

## STRATEGY TO REDUCE COAL HAULING CYCLE TIME TO INCREASE THE PRODUCTIVITY IN PT ADARO INDONESIA

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### **Keywords :**

Coal hauling,  
Cycle time,  
Hauling road,  
Shift change,  
Trailer.

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### **Abstract**

*PT Adaro Indonesia (AI) is one of the largest thermal coal producers in Indonesia with production of around 40-50 million tons per year. AI's mine business processes are managing mining production operations and selling to customers. To transport coal from production sites to sales points, AI travels by land and river. This paper will focus on transportation by land. Land coal transportation is carried out from the Stockpile/ROM (run-of-mine) to the Barito River Port in Kelanis Dedicated Coal Terminal using a coal trailer with capacity of 140-ton through dedicated hauling road along 86 km. one coal hauling cycle takes approximately five hours. It includes loading time in the stockpile, hauling time, weighing time on the weighing bridge and dumping time at Kelanis, then back to the Stockpile. In the period of January – April 2022, the average hauling cycle time is 5 hours 14 minutes which means exceeding the agreed time at the beginning of the year which was 5 hours. This has an impact on the non-achievement of sales target in the period that ultimately has an impact on not achieving the company's revenue target. The focus on this research is to analyze the root cause of the non-achievement of cycle time targets on the dedicated hauling road and will identify the solutions to improve the conditions. The methods used are quantitative and qualitative to obtain data and information from various company stakeholders. The root cause of the problem is identified based on the data then validated based on the results of interviews and literature studies. The problems concluded from this study are transportation time and weighing time. The hauling time is affected by the average travel speed of the trailer, while the weighing time is affected by the change shift of trailer operator. Therefore, we recommended solution to increase the average travel speed of the trailers based on the root cause analysis is to increase road maintenance, while to reduce weighing time is to reschedule the number trailer operator shifts.*

## **INTRODUCTION**

Coal that has been a primary energy source for more than a century, is the oldest and one of the most important energies in the world. Coal is burned to produce electricity, heat, and used for industrial purposes. According to the International Energy Agency (2022) Coal is both the largest source of electricity generation and the largest single source of CO<sub>2</sub> emissions, creating a unique challenge in transitioning to low-carbon energy systems.

United Nations (2021) The UN Climate Change Conference in Glasgow (COP26) brought together 120 world leaders and over 40,000 registered participants, including 22,274 party delegates, 14,124 observers and 3,886 media representatives. Countries ultimately agreed to a provision calling for a phase-down of coal power and a phase-out of “inefficient” fossil fuel subsidies – two key issues that had never been explicitly mentioned in decisions of UN climate talks before, despite coal, oil and gas being the main drivers of global warming.

IEA (2022) One year on from Russia’s invasion of Ukraine, the global energy landscape has changed dramatically. It had caused the global energy crisis; natural gas is particularly expensive due to the Russian cutting supplies; resulting in higher prices are supporting coal-based power generation worldwide. Moreover, the world’s dependence on fossil fuel consumption, including the price and resource volatility that entails, has come into sharp focus.

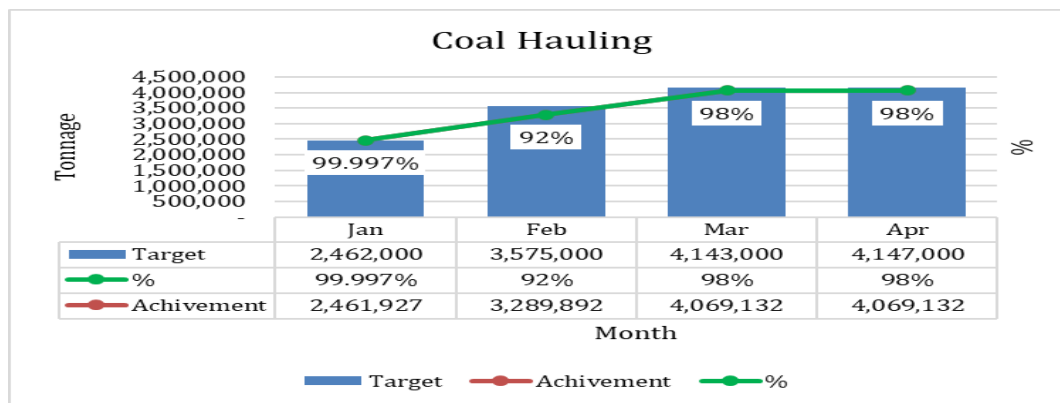
IEA (2021), Indonesia is a resource-rich nation that is the world’s fourth-largest producer of coal and Southeast Asia’s biggest gas supplier. The country is the largest producer of biofuels worldwide and it is scaling up efforts to exploit its renewable energy potential. The Ministry of Energy and Mineral Resources Indonesia (2022) informed that the majority energy for power plants in Indonesia still from coal which is 67.71% in 2022. Looking at the trend, the energy for coal-fired power plants is increasing every year.

