Sinar Traso Jaya is shared according to function that has been set company . As for the duties and responsibilities answer every part in company is as following :

1. Owner
   Leader highest in company this is owner Ray Traso Jaya who owns total capital during the production process take place . Owner responsible answer for give pay and pay attention the welfare of its workers .
   As for the task owner is as following :
   a. on duty supervise the course of the production process and the performance of the workers
   b. Planning, directing, analyzing and evaluating as well as evaluate activities that take place in the company
   c. on duty supervise wisdom and action every worker as well as weave connection good .

2. Administration Worker
   Worker part administration have not quite enough answer on all related things with administration and the working hours of the workers .
   As for the task worker part administration is as following :
   1. Take notes all administration
   2. Pay attention to the working hours and rest hours of the workers .

3. Worker Station Mixing
   Worker station mixing have not quite enough answer on all related things with mixing sand , cement and water.
   As for the task workers at the station mixing is as following :
   a. Stir and mix sand , cement, rock ash with water.
   b. Enter mix sand to in printing .

4. Worker Station Printing
   Worker station printing have not quite enough answer on all related things with formation be paving blocks.
   As for the task worker station printing is as following:
   a. Printing paving blocks.
   b. Lift results paving block mould .

5. Worker Station Drying
   Worker station drying have not quite enough answer on all related things with paving block drying .
   As for the task worker station drying is as following :
   a. Lifting paving blocks from station printing to station drying
   b. Lift from station drying to station storage

Company Workers and Hours
Amount workers at Sinar Traso Jaya can seen in the table following this.

Table 1. Total Worker

No.	Description	Amount Worker
1	Owner	1 person
2	Administration Worker	2 persons
3	Worker Station Mixing	2 persons
4	Worker Station Printing	4 people
5	Worker Station Drying	2 persons
Amount		11 People

As for the working hours at Sinar Traso jaya is starting at 08.00 WIB - 17.00 WIB and break time at 12.00 WIB - 14.00 WIB.

Production Process
Production Process Description
The production process of paving blocks at Sinar Traso Jaya in general shared over 3 stations work, namely: station stirring / mixing, station printing, and station drying. The paving block production process is as following:
1. Sand sifted for get the sand smooth .
2. Mixed sand and cement up to use machine stirrer (*mixer*) and after blending added water.
3. Batter sand , cement and water stirred return so that got mix well and ready used .
4. Ready mix worn placed dialed printing in the form of slab iron special with use shovel .
5. With use slab iron special the mix pressed until congested with use machine *press.*
6. Paving Blocks that have been so the then issued from print with method put piece board above whole surface tool print.
7. Next tool print released with careful so that the Paving Block go out from tool print it .
8. Next process is dry paving blocks with how to dry under hot sun so that obtained paving blocks that have been so.

Raw and Auxiliary Materials
Raw Material
Ingredient raw main from Paving Block making is as following
1. Sand
2. Cement

Ingredient Helper
Ingredient helper is materials used as complement ingredient main for continuity making something product . As for ingredients helper from product this is in the form of rock ash and water.

Machinery and Equipment
Production process Ray Traso Jaya uses machines and equipment that are very important in produce the product that is as following :
1. Mixer
   Mixer is working machine for stirring batter that is mixture Among sand , cement, and stone ash in the process of making paving blocks.
2. Machine Press
   Press Machine is working machine for give pressure on the paving block molding process. Destination gift pressure the is for compress dough that will printed .
3. Drum
   Function as the place water reservoir.

4. Shovel
   Serves to move sand , cement and stone ash into the mixer.
5. Wooden board
   Serves as a base for *paving blocks* as well as the results of the preparation.

C. Platform Theory

Supply

Definition about supply in Thing this is as something assets that include goods owned by company with meaning for for sale in something period effort certain, or supply items that are still in workmanship / production process, or supply ingredient waiting raw use in a production process. So stock is amount materials, supplied parts and ingredients in the existing process in company for the production process, as well as goods finished / provided product for Fulfill Request from consumer or customer every time.

