

## The Aggregate Planning For Trucking Operation in Cikarang Dry Port

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**Abstract.** Cikarang Dry Port currently is the only dry port in Indonesia. This Dry Port has a role to connect or extend the Sea Port to the industrial areas located far from Sea Port. Thus, it creates a value added and also reduce costs. One of the operations done in Cikarang Dry Port is trucking operation. This research aims to examine the planning of 2014 trucking activity in Cikarang Dry Port to determine the right number of the truck that will be best occupied to manage all demands. The analysis begins with demand forecasting by using a moving average method of 12 months or one year period in 2013 which will be used as main information to develop the plans. There are three plans developed in this research. Based on the three plans, Plan A with minimum trucking plan with subcontracting is the most profitable which gives the highest profitability of Rp. 374,984,625. Recommendation for this research is using the current minimum number of 39 trucks rent with additional subcontracting when the demand is exceeding the capacity, thus, Cikarang Dry Port can occupy all demands and gain more profits.

**Keywords:** Aggregate Planning; Scheduling; Trucking Operation; Moving Average; Cikarang Dry Port

### 1. Introduction

International trading activities especially export and import activity has become one of the most important factors to support the national growth with all of its indicators (Hakim, 2012). In the past few years, Indonesia economic has grown rapidly while most of the country in the world struggling in a crisis. The data

published yearly by Indonesian Central Agency of Statistics from the year 2002 up to 2012 shown an increased in export and import values which can be concluded that Indonesia has increased in its economic growth as shown in Figure 1.1. Hence, it affects the loads in most ports in Indonesia; one of them is Tanjung Priok Sea Port which is located in Jakarta greater area.

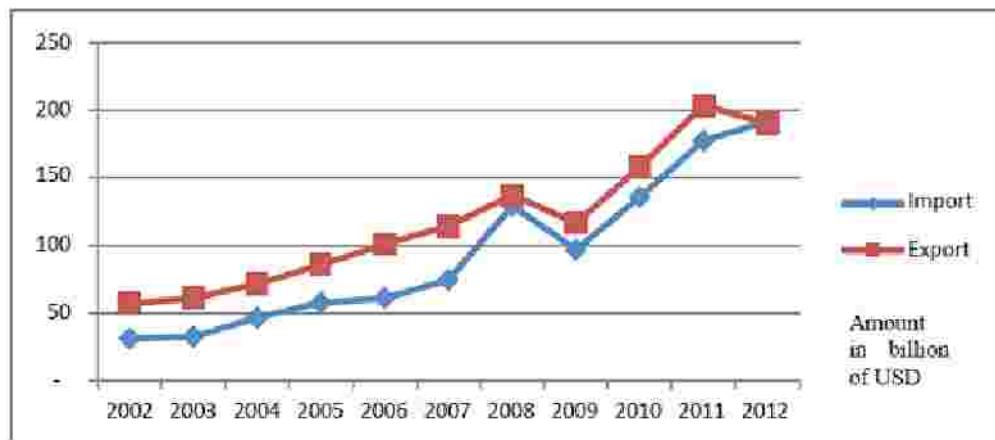


Figure 1.1. Export-Import Value

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Furthermore, the steeply rising container flows have resulted in crowded terminals, crowded activity and longer dwell times for containers (Roso, 2008). He also stated that there is a necessity to open up a new and integrated dry port to minimize the dwelling time in the seaport. A dry port is an inland intermodal terminal directly connected to seaport(s) with high capacity transport, mean(s) where customers can leave/pick up their standardized units as if directly to a seaport. Mostly, the export and import activities in Tanjung Priok come from Cikarang area. Because Cikarang is a largest industrial area in Southeast Asia (Jababeka Press Release, 2008), therefore, to support the activities, PT. Jababeka Tbk. creates the one and only dry port in Indonesia, Cikarang Dry Port (CDP).