PT Adaro Indonesia (AI) is a coal mining company operating in Tanjung South Kalimantan, Indonesia since 1992 initially under Coal Cooperation Agreement (CCA) that has received a Special Mining Business Permit (Izin Usaha Pertambangan Khusus or IUPK) for the Continuation of Contract/Agreement Operation dated 13 September 2022. In line with Adaro’s

mission to maximize shareholder value, Management has the objective to maximize profitability and productivity. This can be achieved if the target of coal hauling is met. Therefore, the writer will explore how to increase the productivity of coal hauling.

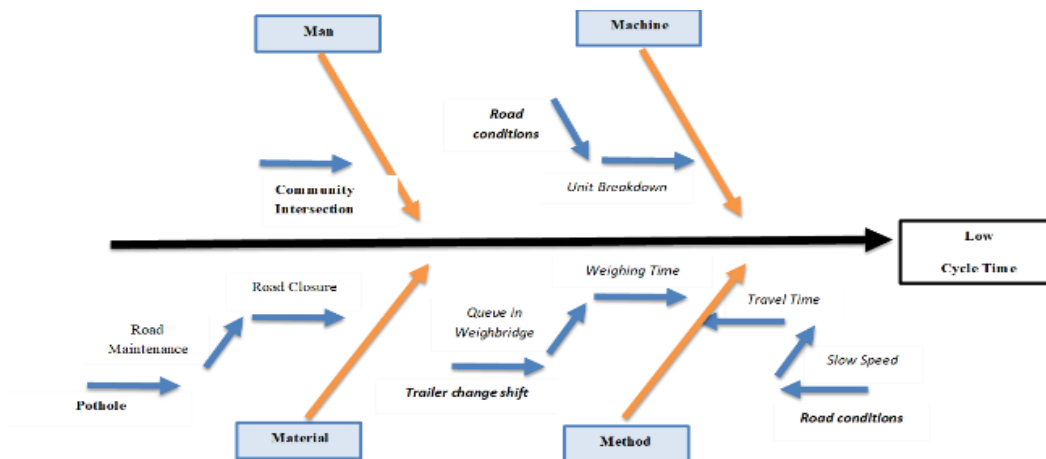
Based on the AI's monthly report, we highlight that Coal Hauling performance in January-April 2022 did not achieve the target.

**Table 1. Coal Hauling Performance**



Source: PT Adaro Indonesia internal data, 2022

We use Fishbone Diagram to explore and clarify the root cause problem of Low Cycle time. We find that Road Conditions, Pothole, Community Intersection and Operator Trailer Change Shift are the root cause of the problem.



**Figure 1. Fishbone Diagram**

We strengthen the fishbone diagram to find the root cause by delivering the questionnaire to the trailer operator to find the problem in the hauling road, and delivering it into the Pareto Chart below:

