

CHAPTER 3 – RESEARCH METHODS & DATA ANALYSIS

3.1 Research Method

The methodology used in this research is categorized as descriptive type quantitative research. In developing the discussion a content analysis approach was used. The discussion was carried out following research (Hadiprasetya & Dinarjito, 2022). By using content analysis, the discussion can be carried out in detail and in depth. The content analysis method is a technique for drawing conclusions by identifying the specific characteristics of a message objectively, systematically and generally (Mahendra & Firmansyah, 2019).

Meanwhile for the technical aspect, the mechanism is data collected through observation, documentation and interviews with engineering department head & business development department head and mining operation department head of PT XYZ at site also few supervisor. The data operation equipment production used is the performance report for the period January-July 2023. Also conducting project visits to carry out benchmarks and measuring data, then the data is tested with data from the time motion study to obtain an overview of production realization after implementing the study results. The data to be taken includes secondary data and primary data. Primary data is in the form of technical data obtained directly by researchers in the field based on interviews and surveys: gradability, rolling resistance, cycle time, terms and conditions of IMBT PSAK 107 (2021).

Meanwhile, secondary data is obtained from existing sources: Pareto problem, machine specifications, production targets and achievements, financial performance, covenant ratios, etc.

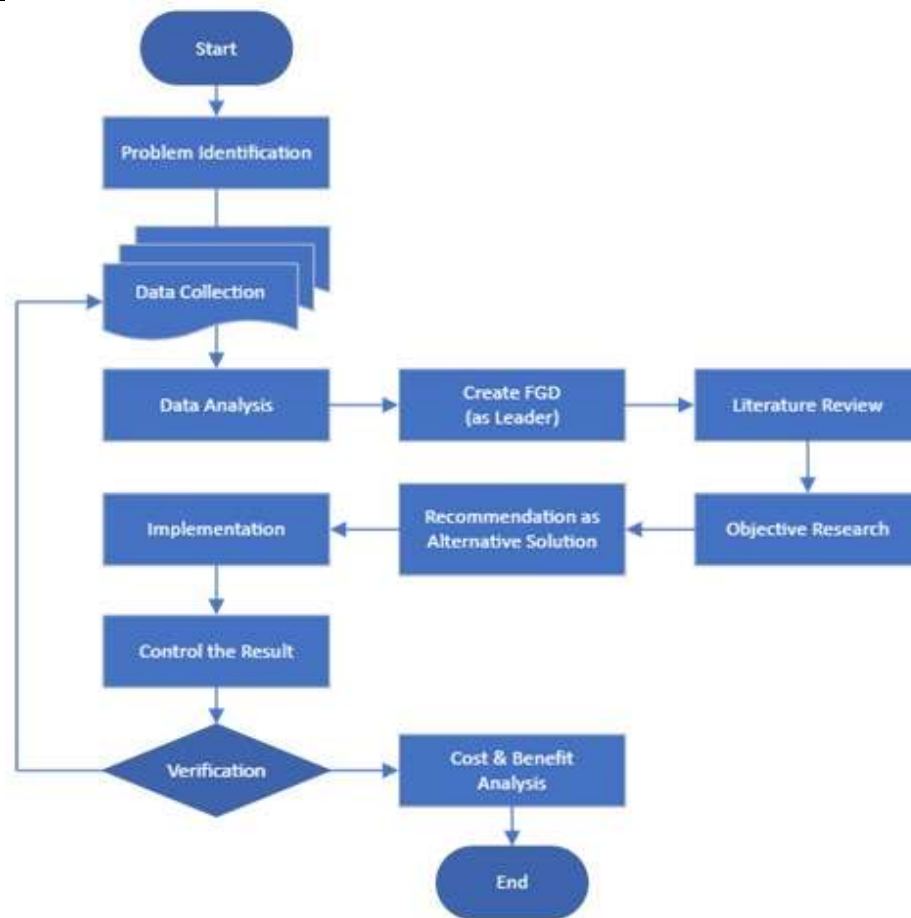


Fig 3.1 Flow Chart Research at Project-X

Refer to fig 3.1 flow chart research at project-X, the research flow process which is the main frame work. Basically this research refers to the DMAIC (Define, Measure, Analyze, Improve & Control) management tool. Starting from identifying problems, collecting and measuring data, analyzing the data whether it is in accordance with the standards and targets set or deviations occur. Which is then carried out root cause analysis and develops a number of solution recommendation activities. Then enter the implementation phase. Of course, from implementation, data is collected and measured again to verify whether it is in accordance with the set targets. As a continuous improvement effort, regular reviews must still be carried out, perhaps there is still room for improvement on what is already running.

3.2 Research Problem to be Solved

Project-X is one of the 7th project PT XYZ, located in West Sumatra as a limestone miner to full fill the supply of limestone to crusher as a raw material for cement manufacturing. Project-X had negative financial performance, the Profit before tax reaching minus Rp. 1.88 Billion or equivalent -(8%). During the 7 months of operation the company never reached its production target : 18,000 tpd (tons per day) or 540,000 tpm (tons per month) during the first semester and 25,000 tpd or 750,000 tpm during the second semester. Average only achieve 430.723 tons per month, only able to achieve 57% production of the demand set target.

On the other hand, the company also has many limitations and covenants: a holding policy for selective investment, the last three years capex was only approved for 55% of the proposals, part of the risk mitigation for market dynamics was to be kept as low as possible from level 20E, current ratio low, debt to equity ratio quietly high, Ebitda to interest and Debt to Ebitda is low. So the equipment procurement mechanism must be careful and selective so as not to be a financial burden, but can contribute to increasing production and revenue.

3.3 Materials and Equipment

Research requires preparation, especially the object being researched. In preparing operating costs with reference to BoQ (Bill of Quantity) from internal PT XYZ. And in this research the focus is on: equipment readiness to support operational readiness in terms of quantity and size, as well as suitability of equipment specifications to extreme operating conditions. And for the further calculation regarding production for research use below data :

CUSTOMER DATA

1. Production Target Limestone

Daily Target	25.000	Ton/day
Monthly Target	750.000	Ton/Month
Yearly Target	9.000.000	Ton/Year

2. Material Density

Desc.	Limestone	Unit
Bank Density	2,20	Ton/BCM
Loose Density (Material Blasting)	1,70	Ton/LCM
Swelling Factor	1,29	LCM/BCM

3. Hauling Distance

Hauling Distance (PIT to Crusher) : 2.200 m (from PIT to Crusher)

4. Work Roster

Limestone Getting		
Working hours per-shift	15	hrs/shift
Effective working hours	14	hrs/shift
Shift per-day	1	shift/day
Working hours per-day	14	hrs/day
Effective working hours per-year	360	day/year
Availability working hours	5.040	hrs/year
PHISICAL AVAILABILITY (PA)	90%	
TIME UTILIZATION FACTOR (UA)	85%	

Effective working hours for production : 3.856 hrs/year

Effective working hours per-day : 10,7 hrs/day

Table 3.1 References Data for Research Project-X

Refer data table 3.1 references data for research project-X, is used as a basis data for doing research in the study which become the reality of the project. This data is used to calculate production targets and in designing equipment specifications that are suitable for work conditions and production targets.

