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Hauling Equipment Assessment Process Case Study: PT Borneo Indobara

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Abstract
PT Borneo Indobara (BIB) is one of the largest mining companies in Indonesia, with a production of 42.1 million tons of coal in 2023 and plans to increase production to over 50 million tons by 2025. However, this growth is hindered by the limited capacity of the company's hauling road, with an internal study revealing a monthly hauling road capacity of 4.3 million tons, resulting in a 1.13 million tons gap in 2025. This study addresses the challenge of increasing production by evaluating the potential replacement of the company's 20-ton hauling trucks with larger capacity trucks. Three truck options were considered: Mercedes-Benz Arocs 4845K, FAW HD420DT, and Scania P460 LA. The study employs the Analytical Hierarchy Process (AHP) to assess the benefits of each truck based on criteria such as capacity, maintenance, speed, and specifications, while Life Cycle Cost (LCC) analysis is used to evaluate the costs. The final decision was made based on the Benefit-Cost Ratio (BCR), which identified the FAW HD420DT as the optimal choice. FAW scored 57% in benefits, outperforming Mercedes-Benz (56%) and Scania (28%), while its production cost of IDR 1,085/Ton.KM was lower than Mercedes-Benz's (IDR 1,244/Ton.KM) but higher than Scania's (IDR 1,002/Ton.KM). The transition to FAW HD420DT trucks will take place from 2025 to mid-2028, with temporary use of third-party haul roads during the transition period. This replacement is expected to enable the company to achieve its target production level of over 50 million tons of coal annually.
Keywords: analytic hierarchy process, lice cycle cost analysis, heavy equipment selection, benefit-cost evaluation, production capacity planning

INTRODUCTION

PT Borneo Indobara (BIB) is one of the largest mining companies in Indonesia, with a permit valid until 2036. The company's vision is to become a leading mining company in Indonesia by creating added value for customers and all stakeholders.

BIB's operational areas are located in Satui, Angsana, Sungai Loban, and Kusan Hulu Districts of Tanah Bumbu Regency, South Kalimantan, covering a concession area of 24,100 Ha. The concession is divided into two blocks:

a. West Block, which includes the Batulaki pit, Pasopati pit, and West Girimulya pit,
b. East Block, which consists of the Sebamban pit and the Kusan-Girimulya (KG) pit.

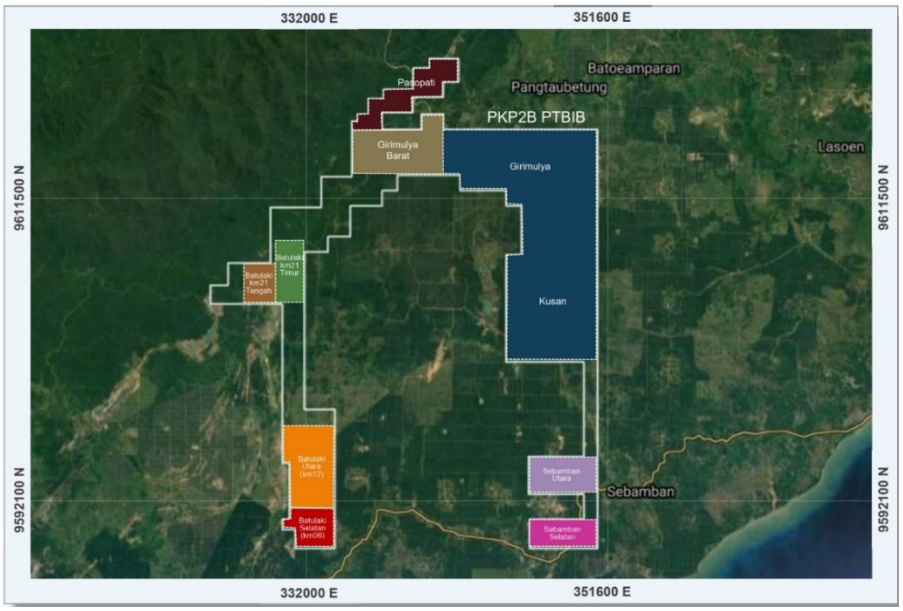

Figure 1 PT. BIB's Concession Area
(Source: BIB Feasibility Study, 2023)

Refer to Figure 2, BIB's production 2009 – 2023 continues to increase rapidly with an annual increase rate of 29% and more than 95% of BIB production comes from the Kusan-Girimulya pit.

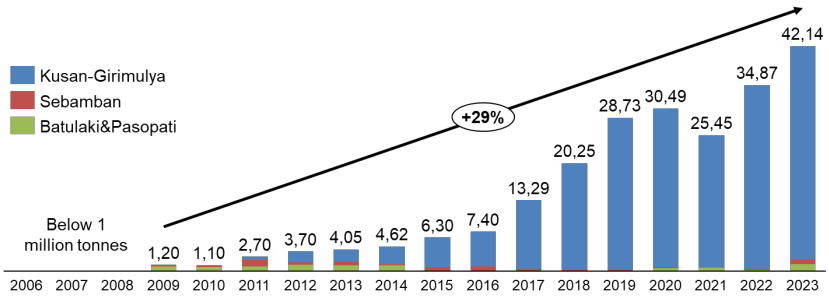

Figure 2 PT. BIB Production 2006 – 2023
(Source: PT. BIB, 2023)

BIB plans to increase its production to 54 million tons of coal starting in 2025, with the majority coming from the KG pit. This production increase aligns with future trends in coal use, where demand is expected to increase until 2030 before declining.