Functions Supply

1. Function *decoupling*
   Is possible supplies company could Fulfill Request customer without depending on the supplier. Supply ingredient raw held so that the company no will fully depending on the supply in Thing quantity and time delivery. Supply goods in the process of being held so that the company's individual departments and processes awake his freedom . Supply goods so required for Fulfill Request products that are not certain from subscribers, Stocks held for face fluctuation Request consumers who do not could estimated or predicted called *fluctuating stock.*
2. Function *Economic Lot Sizing*
   Supply *lot size* this need consider savings or piece purchase , cost transportation per unit to more cheap and so on. This thing caused because company To do purchase in more quantity big , compared with costs incurred because big inventory (cost rent warehouse , investment , risk and so on)
3. Function Anticipation
   If company face fluctuation requests that can be predict and predict based on experience or past data , namely Request seasonal . In Thing this company can stage supply seasonal *(Seasional inventories).*

Costs Supply

For taking decision determination big amount inventory , costs variable following this must considered :

1. Cost storage (*holding costs* or *carrying costs*) i.e consist on various costs by direct with quantity supplies . Cost storage per period will the more big if quantity ordered material the more many or average inventory the more high . Costs included as cost storage are :
   a. Cost facilities storage (includes lighting, cooler room and so on)
   b. Cost of capital *(Opportunity cost of capital)* that is alternative income on invested funds in supply
   c. Cost obsolescence
   d. Cost calculation physique
   e. Cost insurance supply
   f. Cost theft , vandalism or robbery
   g. Cost handling supplies and supplies
      Costs above is variable if varied with level supplies. If cost facility storage (warehouse) no variable, but permanent so no entered in cost storage per unit.
2. Cost booking or purchase *(ordering costs or procurement costs)*
   costs this cover
   a. Processing order and cost expedition
   b. Wages
   c. Cost phone
   d. Expenditure letter correspondence
   e. Cost packing and weighing
   f. Cost inspection (*inspection*) acceptance
   g. Cost delivery to warehouse
   h. Current debt costs and so on

In general , the cost messaging (outside cost materials and cuts quantity) does not increase when quantity order increase. However, if the more many ordered components every time you order , the amount orders per period down, then cost total order will be down .

3. Cost setup *(manufacturing)* or *set-up cost*
   This thing occur if materials no bought , but produced alone in factory company , company face cost setup *(set-up-costs)* for produce component certain . Cost cost this consist from :
   a. Cost machines unemployed
   b. Cost preparation power work direct
   c. Cost scheduling
   d. Cost expedition and so on

Expectation Average Cost per Unit of Time

Suppose matrix transition two states:

P = $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

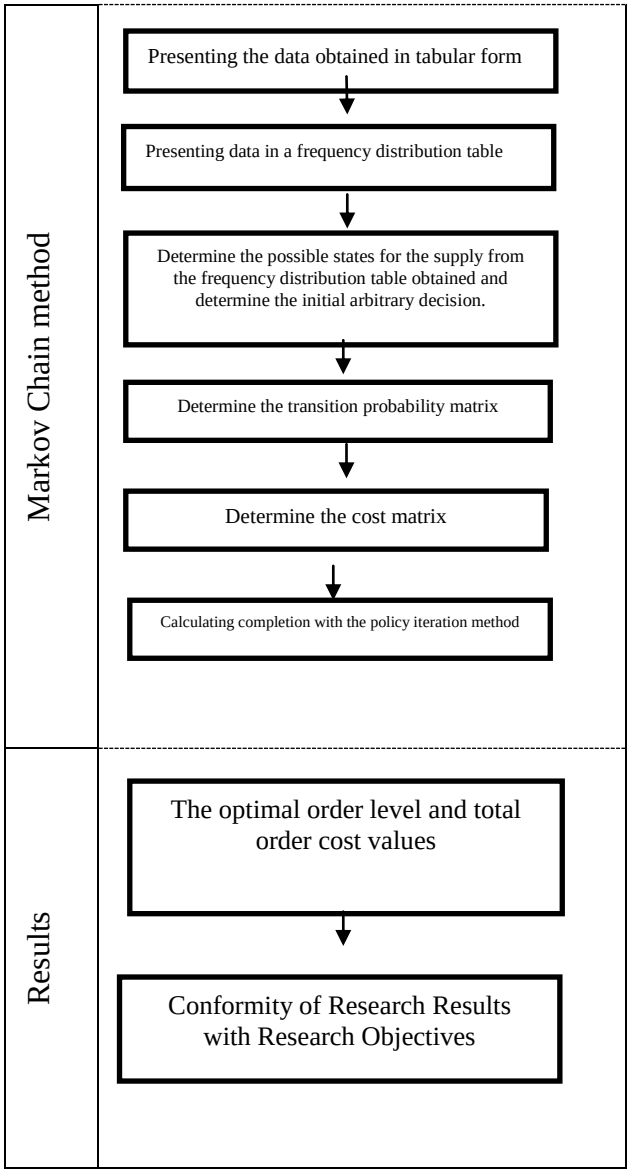
If the process starts at state 0 at time 0 then the process will is in state 0 at times 2, 4, 6, ... and in state 1 at times 1, 3, 5, ... With Thus , $P00^{(n)} = 1$ if n even and $P00^{(n)} = 0$ if n odd . However , the limit in is always there is for Markov chain with finite state .