In study, team also utilize global positioning (GPS) tools to read and measure distance and slope and the Vehicle Optimizer (VO) to calculate precise suitable specification dump truck machine. VO is software application under license from principal, so the researcher not in capacity to describe in detail of the equipment, but will explain the diagram curve result of the tools.

3.4 Root Cause Analysis

In the forum group discussion (FGD) project : engineers, operations and maintenance teams discuss and analyze what causes production never be achieved which has an impact on low production and negative financial performance using Root Cause Analysis (RCA) and Pareto.



Fig 3.3 Forum Group Discussion Project Improvement at Project-X

Refer to fig 3.3, FGD was carried out using 2 methods: offline and online meetings, considering that team members were spread across various areas starting from Padang (West Sumatra), Jakarta (West Java), Surabaya and Tuban (East Java).

The following are the results of the RCA in FGD forum, tree diagram for root caused analysis subject to identify the routing problem precisely.

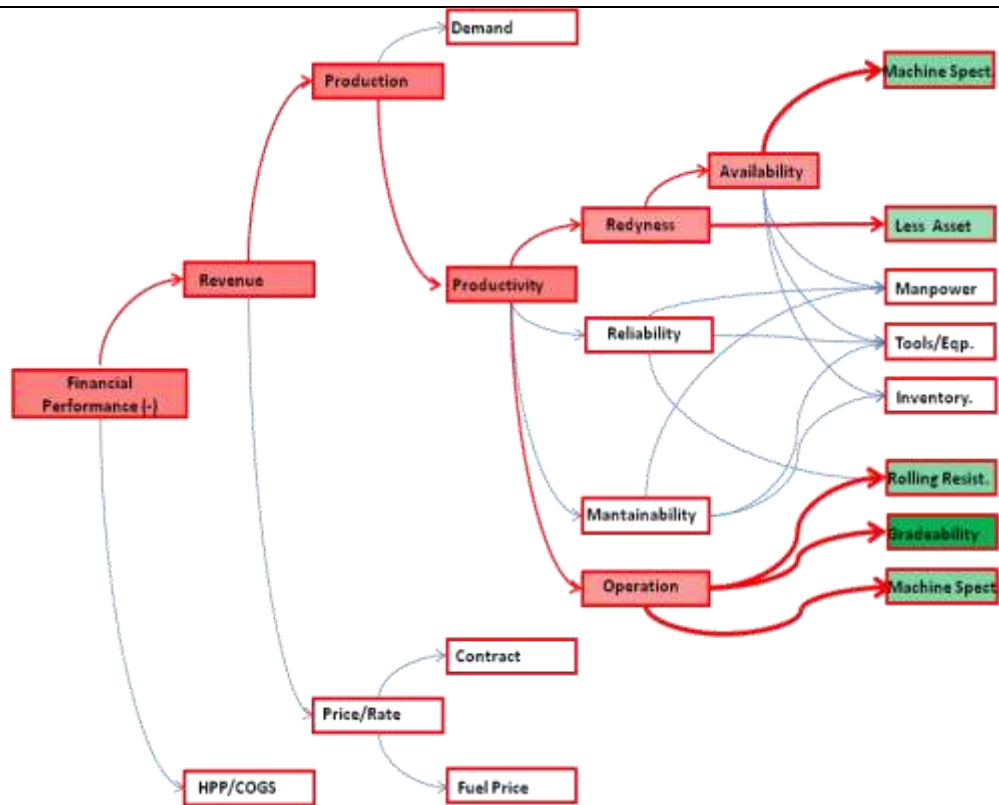


Fig 3.4 Tree Diagram-Root Caused Analysis Project-X

Refer to fig 3.4 tree diagram-RCA project-X, that negative financial performance is caused by not achieving the sales revenue target. The failure to achieve revenue was due to production being below the target of only 57%. The minimum production for this project to break even is 80% of the monthly production target stated in the contract, or 600,000 tons/month (round down). Even though the demand is very high, but production was not achieved due to equipment productivity not being achieved. This is because equipment readiness problem due to low of availability, inappropriate equipment specifications and fleet shortages.

Apart from that, the failure to achieve productivity is also due to extreme operating conditions, namely: rolling resistance very high, extreme gradability exceeding the recommendations in the Scania and Komatsu handbook specifications. And also the excavator equipment specifications are not suitable for the extreme working area. The density and hardness of the lime stone material is very high, exceeding other PT XYZ projects.

The hardness of the material in project-X is 80-85 Mpa (mega pascal) compared to the other 2 projects which only 40-50 Mpa dan 70-80 Mpa, stated below :

Project Location	Density		Hardness	
Project Tuban	1,8	ton/bcm	40-50	Mpa
Project Pangkeb	2,1	ton/bcm	70-80	Mpa
Project-X	2,2	ton/bcm	80-85	Mpa

Table 3.2 Density and Hardness Project-X

Refer to table 3.2 density and hardness project-X, this data was obtained from a joint survey between PT XYZ engineering and PT X customer engineering. And the density very heavy, 2,2 ton/bcm.

Strengthened RCA is also supported data which all equipment readiness below the target in average.