CDP located in Jababeka Industrial Estate, which lies in the heart of the biggest manufacturing zone of West Java, home of more than 2,500 industrial companies, both Multinational Companies and Small and Medium Enterprises (SMEs). CDP uses trucking or road transportation as the main operation. It occurs because Tanjung Priok Sea Port does not have train emplacement that allow the train to take the containers directly from the vessels (Sumantri,

2013). Therefore, the number of the truck will be very significant to the operation of CDP.

One of the main operations in CDP is delivering the container for export and import activities from/to customer to/from CDP and from/to CDP to/from Tanjung Priok Sea Port. Trucking operation in CDP is doing four kinds of services which are the shuttle, feeder, train freight, and others. According to Nossack and Pesch (2013), the trucking problem has risen in many port and logistic operation all over the world. Currently, CDP has rented 30 trucks from the third party logistic providers. 20 trucks from a vendor of Iron Bird and 10 trucks are from Pancaran Darat Transport (PDT). The numbers of trucks are made with the demand volume when CDP first operated in 2010. And today, because of the increasing export and import activities, CDP needs to adjust the number of trucking resources to current demand volume. The following Figure 1.2 shows the comparison of the demand of trucking operation and trucking ability in 2013. Mostly in 2013, the trucking ability are goes under the demand, it means that in those months, there are some containers were late.

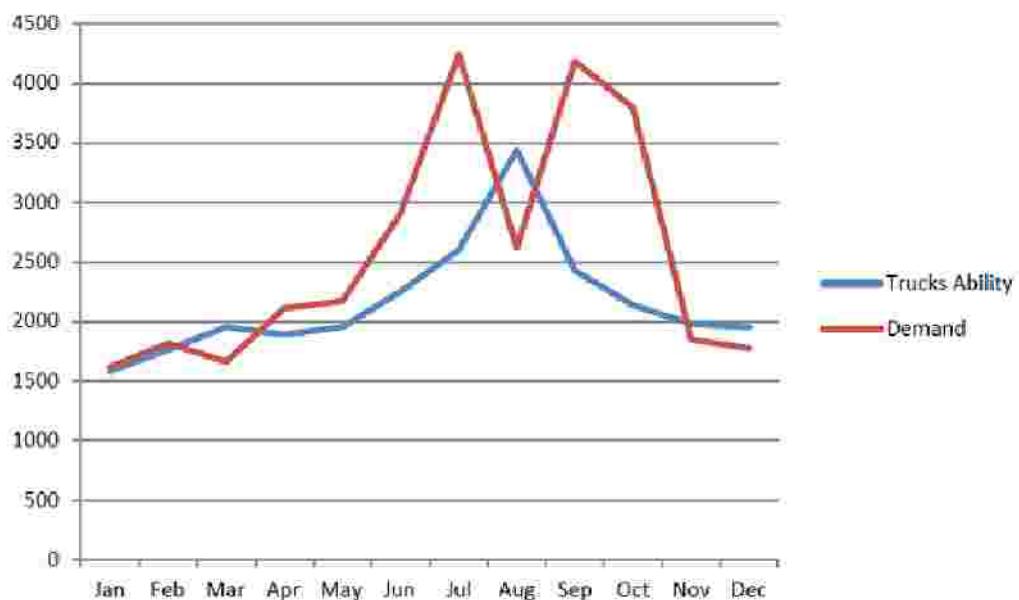


Figure 1.2. Comparison of Trucking Ability and Demand 2013

The data for demand and sales from CDP in the year 2013 was 30,742 while the sales were 29,917. It shows that there was a gap of 825 containers that could not be taken from Tanjung Priok on time. This case becomes the problem that will be discussed in this study. Based on the problem identification mentioned, the research question constructed is, *"What is the most efficient and effective scheduling of trucking operation in CDP for 2014?"*

## 2. Review of Literature

### 2.1. International Trade

According to Seyoum (2009), International trade is the exchange of goods and services across national boundaries. It is also the first type of foreign business operation undertaken by most companies because importing or exporting requires the least commitment of, and risk to the company's resources. Hakim (2012) stated that, International trade through export and import operation has become one of the important factors that contribute to the national economic growth.