Markov Chain Decision Process

At the moment discuss dynamic programming has explained that amount *state* could limited or no limited . This will served something application new program dynamic to solving something application new program dynamic to solving a decision process *stochastic* that can be explained by a number of finite *states* . Probability transition between these *states* explained by a Markov chain (*Markov Chain*), while structure the cost of this process explained by a matrix whose elements state income or generated costs from movement from one *state* to other *states*. Well matrix transition nor matrix This income (cost) nature depend on alternatives decisions that can used by retrieval decision . Destination problem this is determine optimum decision that can be maximize expectation income of a process that has amount limited *state* or no limited that.

If level supply checked each month , then determine supply maximum , determined on the alternative at the level booking *x.* The value of *x* is a satisfactory strategy each score from the state variable and determined as well as possible *policies* (strategies) by any . If every month random request *d* occur with probability P (*d)* in determination Markov chain, then will experience transition from state *i* to state $j = i + x - d$ with probability $Pij (x) = P (d)$.

Skeleton drawing Think



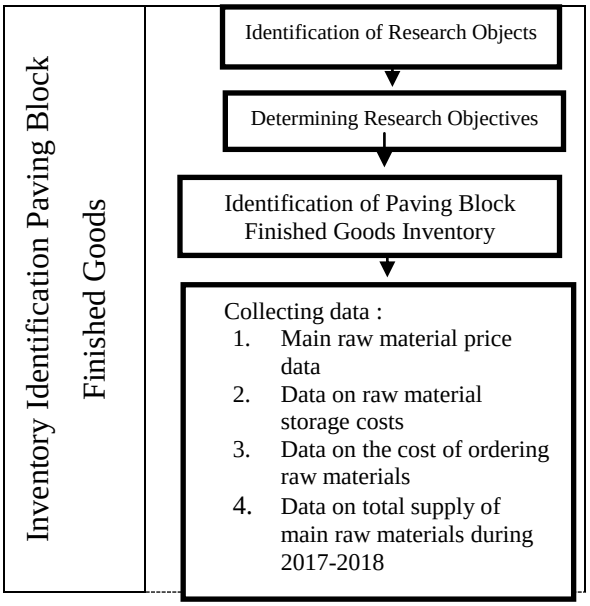


Figure 2.. Thinking framework

4. RESEARCH METHOD

Methodology Schematic Study

Methodology study this containing the steps to be conducted in doing study this . As for the steps in study this could.

seen in form *flowchart* on the picture namely :