NO	UNIT	JAN	FEB	MAR	APR	MAY	JUN	YTM
1	PC 400 - 02 (Aset)	0%	0%	0%	0%	0%	0%	0%
2	PC 400 - 03 (Aset)	0%	0%	0%	97%	100%	83%	47%
3	PC 400 - 04 (Aset)	100%	94%	100%	100%	65%	23%	80%
4	PC 300 - 01 (Aset)	100%	100%	100%	3%	0%	3%	51%
5	PC 300 - 02 (Aset)	100%	96%	100%	76%	85%	74%	89%
6	PC 300 - 03 (Rental)	99%	99%	100%	100%	100%	99%	100%
PA Avg		67%	65%	67%	63%	58%	47%	61%
RFU		4,0	3,9	4,0	3,8	3,5	2,8	
Readyness		67%	65%	67%	63%	58%	47%	61%
1	SCANIA B-01	94%	97%	86%	96%	96%	85%	93%
2	SCANIA B-02	97%	98%	93%	79%	97%	84%	91%
1	SCANIA B-03	91%	97%	90%	92%	91%	89%	92%
2	SCANIA B-04	70%	97%	90%	96%	98%	86%	89%
3	SCANIA B-05	97%	97%	97%	94%	93%	96%	96%
4	SCANIA B-06	98%	97%	97%	96%	98%	96%	97%
5	SCANIA B-07	91%	98%	98%	93%	99%	89%	95%
6	SCANIA B-08	98%	96%	97%	95%	99%	94%	97%
7	SCANIA 01	79%	0%	80%	95%	43%	0%	49%
8	SCANIA 02	91%	74%	53%	67%	97%	91%	79%
9	SCANIA 03	95%	95%	95%	84%	96%	91%	93%
10	SCANIA 04	35%	99%	84%	98%	73%	97%	81%
11	SCANIA 05	94%	98%	94%	5%	27%	96%	69%
12	SCANIA 06	94%	96%	55%	97%	98%	94%	89%
13	SCANIA 07	85%	74%	31%	0%	0%	0%	32%
14	SCANIA 08	54%	0%	0%	0%	0%	0%	9%
15	SCANIA 09	60%	68%	73%	89%	91%	57%	73%
16	SCANIA 10	85%	72%	95%	46%	52%	84%	72%
17	SCANIA 11	29%	28%	97%	79%	71%	74%	63%
18	SCANIA 12	66%	51%	90%	91%	89%	96%	81%
19	SCANIA 13	93%	79%	62%	86%	64%	79%	77%
20	SCANIA 14	57%	66%	93%	56%	91%	93%	76%
21	SCANIA 15	98%	65%	0%	24%	94%	9%	48%
22	SCANIA 16	0%	0%	0%	89%	0%	0%	15%
23	SCANIA 17	96%	88%	67%	89%	89%	90%	86%
PA Avg		78%	73%	73%	73%	74%	71%	74%
RFU		17,9	16,8	16,7	16,9	17,0	16,3	
Readyness		64%	60%	60%	60%	61%	58%	61%

Table 3.3 Performance Availability and Readiness Existing Equipment

Refer to table 3.3 performance availability and readiness existing equipment (source : internal at project-X), the readiness of existing equipment only 61% for dump truck

and excavator, it means the project-X lack of equipment for achieve production target. The largest problem of the existing equipments will identified in both Pareto on the Scania P360 B6x4 DV17 and Pareto PC300LC-8M0/PC400LC-8.

3.4.1 Pareto Problem on Excavator

Pareto data was collected from January to July 2023, taken from the planner section data.

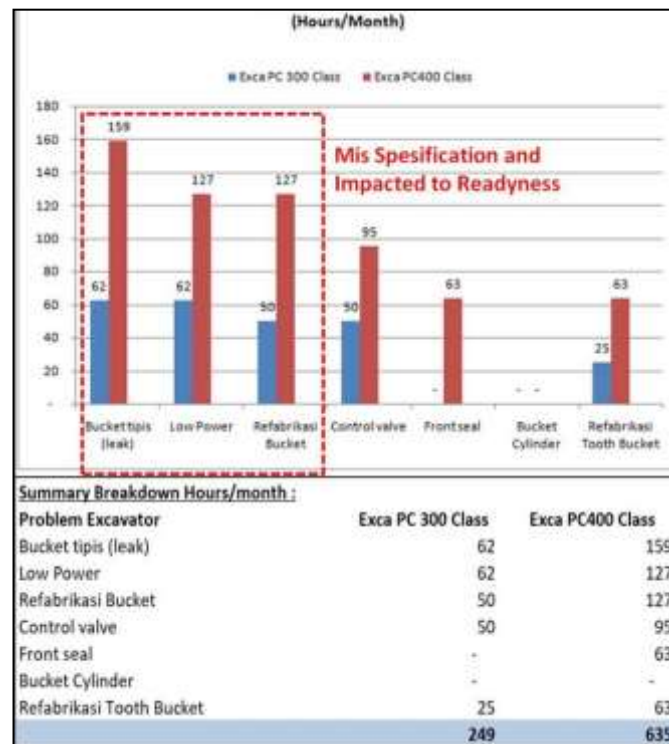


Table 3.4 Pareto Problem PC300/400

Refer to table 3.4 Pareto problems on PC300/PC400 put 3 main problems, namely:

1. Bucket weaks, of course the material and specifications of the bucket attached to the PC300/400 are not suitable with the operating condition of hard limestone.
2. Low Power, due to fuel and also requires power digging force and arm crowd forces that are greater than the PC300/400 class.
3. Fabrication, there was a lot of damage in the form of bucket, attachment and ground engaged tools (GET) fabrication as well as several problems that required fabrication repairs.

The top three major problem mentioned above due to machine under specification, not match with the material density and hardness. Those three problem categories per month contribute 27% (round up) losses working hours of the average availability of effective equipment operating hours. That is 675 hours breakdown from 2520 hours from effective monthly working hours of the 6x PC300/400.

3.4.2 Pareto Problem on Dump Truck

Pareto data was collected from January to July 2023, taken from the planner section data.

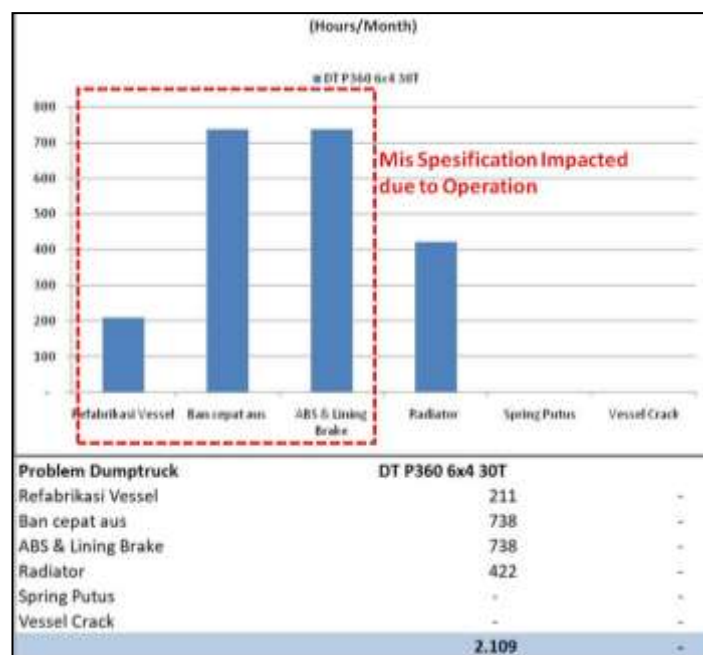


Table 3.5 Pareto Problem Scania 24x P360

Refer to table 3.5 Pareto problems on Scania 24x P360, the top three major problems, namely:

1. ABS lining brake, Many ABS lining brake damages are caused by extreme slop on the hauling road which reaches 14.5% of the factory standard which should be 8% effective.
2. Tire problem, Tire damage and abrasiveness levels are very high so the machine has to replace tires and lose effective working time. This is also due to slop, rolling resistance and high resistance grades. And often the ABS service brake works.