### 2.2. Logistic

According to Lu and Su (2002), logistic deals with the flow and storage of goods and related information. All the processes of planning, implementing and controlling the efficient, cost-effective flow and storage of raw materials, in-process inventory, finished goods, and relation information from point-of-origin and point-of-consumption are for the purpose of conforming to customer requirements.

### 2.3. Dry Port Operation

Developed economies like Europe and North America, seaport brought out existing dry port so as to control the supply chain (Notteboom and Rodrigue, 2005). According to Sumantri (2013), operations of CDP usually appear in the inland port is shuttle and feeder. The shuttle is the activity to take out the container from the sea port to the inland port or in other words it is inter-port operations. This activity usually supported by either truck or

train. On the other hand, a feeder is the activity to bring the container from dry port to consignee's warehouse or, in other words, it is the extension to shuttle activity.

### 2.4. Container Yard (CY)

According to Suprapto (2013) as a CY Manager in CDP, container yard is made to store the containers that come to the port. This is a basic and fundamental facility of every port. Each container that arrives in the port is put in the CY until the consignees take them out from the port. In the dry port, CY also plays an important role in its operation.

### 2.5. Aggregate Production Planning (APP)

According to Takey (2006), Aggregate Production Planning (APP) is a middle term planning concerned with the determination of production, inventory, and workforce levels to meet such a fluctuating demand requirements over a planning horizon typically of one year. The goal is to meet the seasonal forecasted product demand in a cost-effective manner.

### 2.6. Scheduling and Capacity Planning

The capacity planning problem is closely related to product mix problem, deadline setting, order acceptance, and demand/revenue management problems (Chen, 2009). There are two circumstances where the capacity adjustment is considered really necessary. The first condition is when the demand is exceeding the capacity, which concluded that the capacity need to expand if the demand still wants to be coped. The second condition that might be appear to be necessary for capacity adjustment is when the capacity exceeding the demand. It means that there is a need for a company to give up some of their resources in order to minimize the cost.

## 3. Methodology

This paper can be classified as applied research since the objective is to solve the real problem in the organization. This research tries to solve the problem related

to the decision-making process. Therefore, is made in order to know what the best trucking scheduling that CDP has to use for the next year period of 2014. The first step is to determine the number of trucks that will be needed for next year period. The number of trucking should be matched between ability and demand. Therefore, the number of trucks is calculated based on forecasted demand. The period of the data being used was the data of sales of CDP for January-December 2013.

This research used aggregate planning method, where it's concerned with determining the quantity and timing of production for the intermediate future, often from 3 to 18 months (Heizer and Render, 2014). Since this case study is about the transporting goods, therefore, this research is using the transportation method. Transportation method is a method to solve for the optimal solution to an aggregate planning problem for minimizing costs, hence maximizing profits. This method is also flexible when it can be specify regular and overtime production in each time period, the number of units to be subcontracted, extra shifts, and the inventory carryover from period to period. Not only subcontracting way, other factor such as hiring and layoffs are introduced. In this case, the method of subcontracting, layoffs and mixed method of subcontracting and layoffs will be used to

answer the research question. The best option will be chosen as the solution. This method done by following the steps explained are as follow.

### 3.1. Current General Condition

The current general condition is basic information to do the capacity planning of trucking operation in CDP. The cost and revenue will become a basic and main consideration of choosing the most efficient plan among others. Besides the cost and revenue, the trip per day will also become the consideration to determine the ability of a truck. The trip per day shows the ability of a truck to bring the container from Tanjung Priok sea port to CDP. The higher the trip per day means that the truck has the ability to bring more containers to CDP (Sumantri, 2013).