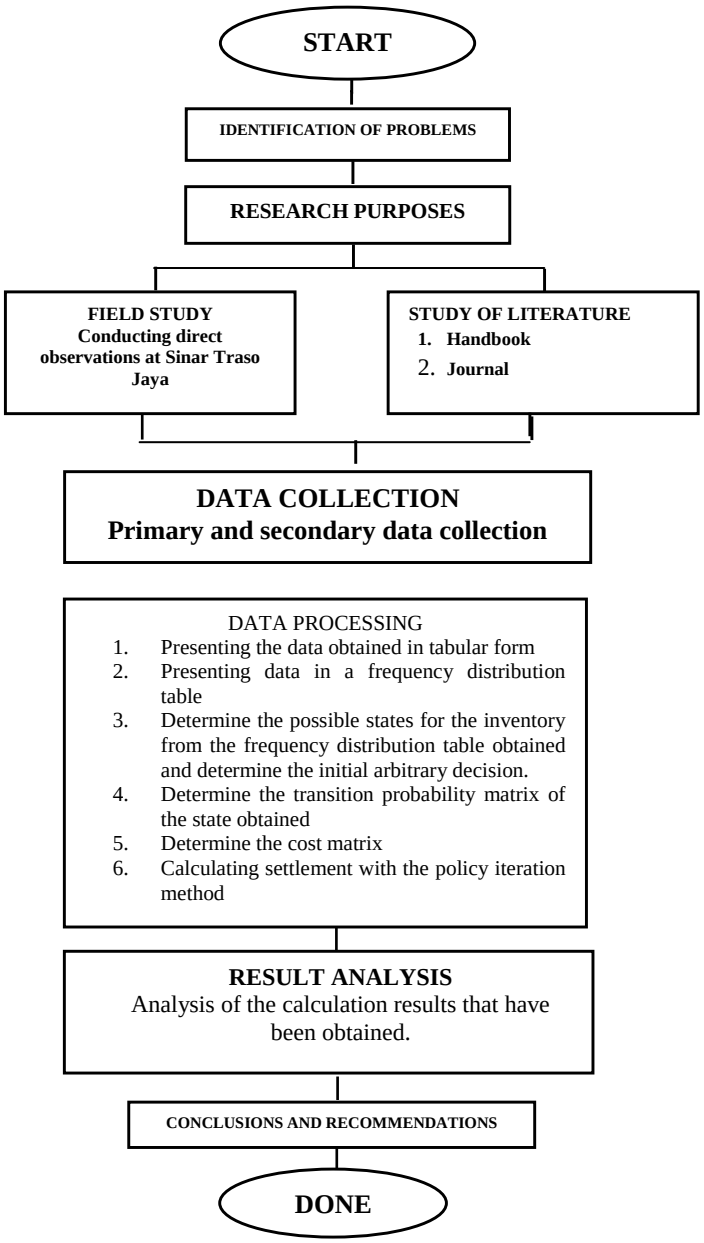


Figure 3. Schematic of the Research Methodology

Research Location and Time

This research was conducted in Ray Traso Jaya Guarantee Ginting Street, KM.7.5, Kwala Supplies , District. Medan Johor, Medan City, North Sumatra 20142. Research this conducted in February 2021 - March 2021

Data Collection

Data obtained is results observation from company interview with the employee who in charge of administration company in management supply as well as citing data and information company.
Following this are the data obtained from owned archive Ray Traso Jaya :
1. Quantity data used supplies During year 2019-2020
Quantity data supply ingredient raw main *paving blocks* for 2019-2020 can be seen in the table under this .

Table 2.Data Amount Supply ingredient raw used sand _ Year 2019-2020 (kg)

Month	Year 2019 (kg)	Year 2020 (kg)
January	163.433	150,480
February	168,240	167,148
March	150,351	147,563
April	145.140	161,638
May	152.349	164.239
June	166,340	164.571
July	168.150	172.418
August	170,330	162.180
September	168,890	176,862
October	171.762	139,508
November	160,247	169,417
December	167,459	154,380

Source : Sinar Traso Jaya

Table 3. Total Data Supply Cement Raw Materials Used Year 2019-2020 (kg)

Month	Year 2019 (kg)	Year 2020 (kg)
January	54,570	50,940
February	56,610	55,249
March	50,792	49,371
April	48,582	52,938
May	51.138	54,396
June	55.418	55,730
July	56.255	57,319
August	57.992	54,319
September	56,950	59,612
October	58160	47,502
November	52.837	56,792
December	55.890	51,619

Source : Sinar Traso Jaya

2. Price data ingredient raw year 2019 -2020

Table 4. price ingredient raw year 2019- 2020

Raw material	Price (Rp)
Sand	400,000/ dump truck
Cement	50.000/ sack

3. Cost average data booking
Cost included in booking ingredient raw could seen in the table under this.

Table 5. Average Cost Booking ingredient raw

Order Fee Type	**Price (Rp)**
Shipping costs to warehouse	500,000
Miscellaneous expense	150,000
Total Ordering Cost	650,000

4. Average Data Cost Storage year 2019-2020

Recapitulation cost storage ingredient raw in Sinar Traso Jaya can seen in the table under this .