3. Fabrication & radiator, The design and hardness of the material also have an impact on vessel damage. It also requires a large ratio power train so that it is not too heavy and takes a long time when you are on an extreme incline which results in overheating and other radiator damage due to overheating.

The top three major problem mentioned above due to un match machine specification compare to the operation extreme condition.

These three problem categories per month contribute 21% (round up) of the average availability of effective equipment operating hours. That is 2.109 breakdown hours from 10.080 effective monthly working hours of the 24x Scania P360.

3.4.3 Gradability and Rolling Resistance.

From the RCA FGD also stated that production was not achieved due to constraints in field operating conditions, namely: slope, gradability and rolling resistance.



Fig 3.5 Working Area Hauling Road Pit PLB Gradability

Refer to fig 3.5 working area hauling road, from the survey conducted by the engineering team that the PLB pit up to crusher 6 with a distance of around 750-2200 meters has an average grade ability of 12.29% from the ideal condition of 8-10%.

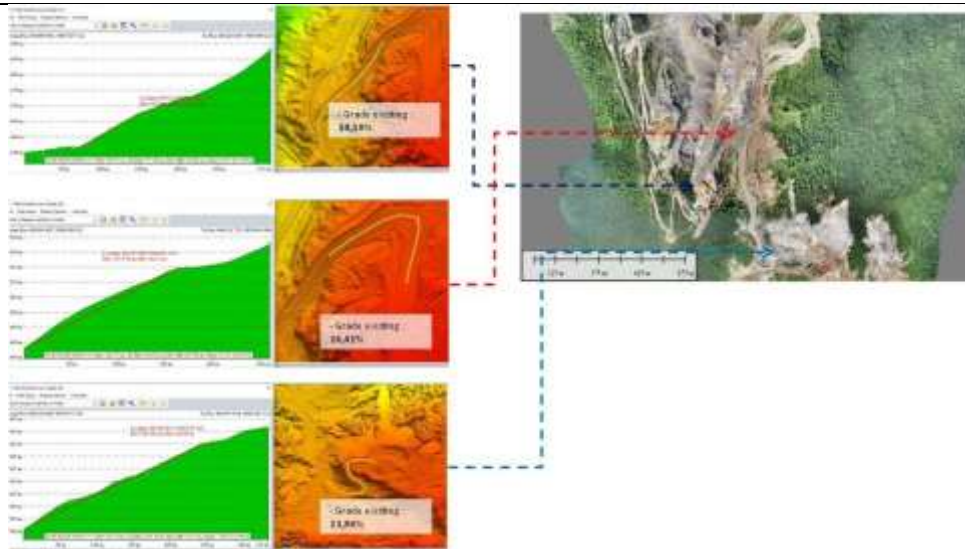


Fig 3.6 Working Area Hauling Road Pit PNPB Gradability

Refer to fig 3.6 working area hauling road, from the survey conducted by the engineering team that the PNPB pit up to crusher 6 with a distance of around 2200-4400 meters has an average grade ability of 15% from the ideal condition of 8-10%.



Fig 3.7 Working Area Hauling Road Rolling Resistance

Refer to fig 3.7 rolling resistance Hauling road, the rolling resistance of hauling roads is also very bad, ranging between 5-7%, strong operating recommendation should be 2-3% (illustrate : asphalt road 1%, rigid pavement 2%) (Ir Rohmanhadi, 1992).

If the rolling resistance of the road is high, the dump truck suffered serious high problem of abrasion and tire damage. And also has an impact on other problems : suspension springs, body cracks and of course the dump truck cycle time will be longer and cause productivity to decrease.

3.5 Vehicle Optimizer (VO)

This Vehicle Optimizer (VO) is application software developed by the principal which is used to determine the suitability of equipment specifications to actual field operating conditions.

This VO is to prepare a recommendation for a solution in terms of suitability of dump truck equipment specifications.

The equipments that will be compared as proposed solutions are the existing P360 B6x4 DV17 fleet without a retarder, the existing fleet which has undergone modifications in the form of adding a retarder (engine brake) and recommendation equipment that have been recommended by a team consisting of principals represented by distributors, customers and PT XYZ engineering. Below table 3.6 is machine that will compared using VO :

No	Equipment Specification :	Standard Spect	Additional Spect	Remark
1.	Scania P360 B6x4 DV 17	Without retarder		Existing
2.	Scania P360 B6x4 DV 17		With retarder	Modification at site guide by principal
3.	Scania P410 B8x4 DV25	With retarder		Originally

Table 3.6 VO Machine Specification

Refer to table 3.6 machine specification, basically there are 2 model will compare with usage vehicle optimizer (VO), another one is modification from existing just for comparison and make alternative more precise and challenging.

VO 1st simulation for Scania P360 B6x4 DV17 without retarder result :

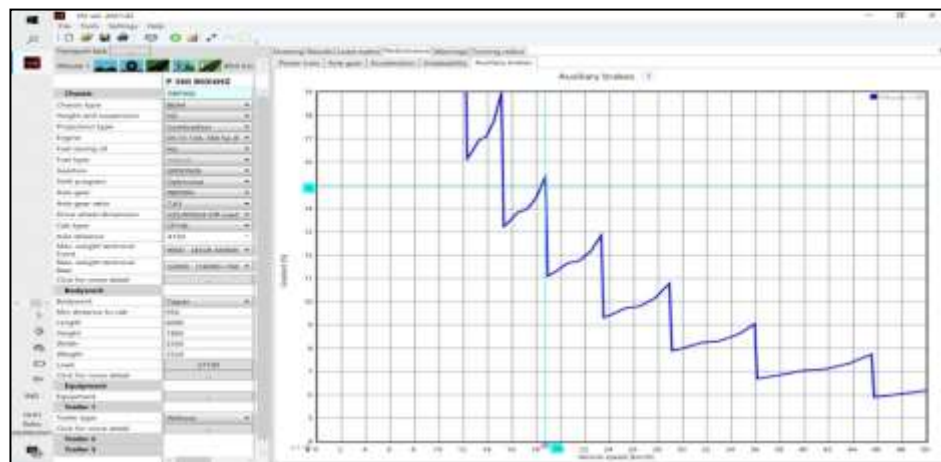


Fig 3.8 VO 1st Simulation Result in Gradient and Speed

Refer to fig 3.8 VO 1st simulation result, At a gradability of 15%, with a downhill hauling position, the speed of the DT Scania P360 6x4 (Existing) unit can be 19 km/h or even lower in F3 transmission position.