### 3.2. Forecast Future Demand

The forecast is the main tools in the aggregate capacity planning. In this research, the object that will be forecasted is the sales in the period of January until December 2013. The forecast method that the writer uses for this research is simple moving average. Moving average is a method of taking new average every time the new information is obtained (Siegel, et. al., 2006). Furthermore, Siegel said that moving average is one of the effective methods to forecast for a middle term or one until three years. The formulation of the moving average is defined as follows:

$$MA_n = \frac{\sum_{i=1}^n D_1}{n}$$

Description:

n = number of periods in the moving average  
 $D_1$  = demand in period 1

Source: Siegel, et.al. (2006)

### 3.3. Develop Alternative Plans

According to Hill and Rich (2010), the proper number of plans that need to be developed was three plans. In this research, the plans will be compared using profit and loss projection and also trucking ability.

- Plan A: Minimum Trucking Plan with Subcontracting

In this plan the researchers assume that CDP will only use a minimum number of trucks. The number of

trucks calculated based on the minimum numbers of demand in the entire year of 2013. Since this plan A is using minimum numbers of trucks, therefore, it needs subcontracting when the demand is more than minimum numbers. In this case, the variable costs will be affected, hence, the fixed costs will be lowest.

- Plan B: Maximum Trucking Plan by Hiring and Layoffs

In the maximum plan, assumes that CDP will use the number of trucks based on the highest possible number of demand in the entire year of 2013. Since this plan B requires the highest number of demand, therefore, it needs to hire more trucks as well as drivers. But, when the demand is low some trucks are unused and some drivers need to be layoffs to match with the demand. In this case, it affects the fix cost will be high.

- Plan C: Average Trucking Plan with In this plan, assumes that CDP will have an average number of trucking in the year of 2013. The number of trucks in this plan got from the calculation using the ability of trucking (trip-per-day) and combined with the profit consideration. The average number of trucks will creates constant in fixed costs but vary in variable costs. But, when demand is

high or low it needs to be adjusted. Either subcontracting or hiring and layoffs need to be considered.

#### 3.4. Choose the Best Alternative

To choose the best alternative among three plans, the researchers use three projected profit and loss from each plan. The plan that gives the highest profit will be chosen as the best alternative as it considered the most effective and efficient plan among others.

### 4. Data Analysis and Result

#### 4.1. Current General Conditions

The first general condition is the rent cost of each truck, RP. 20,000,000 per truck per month. However, the contract has to be yearly. Another fix costs are: distance by every truck, price per trip, and trip money percentage will be shown in Table 4.1 below:

Table 4.1. Fix costs in CDP Operations

No	Variables	Distance/ truck (KM)	Price/ trip (Rp.)	Trip Money/ revenue
1	Trip Feeder	25	550,000	39
2	Trip Shuttle	120	1,000,000	
3	Trip train freight (Jababeka Zone)	25	550,000	
4	Trip train freight (Non-Jababeka Zone)	100	1,000,000	
5	Trip other (Jababeka Zone)	25	550,000	
6	Trip other (Non-Jababeka Zone)	100	1,000,000	

Note:

- Shuttle is the activity to take out the container from the sea port to the inland port (inter-port operations)
- Feeder is the activity to bring the container from dry port to consignee's warehouse (extension to shuttle activity)
- Train freight is the activity to take the container from the customer's warehouse (to be sent by train to another local region)
- Other activity is usually a dry port has to deliver the empty containers from their empty depot to the yard

in the shipping line who owned the containers.

The data shown in Table 4.1 above assumed that the value of the following data will remain the same over years. To operates the trucks in every activity (Feeder, Shuttle, and others), CDP also give a driver certain amount of money called trip money for all trips for trucks necessities (gasoline, toll fees, etc) of 39% of price/trip. For example, the feeder activity for trip money is Rp. 214,500/trip. Additionally, according to Sumantri (2013), in a day one truck could make from 1.7 trips per day up to 2.5 trips per day.

Next general condition is the CDP's demand and sales data for the year 2013 in order to make the aggregate planning because this data will be used as the basic data for forecasting. In CDP, demand

means it receives order to bring the container from Tanjung Priok Sea Port to CDP container yard. The data will be shown in Table 4.2 below.