Table 6. Average Cost Storage ingredient raw year 2019-2020

Type Cost Storage	**Price (%)**
Cost Warehouse Facilities	10% of price ingredient raw
Miscellaneous costs	5% of price ingredient raw
Total Cost Storage	15% of price ingredient raw

Data Processing For Sand Raw Material .

Determine the data range

Range = largest data – smallest data

Determine many class (k)

K = 1 + 3.3 log n

Determine class interval length (i)

i =Range/K

Count probability transition from each state and total cost

Probability transition from state i to state j = i + x – d is Pij (x) = P(d).

Shortage cost is calculated with equation E = a + [b{∑d> i+x (d- i - x)P (d)}]

Total cost is calculated with equation Ci(x) = a + bi + E

Data Processing For Cement Raw Material

Determine the data range

Range = largest data – smallest data

Determine many class (k)

K = 1 + 3.3 log n

Determine class interval length (i)

i =Range/K

Count probability transition from each state and total cost

Probability transition from state i to state j = i + x – d is Pij (x) = P(d).

Shortage cost is calculated with equation E = a + [b{∑d> i+x (d- i - x)P (d)}]

Total cost is calculated with equation Ci(x) = a + bi + E

5. RESULTS AND DISCUSSIONS

Calculation Analysis With *Markov Chain*

Based on results calculations that have been conducted in accordance with results calculation *Markov Chain* for determine level supply start and election level booking so election optimal supply for :

Supply Sand Raw Material are :

1. If stock beginning is at level 0 kg then alternative booking maximum done is 170.638 kg with cost IDR 1,300,000
2. If stock beginning is at the level of 6.226 kg then alternative booking maximum done is 164.412 kg with cost IDR 347,860,000

3. If stock beginning is at level 12452 kg then alternative booking maximum done is 158,186 kg with cost IDR 748,420,000
4. If stock beginning is at the level of 18,678 kg then alternative booking maximum done is 151,960 kg with cost Rp 1.121.980.000
5. If stock beginning is at level 24,904 kg then alternative booking maximum done is 145,734 kg with cost Rp 1.495.540.000
6. If stock beginning is at the level of 31,130 kg then alternative booking maximum done is 139,508 kg with cost IDR 1,869,100,000

Supply Cement Raw Materials are :

1. If stock beginning is at level 0 kg then alternative booking maximum done is 57,617 kg with cost IDR 1,300,000
2. If stock beginning is at the level of 1996 kg then alternative booking maximum done is 55.621kg with cost IDR 16,270,000
3. If stock beginning is at the level of 3.992 kg then alternative booking maximum done is 53,625 kg with cost IDR 31,240,000
4. If stock beginning is at the level of 5,988 kg then alternative booking maximum done is 51,629 kg with cost Rp 46,210,000
5. If stock beginning is at level 7,984 kg then alternative booking maximum done is 49,633 kg with cost IDR 61,180,000
6. If stock beginning is at the level of 9,980 kg then alternative booking maximum conducted is 47,637 kg with cost IDR 76,150,000

6. CONCLUSION

Conclusions that can be drawn from the results of the study that is as following :

1. Optimal supplies for ingredient raw sand as well as determination cost produce decision at the time level election supplies made as much as 170.638 kg with costs IDR 1,300,000 if supply initial 0 kg, a total of 164,412 kg with costs IDR 374,860,000 if supply initial 6,226 kg, totaling 158,186 kg with costs IDR 748,420,000 if supply initial 12,452 kg, 151,960 kg with costs Rp. 1,121,980,000 if supply initial 18,678 kg, a total of 145,734 kg with costs IDR 1,542,220,000 if supply initial 24,904 kg, a total of 139,508 kg with costs IDR 1,869,000 if supply initial 31,130 kg,
2. Optimal supplies for ingredient cement raw materials determination cost produce decision at the time level election supplies made as much as 57,617 kg with costs IDR 1,300,000 if supply initial 0 kg, as much as 55,621 kg with costs IDR 16,270,000 if supply initial 1996 kg, a total of 53,625 kg with costs IDR 31,240,000 if supply initial 3,992 kg, a total of 51,629 kg with costs IDR 46,210,000 if supply initial 5,988 kg, 49,633 kg with costs IDR 61,180,000 if supply initial 7,984 kg, a total of 47,637 kg with costs IDR 76,150,000 if supply initial 9,980 kg

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