VO 2nd simulation for Scania P360 B6x4 DV17 with retarder (modify) result :

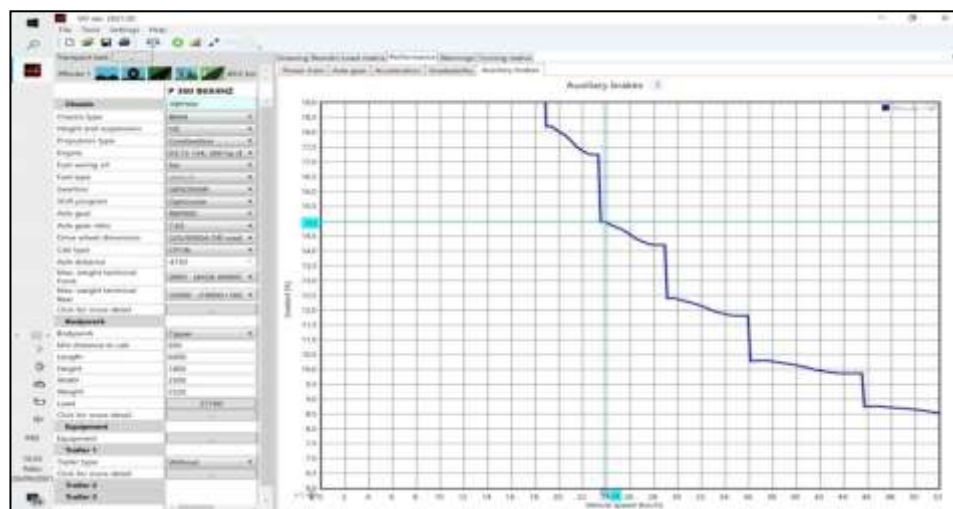


Fig 3.9 VO 2nd Simulation Result in Gradient and Speed

Refer to fig 3.9 VO 2nd simulation result, At a gradability of 15%, with a downhill hauling position, the speed of the DT Scania P360 6x4 (Existing) unit can be 24 km/h or even lower in F3 transmission position.

VO 3rd simulation for Scania P410 B8x4 DV25 with retarder (standard) result :

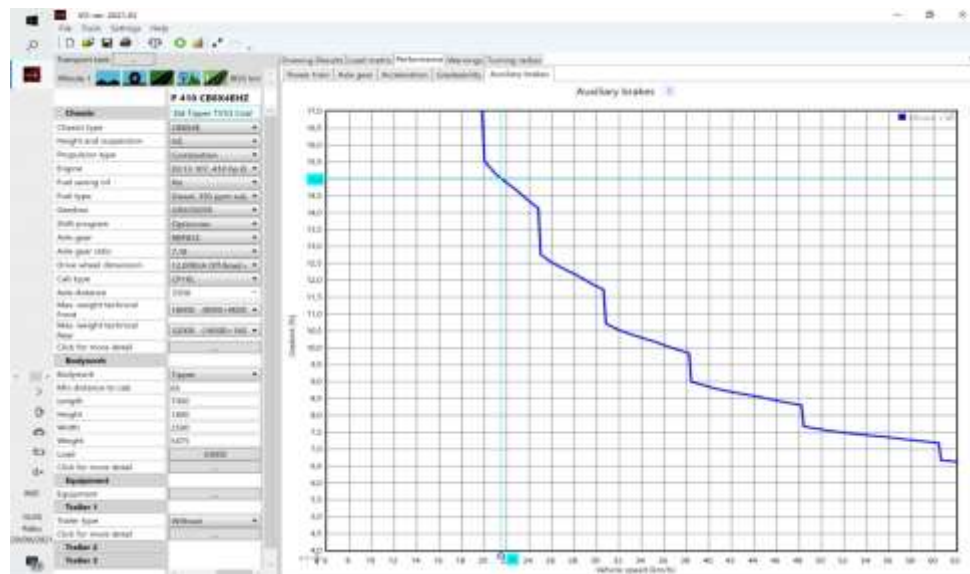


Fig 3.10 VO 3rd Simulation Result in Gradient and Speed

Refer to fig 3.10 VO simulation result, At a gradability of 15%, with a downhill hauling position, the speed of the DT Scania P410 B8x4 DV25 (new spect recommendation) unit can be 21 km/h or even lower in F3 transmission position.

The summary result from VO simulation :

No	Equipment Specification :	Standard Spect	Modify Spect	Result
1.	Scania P360 B6x4 DV 17	Without retarder		Gradeability 15%, F3, Speed 19 km/hrs
2.	Scania P360 B6x4 DV 17		With retarder	Gradeability 15%, F3, Speed 24 km/hrs
3.	Scania P410 B8x4 DV25	With retarder		Gradeability 15%, F3, Speed 21 km/hrs

Table 3.7 VO Fleet Recommendation Summary

Refer to table 3.7 VO fleet recommendation summary, dump truck equipment that is very suitable for the conditions and terrain operation is a machine that uses retarder specifications. There are 2 options, namely the result of modifications from existing model and new model of dump truck equipment with a retarder standard specifications Scania P410 B8x4 DV25 Retarder.

3.6 Optimum Fleet Recommendation (OFR)

A decision for selecting and purchasing new mining or quarry equipment must usually be made without the luxury of a pre-test. Engineering PT XYZ, customer and Application Engineers principal can provide accurate simulations to assist customers to conduct optimum fleet recommendation (OFR).

The team visit job site project-X to gather the necessary information and perform on-site measurements. This includes production & haul road characteristics, as well as material data and working regime. In project-X current operations are also observed to establish the base for further analysis. With refer to data in table 3.1 references data for research project-X and calculate using formulation which is explained in chapter 2 literature review in sub-chapter production calculation for dump truck and excavator we use to calculate between two option of alternative, as follow :

EXISTING	PROPOSE SOLUTION
PC400LCSE-8R (3,2 M3)	PC850-8R1 (5,0 M ³) ME Heavy Duty Bucket
P360-B6X4 with DV17 = 27 TON	P410-B8x4 w/ DV25 (5 Passes) , 33-37 Ton

Table 3.8 Fleet for OFR Recommendation

Refer to table 3.8 fleet for OFR, the four equipment models that will be counted in the OFR recommendation, namely the existing fleet compared with the new fleet recommendation as an alternative solution. The result of this OFR is the lowest cost of IDR/ton which will be the main option. Of course, there are also several technical considerations as a final adjustment.