In 2025, BIB's production plan is set at 50.29 million tons, with 49.24 million tons (or 98%) coming from the KG pit, and the remaining 2% coming from other pits. However, this production plan faces challenges due to the limited capacity of the hauling road currently owned by BIB. Based on an internal study (2023), BIB's hauling capacity is around 4.3 million tons per month. When comparing the capacity of the hauling road with the production

plan of the KG pit, as stated in Table 1, the production achievement is predicted to be only 49.16 million tons, or a shortfall of 1.13 million tons. This will affect the company's profit by approximately 12.43 million USD.

Table 1 BIB Production Plan of 2025

2025	Kusan Girimulya (in KiloTons)	N.Sebamban (in KiloTons)	Batulaki (in KiloTons)	**TOTAL (in KiloTons)**
January	4.210	81,33	4,17	**4.296**
February	3.838	81,33	4,17	**3.924**
March	3.584	81,33	4,17	**3.670**
April	3.524	83,33	4,17	**3.612**
May	3.752	83,33	4,17	**3.840**
June	3.637	83,33	4,17	**3.725**
July	4.059	85,33	4,17	**4.148**
August	4.410	85,33	4,17	**4.499**
September	4.519	85,33	4,17	**4.608**
October	4.602	83,33	4,17	**4.689**
November	4.674	83,33	4,17	**4.761**
December	4.431	83,33	4,17	**4.518**
TOTAL	**49.240**	**1.000**	**50**	**50.290**

(Source: PT.BIB)

Previous studies in the field of heavy equipment selection for mining operations have focused on various approaches to optimize equipment performance and operational efficiency. A study by Abbas et al. (2018) analyzed the selection of mining trucks using Multi-Criteria Decision Analysis (MCDA) methods, emphasizing capacity, maintenance, and operational costs as key criteria. However, the study did not incorporate a detailed cost evaluation through Life Cycle Cost (LCC) analysis, which limits the understanding of the long-term financial implications of truck selection. Additionally, Abbas et al. (2018) mainly considered truck specifications without examining how the truck's operational cost directly affects overall profitability in large-scale mining operations, which is a crucial factor in the context of BIB's future production needs.

In another study, Zhao et al. (2020) explored the use of the Analytical Hierarchy Process (AHP) in selecting mining equipment, focusing on qualitative criteria such as reliability, manufacturer reputation, and safety features. While the study effectively used AHP to compare different truck options, it failed to integrate financial aspects such as LCC or Benefit-Cost Ratio (BCR) into the decision-making process. This gap is significant for companies like BIB, where the selection of equipment must not only be based on technical specifications but also on long-term financial viability and the ability to meet ambitious production targets.

The study aims to evaluate and select the most suitable hauling truck for PT Borneo Indobara (BIB) to meet its increased production targets by 2025. By using AHP and LCC analysis, the study aims to provide a clear comparison

of three truck options—Mercedes-Benz Arocs 4845K, FAW HD420DT, and Scania P460 LA—considering both operational and financial factors. The benefits of this research include enabling BIB to make an informed decision on truck replacement, ensuring that the company can achieve its production goals of over 50 million tons of coal annually while optimizing costs. Additionally, the study provides insights that can be applied to other mining companies facing similar challenges in heavy equipment selection and capacity planning.

RESEARCH METHOD

This study is limited to the KG pit, where the majority of the company's coal production comes from. The KG pit itself is divided into three locations, each associated with a specific ROM: KG Barat with ROM A3, KG Utara with ROM A1, and KG Bawah with ROM B.

The research design for this study is explained in Figure 3 below. The study begins with stakeholder analysis, where stakeholders and problem owners of the business issue are identified. Stakeholders are then differentiated by their power and interest related to the business issue. After stakeholder analysis, root cause analysis follows. This study uses the current reality tree as a tool. Inputs are UDEs (undesirable effects) collected from problem owners, and the output is the root cause of the business issue.

After the root cause is identified, the study provides several alternative solutions. A list of alternative solutions becomes the input for the next step, which is decision-making. The Benefit-Cost Ratio (BCR) is chosen as the tool for deciding which alternative solution is best for the company. To carry out the Benefit-Cost Ratio analysis, this study will use two other tools: AHP and LCC. AHP is used to calculate the equivalent value of the benefits of each alternative solution, and LCC is used to calculate the equivalent value of the cost.

After an alternative solution is selected, the next step is to build a transition plan. Three important pieces of information serve as input for this process: the company's production plan, constraints for the transition, and timing. The available production plan covers the 2025 to 2030 period. The basis for determining constraints is the concerns of the problem owners and the literature review. Concerns from problem owners are considered to ensure that the transition plan does not cause new problems, while the literature review provides information on the timing of the transition plan.

The transition plan is then tested: Is the transition plan able to address the business issues directly? If not, additional adjustments will be made to the transition plan. This study will provide information about the duration and impact of these adjustments.