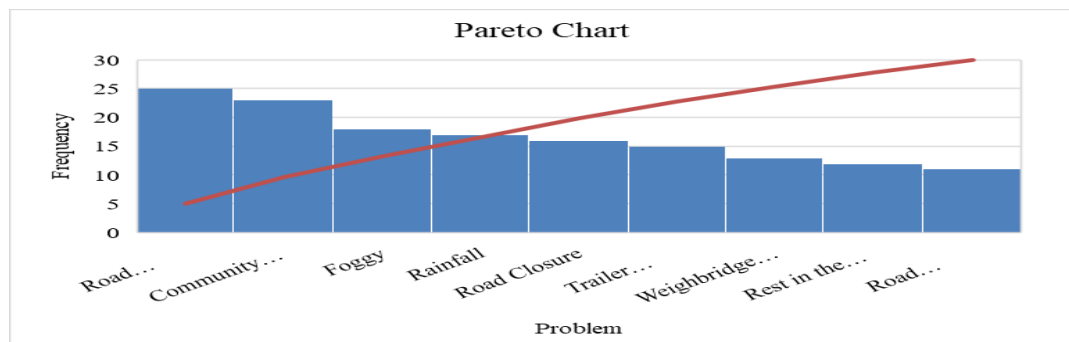


Figure 2. Pareto Diagram

According to pareto analysis above, there are two main problems (vital few) based on the questionnaire distributed to 25 operator trailers, 100% mentioned that road condition is the main problem (vital few) while 92% (23 people) mentioned that community intersection is the second main problem. From the exploration above we conclude that the low cycle time is because of Road Conditions, Community Intersection and Trailer Change Shift. Community Intersection is the intersection of Adaro Dedicated Hauling Road to the Community Road. Since Adaro holds the IUPK for the Continuation of Contract/Agreement Operations from the Government, it is by law that Adaro should give priority to the community to pass the road. Therefore, we will focus on Road Conditions and Trailer Change Shift.

## RESEARCH METHOD

This paper is conducted using Mixed-Method in evaluating Coal Supply Chain Model. It is an approach to inquiry that is both qualitative and quantitative form of research. The types of research designs are descriptive that gathering, analyze and presenting collecting data.

### Data Collection Methods

The quantitative research from data collection consists of primary data and secondary data. The primary data from the company internal report consists of coal hauling performance, trailer cycle time, trailer travel speed, trailer weighing time and road condition index. Coal hauling performance measured by the tonnage dumping in the Kelanis hopper, the trailer cycle time measured by GPS, the trailer travel speed measured by the RFID and the road condition index by

daily human reporting on the road measured in certain scoring criteria. The secondary data are industry analysis using Porter 5 Forces and SWOT Analysis of the Company. The qualitative research gathered by interview the management and contractor, conducted at the Job Site Office in Tanjung South Kalimantan in April 2023. The author used notes as an instrument in the study.

### Coal Hauling Performance

We highlighted that the Coal Hauling achievement in January – April 2022 did not achieve the target as written in the symptom above.

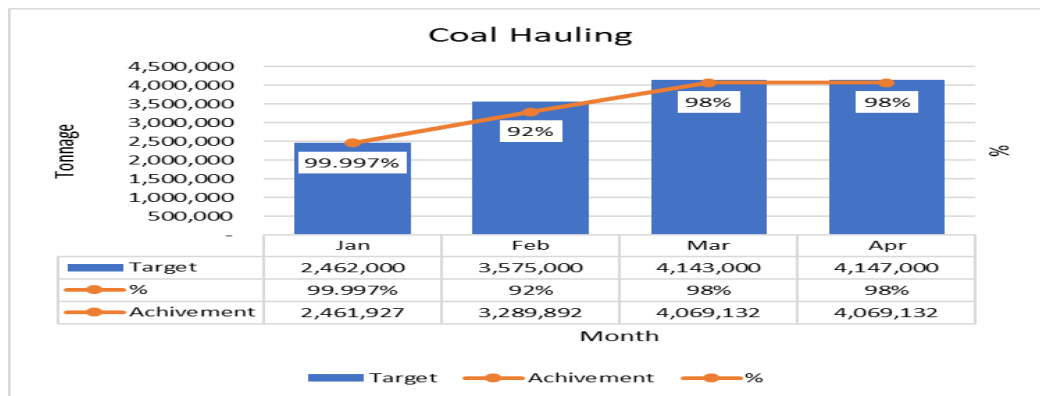


Figure 3. Coal Hauling Performance

We can see from the figure above that the coal hauling performance did not achieve the target, therefore there is inventory in the stockpile with the total of 216,931.11 Mt in total Jan – April 2022.