EXCAVATOR	SCANIA P410-B8x4 with DV25	SCANIA P360-B6x4 with DV17
PC850-8R1 (4,5 m ³)	5 passes	4 passes
PC400LCSE-8R (3,2 m ³)	7 passes	5 - 6 passes

Table 3.9 Standard Bucket Passes to Loading Vessel

Refer to table 3.9 standard bucket passes to loading vessel, the reference for the number of filling passes from the excavator to the dump truck is very important and crucial in determining cycle time and fleet productivity in OFR. And this calculation

is based on matching bucket capacity to vessel capacity based on manual recommendation of Komatsu, which is the passes between 5 to 6 is the suitable one. Matching for chase up the cycle time and impact material to the truck vessel. And than following with some calculation start with production calculation as follow :

PRODUCTION ESTIMATION OF LIMESTONE GETTING			
		Alternative 1	Alternative 2
HAULER	:	P360-B6X4 DV17	P410-B8X4 DV25
ATTACHMENT	:	VESSEL	VESSEL
WORKING TYPE	:	LIMESTONE	LIMESTONE
LOADER	:	PC400LCSE-8R	PC850-8R1
DESCRIPTION	UNIT	PC400LCSE-8R LIMESTONE	PC850-8R1 LIMESTONE
EXCAVATOR	BCM/hour	188,68	253,15
ESTIMATION LOADING PRODUCTION	LCM/hour	244,17	327,60
	Ton/hour	415,10	556,92
MAX. TRUCK CAPACITY	Ton	27,00	33,00
BUCKET CAPACITY	LCM	3,20	4,80
BUCKET FILL FACTOR AVERAGE	%	0,75	0,70
CYCLE TIME	sec	23,00	24,00
THEORITIC BUCKET CYCLES/TRUCK	no.	6,62	5,78
ACTUAL BUCKET CYCLES/TRUCK	no.	6,62	5,78
ACTUAL LOAD/TRUCK	Ton	27,00	33,00
ACTUAL LOAD VALUE/TRUCK	%	1,00	1,00
PRIMARY CYCLE TIME	sec	152,21	138,66
SECONDARY CYCLE TIME	sec	81,96	74,66
TOTAL CYCLE TIME	sec	234,16	213,32
TIME UTILIZATION	%	0,65	0,65
NUMBER OF TRUCK PER HOUR	no.	15,37	16,88
NUMBER OF TRUCK PER FLEET	no.	9,00	10,00
MATCHING FACTOR		0,96	1,00

Table 3.10 The Calculation of Excavator Production

Refer to table 3.10 the calculation of excavator production, table show the production of excavator PC400LCSE-8R and PC850-8R1. The calculation refer to formulate that explained in chapter 2. The result is that PC400LCSE-8R the production achieved 415,10 ton/hour and production PC850-8R1 is 556,92 ton/hours.

DESCRIPTION	UNIT	P360-B6X4 DV17	P410-B8X4 DV25
		LIMESTONE	LIMESTONE
DUMP TRUCK	BCM/hour	30,96	38,79
ESTIMATION HAULING PRODUCTION	LCM/hour	40,07	50,20
	Ton/hour	68,12	85,34
HAULING DISTANCE	meter	2200	2200
AVERAGE HAULING SPEED	km/hour	16,00	16,00
AVERAGE RETURNING SPEED	km/hour	22,00	22,00
MANUEVER TIME	minute	1,00	1,00
LOADING TIME	minute	2,54	2,31
TRAVELLING TIME	minute	14,25	14,25
DUMPING TIME	minute	1,00	1,00
PRIMARY CYCLE TIME	minute	18,79	18,56
SECONDARY CYCLE TIME	minute	4,99	4,64
TOTAL CYCLE TIME	minute	23,78	23,20
TIME UTILIZATION	%	0,79	0,80
NUMBER OF CYCLE PER HOUR	no.	2,52	2,59
EXCAVATOR TIME UTILIZATION	=	0,65	0,65
DUMP TRUCK TIME UTILIZATION	=	0,79	0,80
AVERAGE HAULING SPEED	= km/hr	16,00	16,00
AVERAGE RETURNING SPEED	= km/hr	22,00	22,00
MATERIAL CHARACTERISTIC			
MATERIAL DENSITY - BANK	= Ton/BCM	2,20	2,20
MATERIAL DENSITY - LOOSE	= Ton/LCM	1,70	1,70
SWELLING FACTOR	= LCM/BCM	1,29	1,29

Table 3.11 The Calculation of Dump truck Production

Refer to table 3.11 the calculation of dump truck production, table show the production of Scania P360-B6x4 DV17 and Scania P410-B8x4 DV25. The calculation refer to formulate that explained in chapter 2. The result is that P360-B6x4 DV17 the production 68,12 ton/hour and production P410-B8x4 DV25 85,34 ton/hours. And then calculate the quantity of unit for each alternative fleet :

Working Type	Machine Model	Production Capacity		Production Target	Number of Unit		Production Cost	Investment Cost
LIMESTONE GETTING								
Limestone Loading		TON/Hour	TON/Day	TON/Year			Rp/TON	Rp
- Loading Limestone	PC400LCSE-8R	415,10	26.674	9.000.000	6	5,62	615	27.600.000.000,00
- Hauling Front to Crusher	P360-B6X4 DV17	68,12	25.536	9.000.000	35	34,27	6.033	79.100.000.000,00
							6.648	106.700.000.000,00

Table 3.12 OFR Recommendation 1st alternative

Refer to table 3.12 OFR recommendation for 1st alternative, to meet production achievements according to the contract agreement and the capability of fleet production per-hour 6x PC400LCSE-8R and 35x P360-B6x4 DV17 are required, which in terms of investment requires capex of IDR 106.7 Bio.

And model propose solution as 2nd propose alternative, as follow ;

Working Type	Machine Model	Production Capacity		Production Target	Number of Unit		Production Cost	Investment Cost
LIMESTONE GETTING								
Limestone Loading		TON/Hour	TON/Day	TON/Year			Rp/TON	Rp
- Loading Limestone	PC850-8R1	556,92	29.823	9.000.000	5	4,19	1.323	45.675.000.000,00
- Hauling Front to Crusher	P410-88X4 DV25	85,34	25.592	9.000.000	28	27,35	5.016	76.020.000.000,00
							6.339	121.695.000.000,00

Table 3.13 OFR Recommendation 2nd alternative

Refer to table 3.13 OFR recommendation for 2nd alternative, to meet production achievements according to the contract agreement and capability of fleet production per-hour 5x PC850-8R1 and 28x P410-B8x4 DV25 are required, which in terms of investment requires capex of IDR 121.69 Bio.