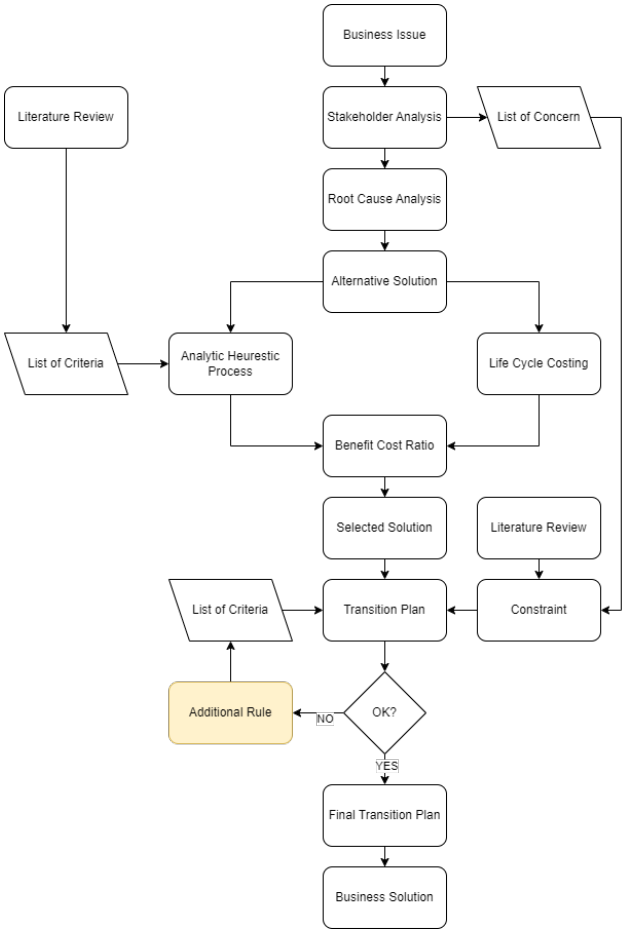

Figure 3 Research Design

Data used in this research is divided into two, primary data and secondary data. Primary data is obtained by author directly through interviews or discussions with stakeholders, problem owners or competent persons. Secondary data is data author doesn't create or collect directly. Figure 4 show which primary and secondary data collected.

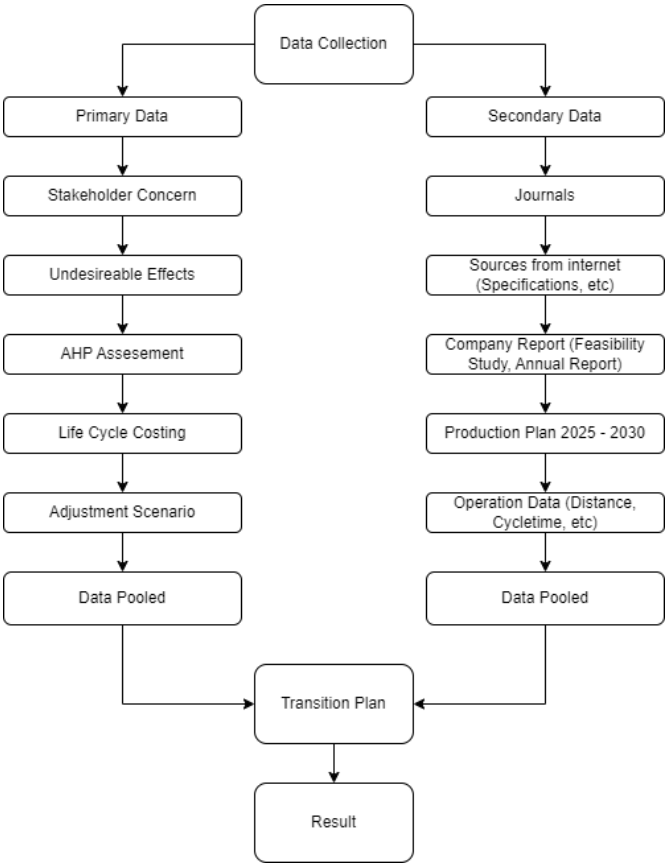

Figure 4 Data Collection Method
(Source : Author Analysis)

RESULT AND DISCUSSION

Teng et al. (2017) said that stakeholders are significant due to the complex interactions and dependencies among entities such as developers, suppliers, contractors, manufacturers, designers, public authorities, and end users. According to Project Management Institute (2017) in Project Management Body of Knowledge (PMBOK), stakeholder management involves identifying stakeholders, analyzing their expectations and impacts, and developing strategies to manage them effectively. Hu et al. (2019) said that effective stakeholder management is essential for enhancing the likelihood of project success. This study identified 8 stakeholders shown by Table 2 below.

Problem owner is a specific stakeholders who has the primary responsibility for identifying, defining, and solving a particular problem. From 8 stakeholders, this study identified 4 problem owners which are BU Head, CLORM Div Head, Hauling Dept Head and RM Dept Head.