Descriptions	UOM	2022				Total Inventory
		Jan	Feb	Mar	Apr	
Coal Poduction	Mt	5,372,927.11	6,681,892.00	7,839,132.00	8,540,063.00	
Coal Hauling	Mt	4,923,927.00	6,864,892.00	8,212,132.00	8,216,132.00	
Inventory	Mt	449,000.11	(183,000.00)	(373,000.00)	323,931.00	216,931.11

Figure 4. Inventory

### Trailer Cycle Time Data

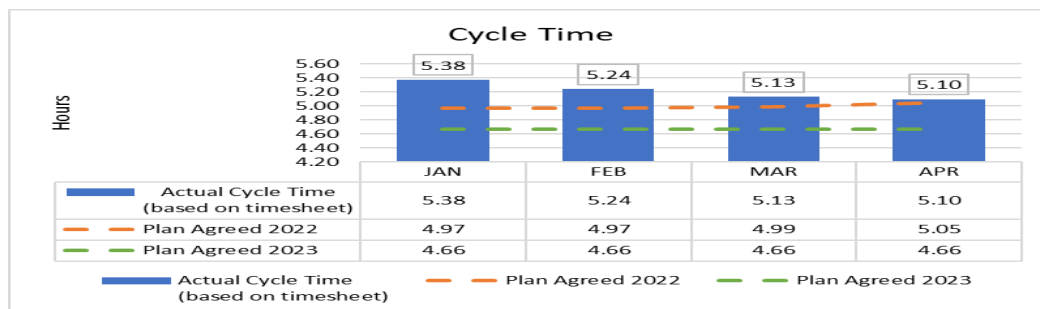


Figure 5. Trailer Cycle Time

From the figure above we can see that there is gap between achievement and agreed parameter every month.

### Trailer Weighing Time

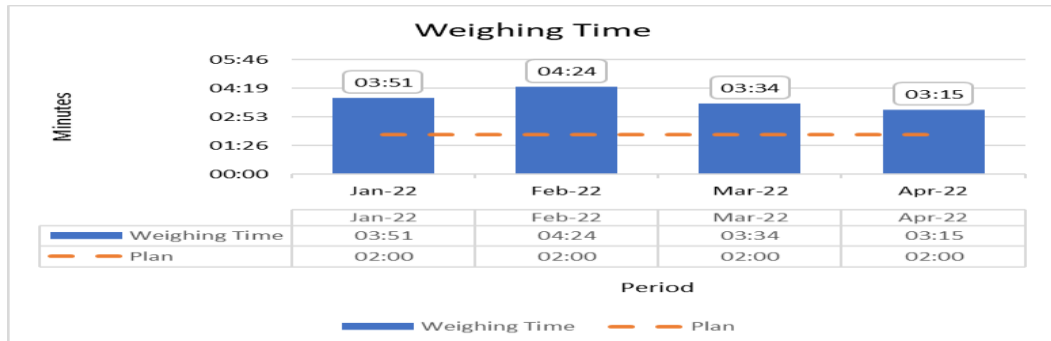


Figure 6. Trailer Weighing Time

We can see from the graphic above that with the target of 02:00, the achievement every month is above the target weighing. The highest was 04:24 in February 2022, so there is always a gap between actual weighing time and plan.

### Trailer Travel Speed Data

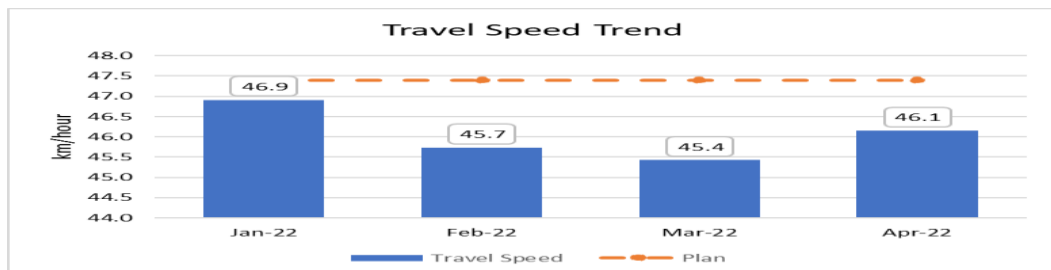
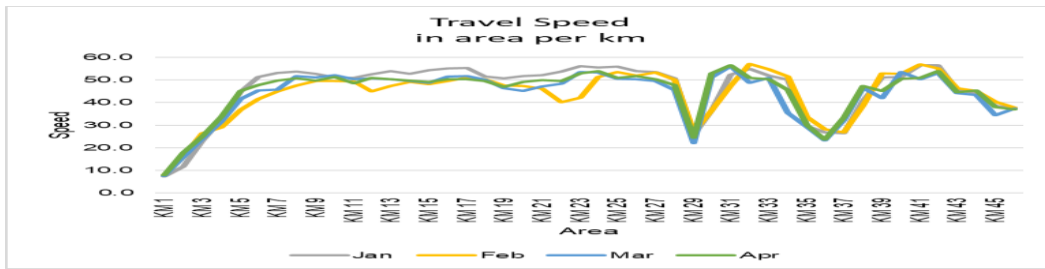