Table 4.2. Demand and Sales Data 2013

Months	Shuttle	Feeder	Train Freight		Other		Total Demand	Total Sales
			Jababeka	Non-Jababeka	Jababeka	Non-Jababeka		
January	720	304	64	48	256	224	1616	1581
February	810	342	72	54	288	252	1818	1818
March	740	312	66	49	263	230	1661	1661
April	941	397	84	63	335	293	2112	1890
May	967	408	86	64	344	301	2170	1953
June	1295	547	115	86	460	403	2907	2250
July	1890	798	168	126	672	588	4242	2604
August	1166	492	104	78	415	363	2617	2617
September	1964	787	166	124	663	580	4184	2430
October	1691	714	150	113	601	526	3795	2139
November	823	347	73	55	293	256	1847	1847
December	790	334	70	53	281	246	1773	1773

Other general conditions that will be needed for this research are explained in the Table 4.3 below.

Table 4.3. Other General Condition in CDP Trucking Operation 2013

Number Of Driver	150%	of trucks
Driver's Daily Salary	Rp. 125,000	per day
Working Day	25 days	per month
Maintenance	Rp. 1,235	per KM

However, this research will be use two numbers of days. The first number of days per months is 25 to calculate the salary of the drivers. Another number of days per month are ranging from 28 until 31 days per months, to calculate the trucking ability.

#### 4.2. Forecasted Condition

In this section, the demand forecasting for

the next 12 months or one year period of 2014 gathered from the data taken in the previous year of 2013. The first step to making demand forecasting is by using the moving average method then plotting the historical demand to time series model. This method is done by using Microsoft Excel 2010. The result of demand forecasting for the year 2014 is show in table 4.4 below.

Table 4.4. Demand Forecasting Year 2014

Months	Shuttle	Feeder	Train Freight		Other	
			Jababeka	Non-Jababeka	Jababeka	Non-Jababeka
January	1141	482	101	76	406	355
February	1177	497	105	78	418	366
March	1207	510	107	80	429	376
April	1246	526	111	83	443	388
May	1271	537	113	85	452	396
June	1297	548	115	86	461	403
July	1297	548	115	86	461	403
August	1248	527	111	83	444	388
September	1254	530	111	84	446	390
October	1203	508	107	80	428	374
November	1163	491	103	78	413	362
December	1191	503	106	79	424	371

The table 4.4 above shows a fluctuation in the forecasted demand. The average growth of 7% forecasted compared with year 2013.

#### 4.3. Alternative Plans Development

From the forecasted demand in the

period 2014, researchers can get the demand volume of each month to determine the number of trucks required to fulfill the demand of every month. The numbers of trucks for each month period are based from the following Equation 1.1:

$$T_n = \frac{D_n}{t * d}$$

Description:

$T_n$  = Number of trucks required for the period of n

$D_n$  = Demand in the period of n

t = Trip per day

d = Number of days in the period of n

Source: Self-constructed by researchers based on the information given by Cikarang Dry Port

As mentioned in the general condition, the trips per day in the year 2013 are varied from 1.7 trips up to 2.5 trips. However, in this planning, the researchers set the trips per day to be 2.1 as average trips per day for every month in the period of 2014. The

summary of total demand of each month period for 2014, the trips per day and the number of trucks that will be required for the year 2014 can be seen in the Table 4.5 below.

Table 4.5. Monthly Trucks Required for 2014

Months	Total Demand	Trips per Day	Number of Days	Number of Trucks
Jan	2562	2.1	31	39
Feb	2641	2.1	28	45
Mar	2709	2.1	31	42
Apr	2797	2.1	30	44
May	2854	2.1	31	44
Jun	2911	2.1	30	46
Jul	2911	2.1	31	45
Aug	2800	2.1	31	43
Sep	2815	2.1	30	45
Oct	2701	2.1	31	41
Nov	2610	2.1	30	41
Dec	2674	2.1	31	41

#### Plan A: Minimum Trucking Plan with Subcontracting

Minimum trucks of a plan that assumed CDP only use the minimum number of trucking for the period of 2014. In this case, CDP will only rent 39 trucks from its vendor. However, to overcome the demand the exceeding the capacity, CDP assumed using the subcontracting method. Subcontracting means a firm can

acquire temporary capacity during peak demand periods. By subcontracting it will cost them additional Rp.25,000,000 per truck. The ability of the trucks to accommodate the demand in 2014 can be seen in Figure 4.2 below. The following Table 4.6 is explaining the profit and loss projection for the plan A. The total revenue for the year 2014 will be Rp. 374,984,625.