Table 2 Stakeholder Analysis

No	Stakeholder	Interest	Power	Concern
1	BU Head	5,45	10,00	Production Quarterly No Incident Low Cost
2	CLORM Div Head	6,97	8,00	Production Monthly No Incident Less Truck used
3	Hauling Dept Head	10,00	6,00	Production Monthly No Incident Less Truck Used
4	RM Dept Head	7,58	6,00	Production Monthly Good Road Condition Less Truck Used
5	HSE Div Head	4,55	7,00	No Incident Less Violations
6	HSE Ops Dept Head	4,55	5,00	No Incident Less Violations
7	Hauling Contractor	9,09	4,00	Production Monthly No Incident
8	RM Contractor	3,03	4,00	Production Monthly Less Truck Used

(Source : Author Analysis)

When asked about business issue faced by BIB, stakeholders mention two UDEs which are :

a. Hauling activities are not smooth, there are piles / queues in several locations
b. Hauling road conditions are damaged

And from UDEs above, this study made current reality tree (CRT) to find the root cause of business issue. Current reality tree show in Figure 5.

Based on the company's current reality tree in there are five root cause for the business issue faced by the company which area use small truck capacity, PPKH constraint, large work area, increased production and hauling a community empowerment effort. From this five, this study will focus on the use of small truck because other root cause are something that outside of problem owners control therefore the proposed solution is to replace existing 20-ton capacity truck with larger capacity truck.

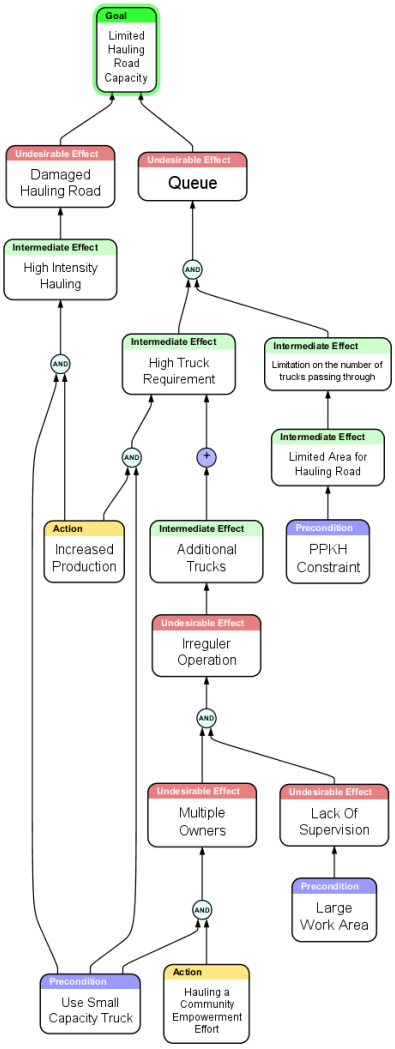

Figure 5 Company Current Reality Tree
(Source : Author Analysis)

The identification of alternative solution for larger capacity truck resulted in three options, namely:

1. Mercedez Benz series 4845K with a capacity of 40 tons (hereinafter written as MERCY). Mercedez-Benz is a guarantee for reliability in addition to its capacity that has met the company's requirements, however this reliability also comes at a considerable cost.
2. FAW series HD420DT with a capacity of 40 tons (hereinafter written as FAW). The development of heavy equipment from China with competitive prices is increasingly rapid. However, the stigma of China equipment being unreliable still remains. The selection of FAW to represent the contrasting conditions of MERCY as well as meeting capacity requirements.

3. Scania P460 LA with a capacity of 80 tons (hereinafter written as SCANIA). SCANIA is a representative for trucks with a prime mover model which is different from MERCY and FAW which are rigid truck models.

This study use Gransberg et al. (2006) and Jesus, et al (2020) study to determined criteria for AHP. Gransberg et al. (2006) convey six factors for selecting heavy equipment which are match to existing activity, availability, condition of work area, productivity, cost effectiveness and versatility. Jesus, et al (2020) convey top 5 criteria widely used for truck selection which are cost, capacity, maintenance, speed and vehicle specifications. Because cost generally restricting other factor, criteria used for AHP are capacity, maintenance, speed and vehicle specifications. Cost criteria will be used in LCC.

Capacity and speed represent desired productivity factor. Higher productivity achieve with higher capacity truck and lower cycle time. Maintenance represent availability factor, because availability convert productivity into production. Maintenance criteria will see the ease of implementing truck maintenance including support from truck distributors, better maintenance lead to higher availability. Vehicle specifications criteria used to match truck with existing activity factor. This criteria divided into two sub-criteria, namely dumping type to match truck with existing activity in port and horse power per ton to match truck with existing condition of hauling road. Detail specification of alternative option collected and present in Table 3.

Table 3 Specifications Detail

Specification	Mercedes-Benz Arocs 4845K	FAW HD420DT	Scania P460 LA
Model	Arocs 4845K 8x4	HD420DT	Scania P460 LA 6x4
Distributor	Star Wagen Indonesia	Gaya Mobil Makmur	United Tractor
Estimated Price (IDR)	IDR 3,450,000,000	IDR 1,464,500,000	IDR 3,600,000,000
Payload Capacity (Approx.)	40 tons	40 tons	80 tons
Average Loaded Speed	35 km/h	35 km/h	30 km/h
Dumping Type	End Dump	End Dump	Side Dump
Engine Power per Ton Capacity (HP/ton)	11.23 HP/ton	10.5 HP/ton	5.75 HP/ton
Picture			

This study forms a hierarchical structure from data on Table 3 and presented in Figure 6.