Figure 7. Trailer Travel Speed

We can see from figure above that there is a gap between the travel speed and target. Average travel speed in the whole month between January – April 2022 is below the agreed parameter target. The slowest travel speed was in March, that is 45.4 km/hours when the target is 47.5 km/ hours.

### Trailer Travel Speed in area per km



**Figure 8. Trailer Travel Speed**

We can see from figure above that the slowest speed in km 27-29, km 35-37 and km 45. We also can see that in km 1 – 7 the travel speed is considered low. 0 km located in Kelanis Dedicated Terminal.

**Road Condition Index**

Month	Index RCI	
	2022	
	CS	NCS
January	3,23	3,04
February	3,19	3,03
March	3,18	2,99
April (Mid)	3,13	2,99
April (End)	3,18	2,97

**Figure 9. Road Condition Index**

Note:

CS = Chip Seal area contains chip seal, aggregate base A & B and topsoil.

NCS = Non-Chip Seal area contains topsoil land only.

From the table above, we can see that the Road Condition Index in January and February 2022 both for Chipseal and Non-Chip Seal area are green (good) while in March – April is yellow in Non-Chip Seal Road.

The Scoring criteria for the table as below:

**Table 2. RCI Scoring Criteria**

Score	Chipseal assessment criteria	Non chipseal assessment criteria
4	Surface layer in a good condition (no undulation and loose surface aggregate)	
3.5	Surface layer in a good condition (there is some loose surface aggregate)	
3	Aggregate base A ( <i>Lapisan Fondasi Atas/ LFA</i> ) is ready for coating surface finish	Aggregate base A is ready for coating surface finish
	There are <5 pothole with small dimensions of <0.3 square meters	There are <10 pothole with small dimensions of <0.5 square meters
2.5	There is a pothole on the wheel track of the production unit (trailer)	
	There are > 5 potholes with small dimensions <0.3 square meters	There are > 10 potholes with small dimensions <0.5 square meters
	Roads in bumpy or rutting condition	Roads in bumpy or rutting condition
	There is an aggregate surface layer that is loose	
	There is puddle after rain < 1 hour after rain	
2	There is a pothole with medium dimensions (0.3 – 1 square meters)	There is a pothole with medium dimensions (0.5 – 1 square meters)
	There is a layer of geotextile that is peeled off	There is puddle after rain < 1 hour after rain
1.5	There is a pothole with large dimensions (>1 square meters)	There is a pothole with large dimensions (>1 square meters)
	There is area of subsidence	There is area of subsidence
	There is <i>agem</i> material that is not well dense	
	There are patches of <i>agem</i> mounding	

From the table above we can see the assessment of the road conditions is based on the eyes sight of the patrol that compare the day they assess and before. Then the report was given to the Road Maintenance Dept to decide where to be the priority to be maintained the next previous day. From the Scoring Criteria above we can conclude that the non-chip seal road index in March – April 2022 is yellow means that there are > 10 potholes with small dimensions <0.5 square meters and there is puddle after rain < 1 hour after rain.