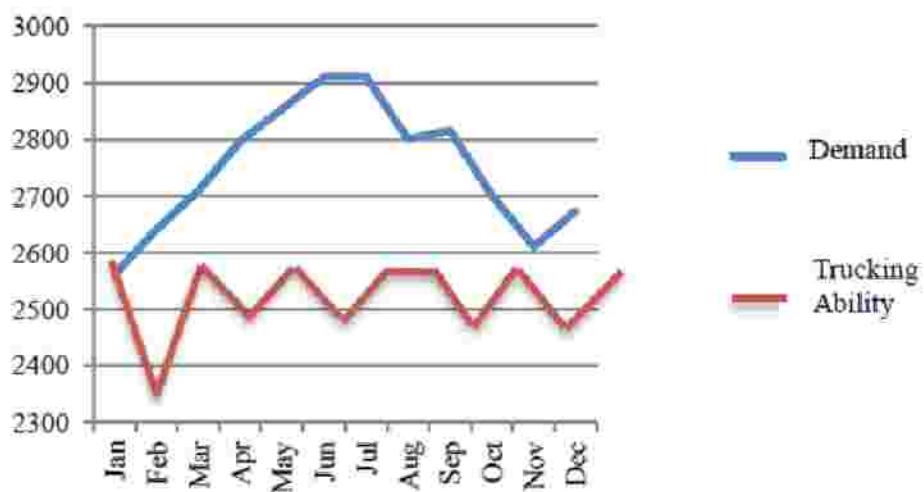


Figure 4.2. Comparison Trucking Ability and Demand Plan A

Table 4.6. Summary of Projected Profit and Loss Plan A

Month	Revenue	Cost		Profit/ Loss
		Fix Cost	Variable Cost	
<b>January</b>	2,115,950,000	780,000,000	1,262,455,575	73,494,425
<b>February</b>	2,182,000,000	780,000,000	1,474,237,900	(72,237,900)
<b>March</b>	2,238,300,000	780,000,000	1,412,300,650	45,999,350
<b>April</b>	2,311,000,000	780,000,000	1,508,710,700	22,289,300
<b>May</b>	2,358,100,000	780,000,000	1,532,698,950	45,401,050
<b>June</b>	2,404,200,000	780,000,000	1,615,573,400	8,626,600
<b>July</b>	2,404,200,000	780,000,000	1,587,448,400	36,751,600
<b>August</b>	2,314,100,000	780,000,000	1,482,152,850	51,947,150
<b>September</b>	2,325,850,000	780,000,000	1,547,524,425	(1,674,425)
<b>October</b>	2,230,650,000	780,000,000	1,380,259,725	70,390,275
<b>November</b>	2,156,850,000	780,000,000	1,342,709,225	34,140,775
<b>December</b>	2,209,150,000	780,000,000	1,369,293,575	59,856,425
		Total		374,984,625

**Plan B: Maximum Trucking Plan with Laying-Off**

Maximum trucks plan is a plan that assumed CDP will use maximum number of trucking for the period 2014 of renting 46 trucks from its vendors. However, to minimize the cost of unutilized trucks, CDP assumed to lay-off some of the

drivers when the demand is low. Figure 4.3 show the ability of trucks has met the entire total demand of each month from January to December 2014. The following Table 4.7 is explaining the profit and loss projection for the plan B. The total revenue for the year 2014 will be Rp. (105,015,375).