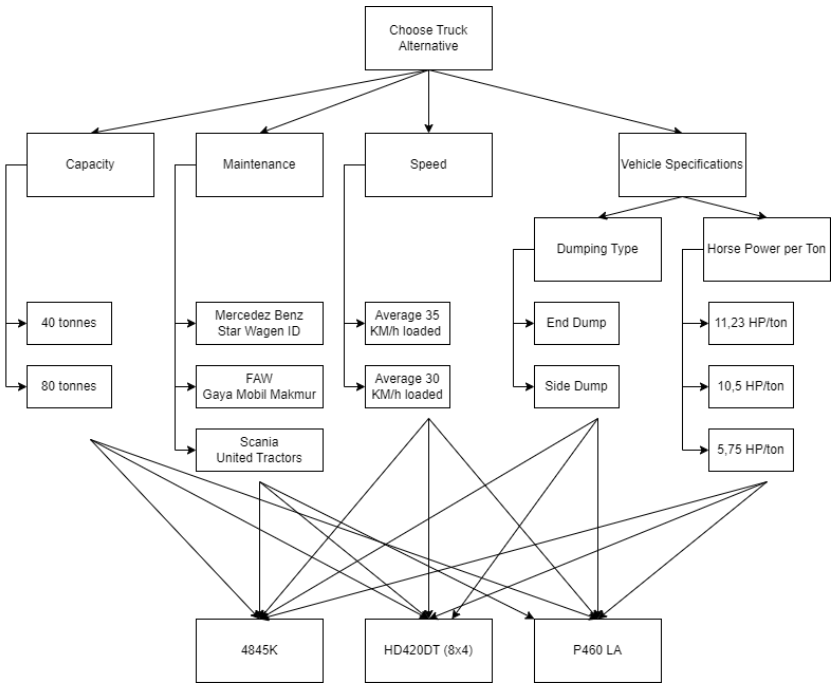

Figure 6 Hierarchy Of Decision
(Source : Author Analysis)

AHP assessment carried out by Problem Owners for criteria's and alternative option. Each problem owner will influence final result where weight of influence calculated from the normalization of the multiplication of Interest and Power as stated in Table 2. Weight of influence for each problem owners presented in Table 4.

Table 4 Weight Of Problem Owner On AHP Results

No	Position	Interest	Power	Interest * Power	**Normalize**
1	BU Head	5,45	10,00	54,55	**25%**
2	CLORM Div Head	6,97	8,00	55,76	**26%**
3	ROM & Hauling Dept Head	10,00	6,00	60,00	**28%**
4	RM Dept Head	7,58	6,00	45,45	**21%**
				215,76	**100%**

Final result of AHP assessment from problem owners of criteria's and alternative option presented on Table 5.

Table 5 Result of AHP

Criteria	BU Head	CLORM Div Head	ROM & Hauling Dept Head	RM Dept Head	Priority	Final Result
Capacity	42%	46%	24%	46%	25%	39%
Maintenance	15%	34%	33%	31%	26%	28%
Speed	12%	14%	19%	17%	28%	16%
Vehicle Spec	30%	7%	24%	6%	21%	17%
Alternative Option	**BU Head**	**CLORM Div Head**	**ROM & Hauling Dept Head**	**RM Dept Head**	**Priority**	**Final Result**
MERCY	40%	60%	59%	67%	25%	56%
FAW	36%	57%	74%	61%	**26%**	**57%**
SCANIA	48%	28%	14%	22%	28%	28%

For problem owners, capacity and maintenance are the most important criteria to selecting truck, accordance to Jesus, et al (2020) study. But problem owners assess vehicle specification more important than speed different from study because there is speed limitation in mining area. From Table 5 above, it show that FAW have the highest benefit according to problem owners at 57% , slightly better than MERCY at 56% and SCANIA at 28%.

This study then conducting Life Cycle Cost assessment to assess equivalent cost of each alternative option. Discussion then conducted with competent person which are truck distributors and ROM & Hauling Dept Head. Result of discussion summarized into Table 6 where total cost present on IDR/hr denomination. To ensure balanced comparison, total cost needs to be converted into a total production cost using equation from Jrade, Markiz, & Albelwi (2012) where :

$$Total\ unit\ production\ cost = \frac{Total\ Cost}{Productivity}$$

Because company have three loading location or ROM, this study need to determined which location will be used for reference. Lowest productivity will be used as reference. This study then conducting productivity of each loading location for each alternative option. From the calculation, lowest productivity occurs in ROM B therefore ROM B productivity will be used to calculated total unit production cost. Result of productivity calculation presented on Figure 7.