### Daily report Road Conditions Example

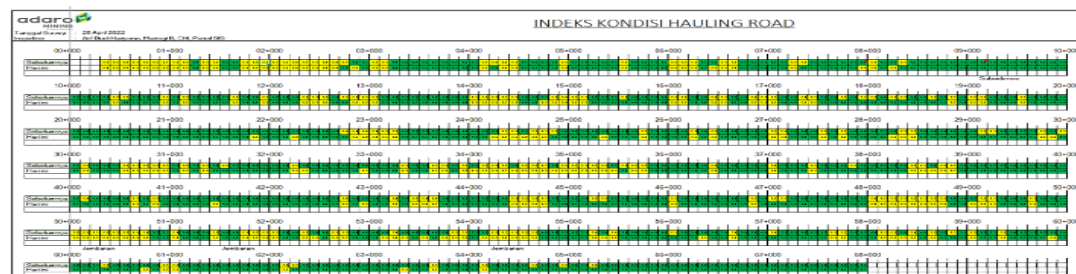
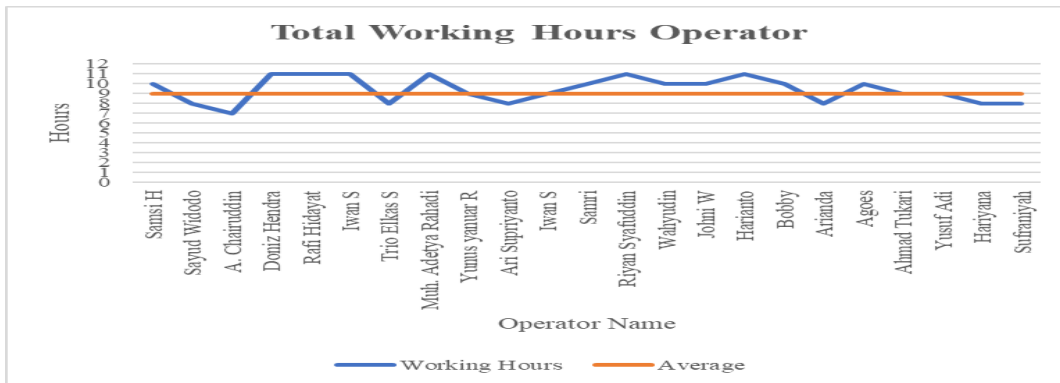


Figure 10. Daily Index Hauling Road

### Operator Change Shift Schedule





**Figure 11. Shifting Schedule**

Based on the figure above, we can see that the longest total working hours is 11 hours while the fastest is 7 hours with the average of 9 hours. It means that there is three hours idle of the trailer unit every shift. We conducts a semi-structured interview with the stakeholder, a data collection method that give them the same theoretical framework, depends on asking questions within predetermined thematic framework, however the question is not set in order or in phrasing, allowing to investigate different aspect of research question. It is summarized as below:

**Coal Hauling Section, Coal Product Assembly Dept**

YY, Coal Hauling Section informed that to count the productivity in mining, we need to calculate:

**Number of unit x productivity x effectivity working hours**

While the productivity is from:

Payload / how many hours it takes to get 1 trip or 1 cycle.

Therefore, we can conclude that the two biggest factors to measure productivity are payload and cycle time. In this case in Adaro, the payload tends to be relatively flat, each trailer loads the same amount of coal, 70 ton per vessel that each trailer has two vessels, so it is 2 x 70 ton = 140 ton or approximately 138 ton per trip. Then the non-constant parameter is the cycle time. He confirmed that there are five components in 1 cycle:

1. Loading time in ROM stockpile
2. Transport/ hauling time from ROM to Kelanis (RTK) – *muatan*
3. When the trailer weighing in weighbridge
4. When the trailer dump in Kelanis

#### 5. When the trailer went back to ROM again – *kosongan*

The average is around 4.5 hours to complete 1 cycle. The biggest component is the hauling time, both *muatan* and *kosongan*. The loading time is relatively short of 13 minutes, weighing time around 5 minutes, dumping also around 5 minutes. So, the hauling time is the biggest factor in this 1 cycle time.