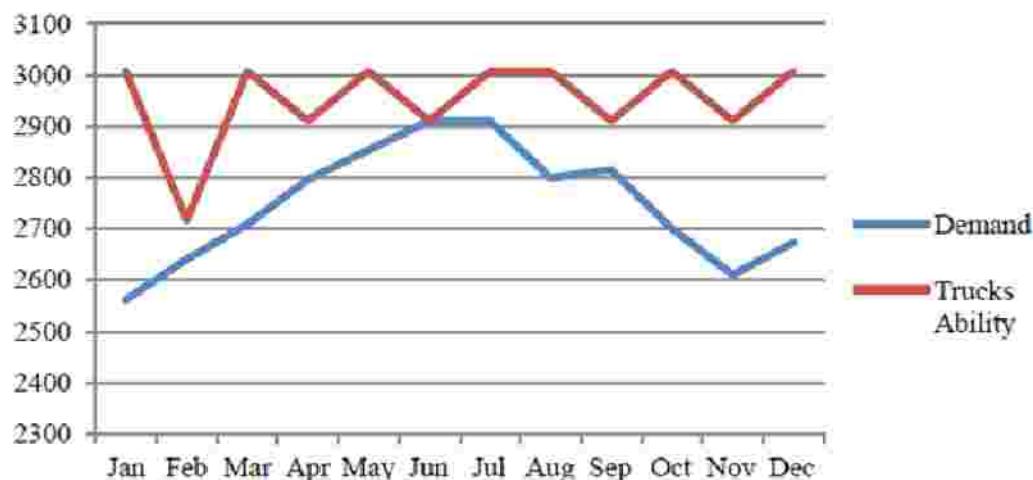


Figure 4.3. Comparison Trucking Ability and Demand Plan

Table 4.7. Summary Projected Profit and Loss Plan B

Month	Revenue	Cost		Profit/ Loss
		Fix Cost	Variable Cost	
January	2,115,950,000	1,262,455,575	920,000,000	(66,505,575)
February	2,182,000,000	1,324,237,900	920,000,000	(62,237,900)
March	2,238,300,000	1,337,300,650	920,000,000	(19,000,650)
April	2,311,000,000	1,383,710,700	920,000,000	7,289,300
May	2,358,100,000	1,407,698,950	920,000,000	30,401,050
June	2,404,200,000	1,440,573,400	920,000,000	43,626,600
July	2,404,200,000	1,437,448,400	920,000,000	46,751,600
August	2,314,100,000	1,382,152,850	920,000,000	11,947,150
September	2,325,850,000	1,397,524,425	920,000,000	8,325,575
October	2,230,650,000	1,330,259,725	920,000,000	(19,609,725)
November	2,156,850,000	1,292,709,225	920,000,000	(55,859,225)
December	2,209,150,000	1,319,293,575	920,000,000	(30,143,575)
		Total		(105,015,375)

**Plan C: Average Trucking Plan with Subcontracting and Laying-off**

Average trucks plan is a plan that assumed CDP will use the average number of trucking for the period of 2014. In this case, CDP will rent 43 trucks from its vendor. However, in some months, the demand exceeding capacity, CDP assumed to use the subcontracting model.

Otherwise, when the capacity exceeding demands, it assumes to lay-off some of the drivers. Figure 4.4 below show the ability of trucks for the year 2014. The following Table 4.8 is explaining the profit and loss projection for the plan C. The total revenue for the year 2014 will be Rp. 339,984,625.