Table 6 Life Cycle Cost Of Options

A	**Detail Truck**				
1.	Distributor		Star Wagen Indonesia	Gaya Mobil Makmur	United Tractors
2.	Brand		Mercedez Benz	FAW	Scania
3.	Model		Arocs 4845K	HD420DT	P460LA
4.	Capacity		40 tons	40 tons	80 tons
B	**Owning cost**	**IDR/ hr**	**168.051**	**97.026**	**154.234**
1.	Purchasing Price	IDR	3.450.000.000	1.464.500.000	3.600.000.000
	Tire cost	IDR	74.400.000	74.400.000	169.000.000
	Purchasing Price - Tire Cost	IDR	3.375.600.000	1.390.100.000	3.431.000.000
	Trade in value	%	15%	0%	15%
	Economic lifetime	year	4,00	3,27	5,45
	Est. annual work hours	hour	5.500	5.500	5.500
2.	Depreciation Cost	IDR/ hr	130.421	77.228	97.212
3.	Annual interest rate	%	8,0%	11,0%	13,0%
	Annual insurance rate	%	1,0%	1,0%	1,0%
	Interest & Insurance	IDR/ hr	37.630	19.798	57.022
C	**Operating cost**	**IDR/ hr**	**409.752**	**407.077**	**638.317**
1.	Fuel cost	IDR/ hr	240.000	270.000	345.000
	Fuel consumption	l / hr	16,00	18,00	23,00
	Fuel price	Rp./ l	15.000	15.000	15.000
2.	Repair & Maintenance	IDR/ hr	92.552	59.877	185.717
3.	Tire cost	IDR/ hr	37.200	37.200	67.600
	Tire life time	hr	2.000	2.000	2.500
4.	Operator Wage	IDR/ hr	40.000	40.000	40.000
D	**Total Owning & Operating cost**	**IDR/ hr**	**577.803**	**504.103**	**792.551**
E	**Total Owning & Operating cost + 15%**	**IDR/ hr**	**664.474**	**579.718**	**911.433**
F	**Analysis**				

A	**Detail Truck**				
1.	Percentage Owning Cost	%	29%	19%	19%
2.	Percentage Operating Cost	%	71%	81%	81%

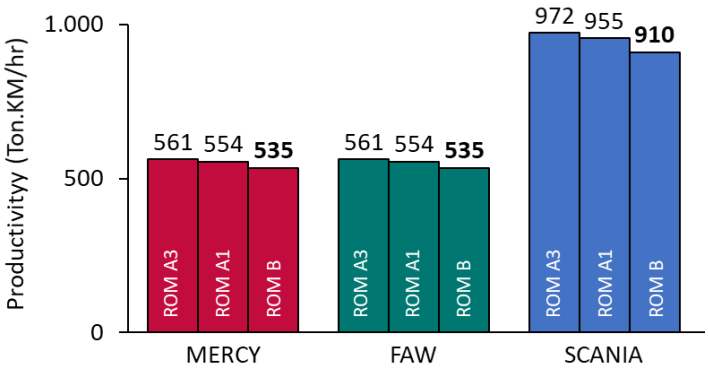

Figure 7 Productivity Of Alternative Solution for Each ROM

Total unit production cost then calculated and result present on Figure 8. MERCY show highest total unit production cost at 1,244 IDR/ton.KM followed by FAW at 1,085 IDR/ton.KM and SCANIA at and 1,002 IDR/ton.KM.

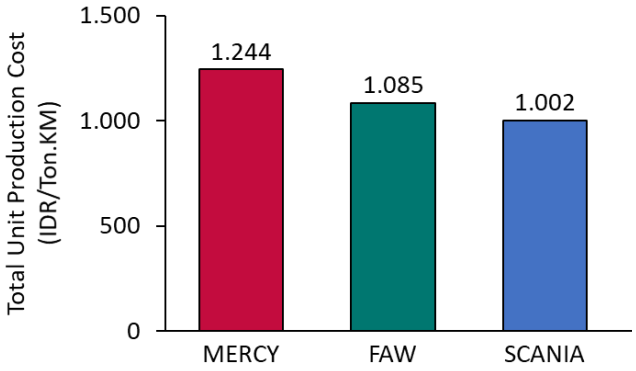

Figure 8 Total Unit Production Cost

This study then calculate benefit cost ratio with data from Table 5 represent benefit and Figure 8 represent cost. Alternative solution with the highest benefit cost ratio is FAW therefore FAW is the truck choose to replace existing truck. The results of the benefit cost ratio are presented in Figure 9.