After we have calculated the number of fleet and production capabilities of each alternative fleet, we continue with calculating whether with this productivity we can achieve the production target of 9,000,000 tons/year for each alternative fleet.

Working Type	Machine	Production Capacity	No. of Units	Achievement		Production Target	Required Hours	
				By Model	By Fleet		By Model	By Fleet
LIMESTONE GETTING								
Limestone Loading		TON/Hour		TON/Year			Hours/Year	
- Loading Limestone	PC400LCSE-8R	415,10	6	9.602.657	9.602.657	9.000.000	3.614	3.614
- Hauling Front to Crusher	P360-B6X4 DV17	68,12	35	9.192.849	9.192.849	9.000.000	3.775	3.775

Table 3.14 The Calculation of Target Production Achievement 1st Alt

Refer to the table 3.14 the calculation of target production achievement 1st alternative, that to achieve the target production 9 mio ton/year need 6x PC400LCSE-8R and 35x P360-B6x4 DV17 and able to achieve 9,192,849 ton/year, above the target.

Working Type	Machine Model	Production Capacity	No. of Units	Achievement		Production Target	Required Hours	
				By Model	By Fleet		By Model	By Fleet
LIMESTONE GETTING								
Limestone Loading		TON/Hour		TON/Year			Hours/Year	
- Loading Limestone	PC850-8R1	556,92	5	10.736.304	10.736.304	9.000.000	3.232	3.232
- Hauling Front to Crusher	P410-88X4 DV25	85,34	28	9.213.096	9.213.096	9.000.000	3.766	3.766

Table 3.15 The Calculation of Target Production Achievement 2nd Alt

Refer to the table 3.15 the calculation of target production achievement 2nd alternative, that to achieve the target production 9 mio ton/year need 5x PC850-8R1 and 28x P410-B8x4 DV25 and able to achieve 9,213,096 ton/year, above the target. The calculation of OFR finally provide the result number of budget bill of quantity (BoQ) as standard target cost. And for existing model as 1st propose alternative, as follow :

Working Type	Machine Model	No. of Unit	Owning Cost ¹	Operating Cost ²	Fleet Required	O & O Cost	Total Cost	Production Achievements	Production Cost
LIMESTONE GETTING									
Limestone Loading	PC400LC95-8P	Unit	Rp/Year	Rp/Year	Hours	Rp/Year	Rp/Year	TON/Year	Rp/TON
- Loading Limestone		5	215.625	56.693	3.614	272.320	5.904.374.057	9.802.857	611,87
- Hauling Front to Crusher	P360-8634 DV17	33	110.833	308.954	3.773	419.787	55.460.172.043	9.192.849	6.032,97
									6.647,84
									0,46

Table 3.16 The Calculation of Production Unit Cost Alternative 1st

Refer to table 3.16 the calculation of production unit cost for 1st alternative, After calculating the owning costs and operating costs which we have attached in the attachment chapter, the OFR calculation can be followed up by calculating the production unit cost per ton. And for the 1st alternative, we get a comparison of production costs of Rp 6,648/ton.

Working Type	Machine Model	No. of Unit	Owning Cost ¹	Operating Cost ²	Fleet Required	O & O Cost	Total Cost	Production Achievements	Production Cost
LIMESTONE GETTING									
Limestone Loading	PC850-8R1	Unit	Rp/Year	Rp/Year	Hours	Rp/Year	Rp/Year	TON/Year	Rp/TON
- Loading Limestone		5	428.203	450.515	3.232	878.718	14.200.257.547	10.736.104	1.322,65
- Hauling Front to Crusher	P410-8834 DV25	38	133.150	305.086	3.766	438.236	48.216.279.841	9.213.096	5.016,32
									6.339,02
									0,44

Table 3.17 The Calculation of Production Unit Cost Alternative 2nd

Refer to table 3.17 the calculation of production unit cost for 2nd alternative, After calculating the owning costs and operating costs which also we have attached in the attachment chapter, the OFR calculation can be followed up by calculating the production unit cost per ton. And for the 2nd alternative, we get a comparison of production costs of Rp 6,339/ton. The 2nd alternative in term of production cost 4,65% lower than 1st alternative.

3.7 Covenants Limitation of PT XYZ

In Chapter 1 as background, sub chapter 1.1, it was mentioned that PTXYZ has a number of covenant restrictions that must be fulfilled by both the holding company PT ABC as a state company and also a number of banking institutions that provide financial facilities. Among them, the current ratio is at 1.08, approaching the critical point, where last year it was still 1.16. Debt to EBITDA 121% exceeded plan target. Apart from that, return on assets (ROA) of PT XYZ are in a minus (-2,03%).