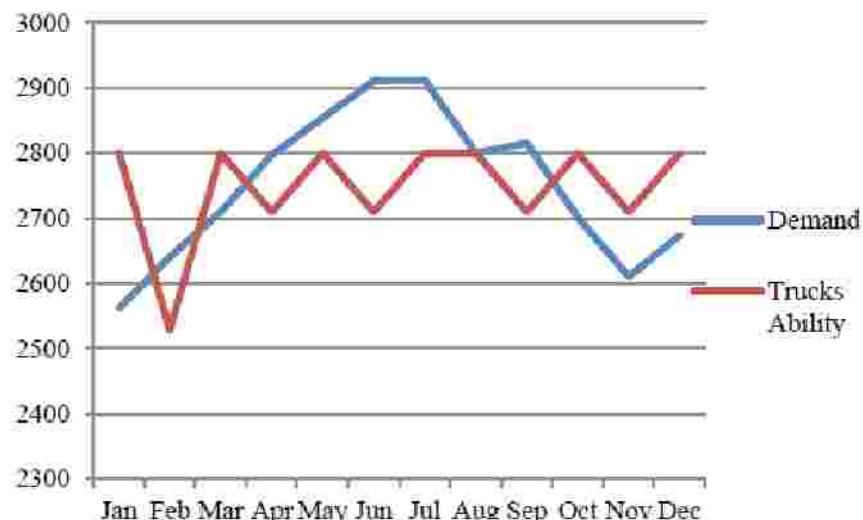


Figure 4.4 Comparison Trucking Ability and Demand Plan C

Table 4.8. Summary of Projected Profit and Loss Plan C

Month	Revenue	Cost		Profit/ Loss
		Fix Cost	Variable Cost	
January	2,115,950,000	860,000,000	1,262,455,575	(6,505,575)
February	2,182,000,000	860,000,000	1,374,237,900	(52,237,900)
March	2,238,300,000	860,000,000	1,337,300,650	40,999,350
April	2,311,000,000	860,000,000	1,408,710,700	42,289,300
May	2,358,100,000	860,000,000	1,432,698,950	65,401,050
June	2,404,200,000	860,000,000	1,515,573,400	28,626,600
July	2,404,200,000	860,000,000	1,487,448,400	56,751,600
August	2,314,100,000	860,000,000	1,382,152,850	71,947,150
September	2,325,850,000	860,000,000	1,447,524,425	18,325,575
October	2,230,650,000	860,000,000	1,330,259,725	40,390,275
November	2,156,850,000	860,000,000	1,292,709,225	4,140,775
December	2,209,150,000	860,000,000	1,319,293,575	29,856,425
		Total		339,984,625

#### 4.4. Interpretation of Result

Month	Plan A	Plan B	Plan C
	Profit	Profit	Profit
January	73,494,425	(66,505,575)	(6,505,575)
February	(72,237,900)	(62,237,900)	(52,237,900)
March	45,999,350	(19,000,650)	40,999,350
April	22,289,300	7,289,300	42,289,300
May	45,401,050	30,401,050	65,401,050
June	8,626,600	43,626,600	28,626,600
July	36,751,600	46,751,600	56,751,600
August	51,947,150	11,947,150	71,947,150
September	(1,674,425)	8,325,575	18,325,575
October	70,390,275	(19,609,725)	40,390,275
November	34,140,775	(55,859,225)	4,140,775
December	59,856,425	(30,143,575)	29,856,425
Total	374,984,625	(105,015,375)	339,984,625

Based on the table above, it can see that Plan A has the most profitable plan comparing to two other plans. Based on the fixed cost, the most efficient one is Plan A since it has the least fix costs among other plans.

#### 5. Conclusion and Recommendations

The aggregate planning is done by setting the right number of trucking that will be needed for trucking operation of CDP. This aggregate planning is

considering all general conditions of the trucking operation. The data is given directly from CDP whether by secondary data as well as an interview with the stakeholder. The optimal planning will be used as the actual trucking operation of CDP is the most efficient plan in term of cost and the most effective planning in term of the trucking ability. To obtain this required condition, the writer has developed three plans as alternatives for the operation in the year of 2014. The plans are using minimum, maximum, and

average trucking plan. From those three alternative plans, the researchers found that the minimum trucking number with subcontracting is the most suitable plan for CDP as it gives the highest profit and most efficient number of trucking needed to rent. This research also proved and answer the research question of the proper planning for trucking operation in CDP for the year 2014.

The research proved that CDP needs more trucks to run their operation. Therefore, it is important for CDP to acquire more trucks from vendors, Iron Birds, and Pancaran Darat Transport. The ways to acquire more trucks could be by buy trucks or combining the ownership as well as renting from vendors. Another recommendation is required for forecasting in the middle and/or long term period, such as five to ten years. This recommendation could help CDP to solve trucking problem better.

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