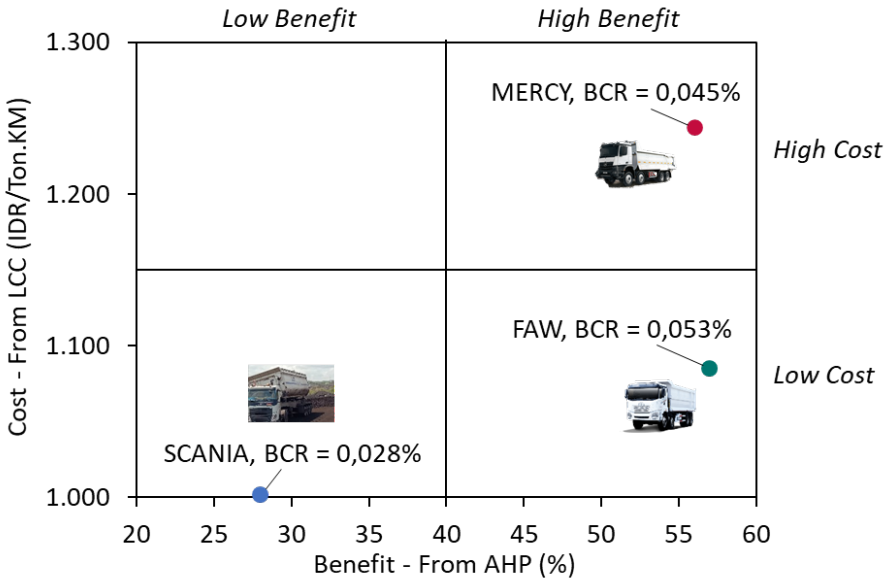

Figure 9 Benefit Cost Ratio Analysis

Company choose to replace existing truck with FAW to overcome business issue. Next, a transition plan needs to be created. Transition plan will give information how much truck population for each type each time needed to meet production plan and overcome business issue. This study then collected population for existing truck as baseline, where majority of existing truck are manufactured in 2022, 2019 and 2023. Data present on Figure 10.

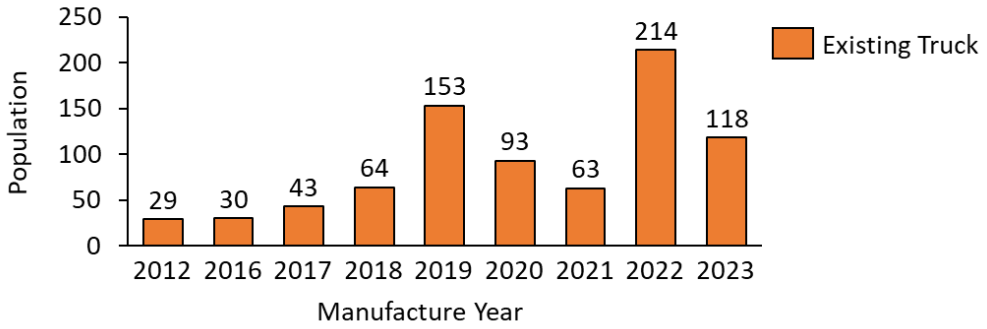

Figure 10 Existing Population of Truck

Using economic life of existing truck at 4,5 years since manufactured, this study then calculated remaining existing truck each year from 2023 until end of 2030. Result of calculation presented on Figure 11. Existing truck will be finished completely on June 2028.

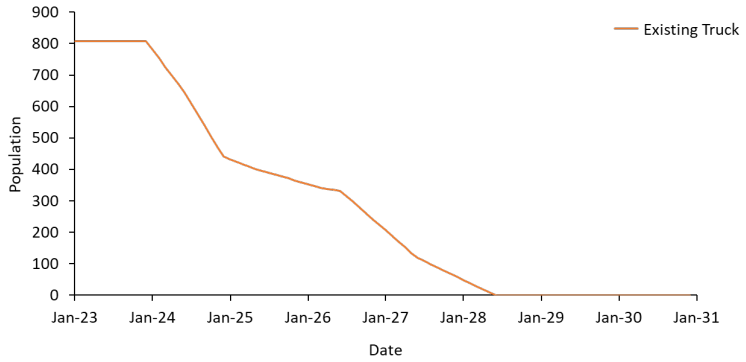

Figure 11 Remaining existing truck in 2023 until 2030

This study then collected company production plan on a monthly basis as a basis for calculating the FAW population needed to meet the production target. Because this study will be limited to the KG pit area so that the production plan used in the transition plan is 49.24 million tons (2025) increasing to 51.8 million tons (2026) continuing to increase to 53.95 million tons (2027-2028) and reach its highest level in 2029 and 2030 with a production of 54 million tons. Figure 12 show company production plan for 2025 – 2030.

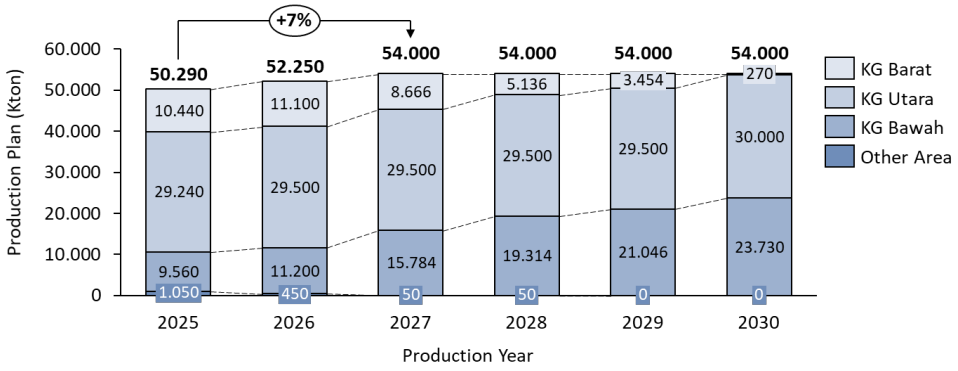

Figure 12 BIB Coal Production Plan 2025 – 2030

With data from Figure 11 and Figure 12, number FAW population needed to meet production plan calculated using formula below.

$$P = 24 \times n \times PA \times UA \times Pty$$ (Source : Komatsu Ltd., 2019)

Where :

P = Production (tons or bcm)

24 = Refer to 24 hours in a day. For monthly basis calculation, the number of reference days is 28 days.