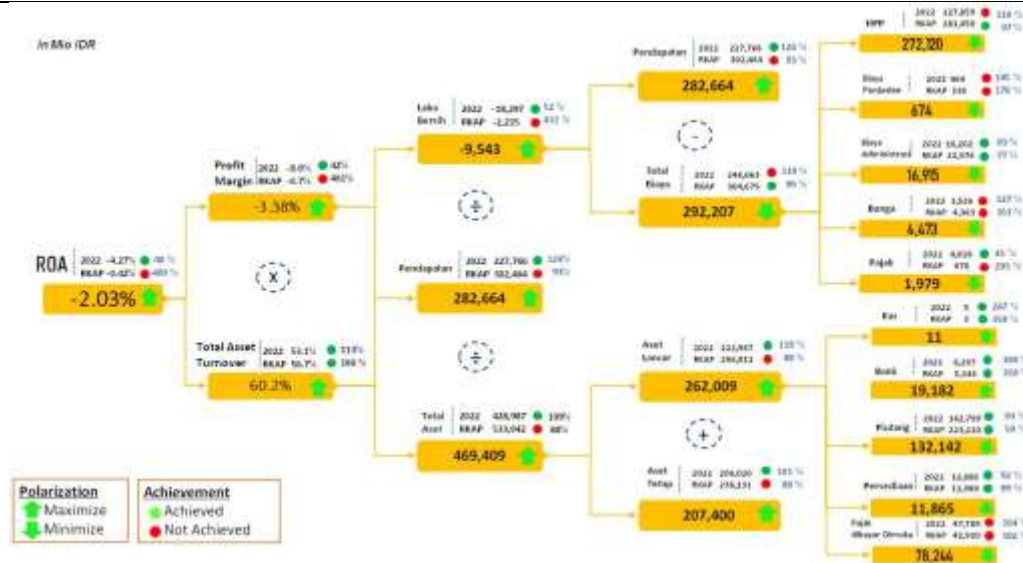


Fig 3.10 Dupont Analysis to Control Return On Asset

Refer to fig 3.10 dupont analysis to control RoA, return on asset of PT XYZ (-2,03%) as per July 2023. If PT XYZ is not careful in deciding on the equipment purchasing scheme, it will have a significant impact on the covenants. With the tight and limited conditions current ratio only 1.08, Debt to Equity Ratio (DER) 3.02 and Debt to EBITDA 15.79 above the target 13,08. PT XYZ is not in aggressive position to increase debt, it means could not make new investment under financial lease scheme. And also increasing the total asset will decrease total asset turnover and then will eroded RoA. The value of total asset per July 2023 of PT XYZ now reached IDR 469.4 Bio. And investment in project-X requires a minimum capex of IDR 121 Bio. Potentially it will increase long term debt and fixed asset on balance sheet if PT XYZ do financial lease with scheme PSAK 73. So the total asset will increase to IDR 590.4 Bio, and off course affected in total asset turn over and potentially erodes RoA even though have opportunity to increase sales production. So the focus is to increase sales revenue by increasing production, without adding assets but still with affordable costs and in accordance with the company's cash flow condition.

Currently PT XYZ has an operating lease status (HGU) with one of the key partner whose treatment must apply PSAK 73. Where in PSAK 73 this must be recognized as an asset in the balance sheet stated as lease debt.

Discuss in FGD and coordination with the holding company, PTXYZ Look for funding sources that can provide top line benefits in term of sales revenue but are not

too burdensome in terms of debt and have less risk. So that we collaborate to explore a number of banking facilities including syariah which provide better benefits. Finally received an operating lease syariah banking facility with accounting treatment referring to IMBT PSAK 107 (2021), which is not recorded in asset, meaning it is off balance sheet and only appears as a rental cost but have opportunity to increase production capacity.

	Fulfillment Scheme						Purchase Assumption PC 300	
	Equipment	IMBT	PSA	Leasing	Off-balance	Not Real	PARAMETERS	DESCRIPTION
Project Duration	5 years	5 years	5 years	5 years	5 years	5 years	MACHINE MODEL	PC 300 Komatsu PC300 SE 8M0/P3
Liquidity Requirement	Flexible	Flexible	Fixed	No	No	No	YEAR BUILD	2023
Treatment :	a. Income Statement	• Rent	• Depreciation	• Depreciation	• Depreciation	• Rent	MACHINE PRICE	Rp 2.800.000.000,-
	b. Balance Sheet	• Account Payable	• Asset	• Asset	• Asset	• Account Payable	TAX	Rp 280.000.000,-
	c. PSAK Regulation	• PSAK 107	• PSAK 73	• PSAK 73	• PSAK 73	• PSAK 1	TOTAL PRICE	Rp 3.080.000.000,-
Tax Treatment	No Correction	Correction	Correction	Correction	No Correction	No Correction	PERIOD	5 Years
Installment Scheme	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	INTEREST	8.17%
	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	INTEREST LEASE	12.80%
	Stage Up Repayment	Stage Up Repayment	Stage Up Repayment	Stage Up Repayment	Stage Up Repayment	Stage Up Repayment	INSURANCE COST	0.45% Annual
							DEDUCTIBLE	Rp 30.000.000,-
							MOB DEMOB	Rp 30.000.000,-
	BENEFIT						CALCULATION SIMULATION (in Mio)	
	Initial Payment	Flexible	Flexible	High	No	No	ITEMS	NO
Financial Ratio							DER	DER
a. Current Ratio (min 1)	High	Low	Low	Low	Low	High	Price/Lease machine	3.080
b. DER (maks 2.5)	Low	High	High	High	High	High	Interest/Margin	648
c. EBITDA (min 1.1)	Low	High	High	High	High	Low	SUB TOTAL A	3.728
Asset Status	Right of Ownership	Right of Ownership	Right of Ownership	Right of Ownership	Right of Ownership	Right of Ownership	MOB DEMOB	30
							Insurance	63
							Deductible	20
							SUB TOTAL B	113
							TOTAL	3.841

Table 3.18 Comparison Scheme PSAK 73 with IMBT PSAK 107

Refer to table 3.18 comparison scheme PSAK 73 with IMBT PSAK 107, the benefit to use facilities from one of national bank which have syariah product. The benefit of IMBT : flexible in liquidity, off balance sheet, treatment only as cost of good sold & recorded as account payable, no correction of tax, flexible installment scheme according to cash flow of company, more acceptable covenants impact, as asset in the end of contract and lowest in cost simulation. Finally PT XYZ decide to lease under IMBT PSAK 107 (2021).

3.8 Prons and Cons for Alternative Solution

Comparison parameters in prons and cons were obtained from FGD's when studies and technical survey in the field. And several parameters from the results of the Vehicle Optimizer calculation (VO) and from the process and results of the Optimum Fleet Recommendation (OFR) calculation. The result of prons and cons comparison as follow :

No	Prons and Cons	Alternative 1	Alternative 2
1.	2 nd to 1 st 10,5% higher Gradeability and Speed from VO		1
2.	2 nd to 1 st 14 % higher Capex (OFR)	1	
3.	1 st to 2 nd Production Cost IDR/ton 4,8% higher (OFR)		2
4.	2 nd to 1 st 25 % higher Productivity or Production (OFR)		3
5.	Purchase New Equipment by IMBT PSAK 107 (2021)	2	4
6.	Safety aspect, in term of traffic crowded		5
7.	Less people, less risk due to less equipment		6
8.	Risk production losses 28% higher for 2 nd when breakdown (OFR)	3	
Score alternative solution		3	6
<i>Note :</i> <i>Scoring base on number of win</i>			

Table 3.19 Prons and Cons to Determined Best Solution

Refer to table 3.19 prons and cons to determined which best solution, in between alternative 1st compare with alternative 2nd . And the result stated that alternative 2nd is the best alternative solution for resolve problem project-X, which is PT XYZ should replace old fleet and purchase new model machine 5x PC850-8R1 and 28x Scania P410-B8x4 DV 25 with retarder to full fill the target production as contract agreement. This means that apart from changing specifications is to adapt with working operation conditions, also improve readiness by adding a dump truck fleet in terms of quantity and size from the existing one.