N = Number of equipment

PA = Physical availability is percentage of time a heavy equipment is ready for use. Ministerial Decree No. 1827 K states minimum PA 90%.

UA = Utilization availability is percentage of time a heavy equipment is used to operate when ready for use. Ministerial Decree No. 1827 K states minimum UA 75%.

Pty = Productivity, production in one unit of time (tons/hour or bcm/hour)

Before production from Figure 12 used in calculation, it need to multiply with each respective distance to port. This is to match production with productivity denomination in Ton.KM/hr. Distance for each location to port presented in Table 7

Table 7 ROM Distance To Port

No	ROM	ROM Pit / Mining Area	Distance (KM)
1	A3	KG Barat	33,371
2	A1	KG Utara	27,290
3	B	KG Bawah	18,166

FAW population to meet monthly production targets in 2025 – 2030 appears to be unstable. It is necessary to rationalize FAW population, as it is not feasible to reduce number of trucks in the following month after they have been increased in a certain month. Results of rationalization for FAW population summarized in Figure 13. FAW population reached peak population of 495 units on August 2028 before declining to 436 units on December 2030.

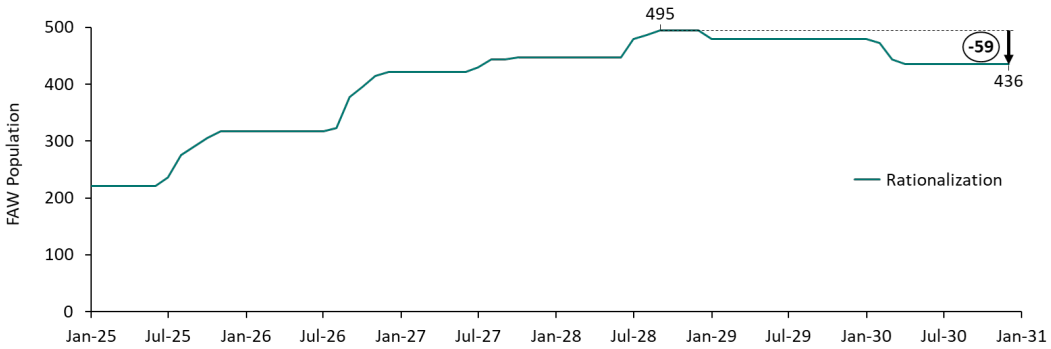

Figure 13 FAW Population to meet Production Plan

After FAW population calculated, this study performed further calculations to determine actual hauling road capacity. It is appeared that hauling road capacity of hauling road Phase 2A exceed its limit from 2025 until 2026. From discussion with company management, company have

opportunity to use third party hauling road for hauling activity from ROM B which will ease burden on hauling road Phase 2A. Further analysis show that, company need to directed 35 unit truck to third party hauling road. To minimize additional cost for company because the use of third party hauling road, all 35 trucks that directed to third party hauling road will be existing truck. Figure 14 show hauling road capacity calculation of Phase 2 for 2025 until 2030.

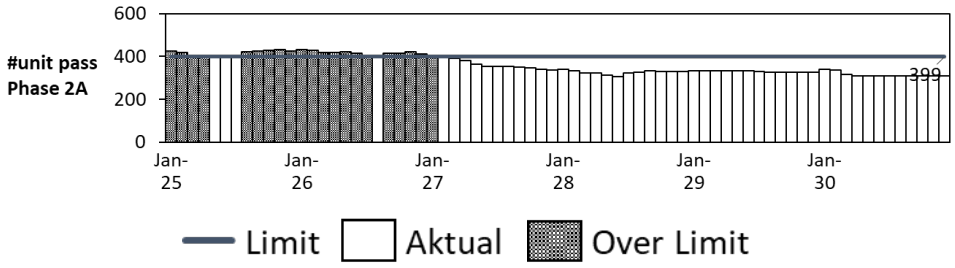

Figure 14 Phase 2 hauling road capacity

CONCLUSION

The root cause of the company's business issue is the use of small-capacity trucks, which limits the hauling road capacity to approximately 4.3 million tons per month. To overcome this limitation, the company has decided to replace the existing trucks with 40-ton capacity trucks, specifically selecting the FAW model over MERCEDES-BENZ and SCANIA. FAW was chosen due to its highest Benefit-Cost Ratio (BCR) of 0.053%, compared to 0.045% for MERCEDES-BENZ and 0.028% for SCANIA. To meet the production targets and address the hauling road capacity constraints, the company needs to implement a transition plan, which includes managing the population of existing and FAW trucks over time, as shown in Figure 15, and directing 35 existing trucks to third-party hauling roads from 2025 to 2026. Suggestions for further improvement include optimizing the transition plan by gradually phasing in the new trucks while monitoring their performance, ensuring a balance between existing and new trucks to avoid overloading third-party roads. Additionally, the company could explore technological solutions like fleet management systems to track truck performance and optimize the route planning process. Engaging in partnerships with third-party hauling road providers early on will also ensure smoother operations and reduce potential bottlenecks during the transition period.

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