The formula is

$$V = s / t$$

Travel speed = distance divided by the time

The strategies that have been implemented to achieve the hauling target are:

1. Incentive given to the operator trailer that achieves 2 trips per shift. Shift one start at 4:00, 5:00 and 6:00 that will be finish in 16:00, 17:00 and 18:00. So, each shift has 10 hours that includes rest time.
2. Good road condition. In this case working together with the Road Construction and Maintenance Dept. that will be explained after.
3. Reduce the queue process at the weighing bridge by sampling method. Every day, weighbridge passed 1,200 times by approximately 380 trailers. Therefore, there is a long queue after shift change and the longest is about 20 minutes to wait. This is a waste and not efficient. So, Adaro tried to do several actions to control and maintain the risk by doing the draft survey, weighing in motion and sampling method. There is a problem in the draft survey system because we have blending CV tonnage so make it difficult to report to the Ministry. The problem with weight in motion is that the accuracy in the data is still plus minus 4%. In the random sampling, the accuracy rate is 99.98% or an error of 0.02%.

#### **Road Construction & Maintenance Dept**

AS, POH Road Maintenance Head confirms that the main problem of road maintenance is the bad weather. They do the maintenance in the hauling road every day from 6:00 to 18:00. The road inspection is carried out three times a week. The report is based on certain categories and reported in the quantitative above. They evaluated the road condition of yesterday compared to the condition today in each 100 meters along the 100 kilometers hauling road from ROM to Kelanis.

#### **Plant Maintenance Dept**

YM, Plant Maintenance Prime Mover confirms that the main problem of cycle time under agreed parameter is that the external factor: road condition and pothole. That caused tires damage and other components such as shock absorber. BS, Plant Maintenance Vessel confirms that the service period for vessel is in every 30,000 km, 60,000 km, 120,000 km, 240,000 km and 480,000 km when the vessel is in recondition. Prime mover maintenance is in every 72 hours working hours.

## RESULT AND DISCUSSION

From the data gathered, we analyze that the most factor that impact to the non-achievement of coal hauling performance:

The cycle time that consists of travel speed and road conditions, while the weighing time number is small, and they already do the feasibility study of random sampling to reduce the weighing time.

We analyzed the correlation between Road Condition Index and Trailer Travel Speed

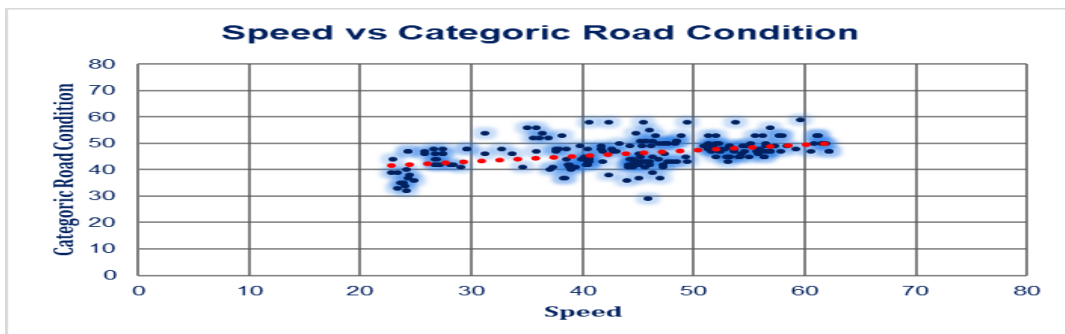


Figure 12. Correlation Analysis

Pairwise Pearson Correlations					
Sample 1	Sample 2	N	Correlation	95% CI for $\rho$	P-Value
Categoric Road Condition	Speed	945	0.602	(0.560, 0.641)	0.000

Area	Correlation ( $\rho$ )	Significant (P-Value)
Km 0 – 43	60%	0.00

r	Correlation Strength
$ r  < 0.3$	Weak
$0.3 \leq  r  < 0.5$	Moderate
$0.5 \leq  r  < 1$	Strong

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The test result is 60% or 0.6 (strong) with the conclusion that accept H1= travel speed has a strong correlation with the Road Condition. Therefore, it is proven that both are key factors of coal hauling productivity. Based on the interview with the stakeholder, we conclude that the two biggest factors to measure productivity are payload and cycle time, and the hauling time is the biggest factor in this 1 cycle time. Because of the formula is below:

$$V = s / t$$

Travel speed = distance divided by the time

As we can see in the correlation result that the travel speed has correlation with the road condition, we conclude that need to improve the road condition by road maintenance. We also find that based on the Time Sheet data, this is the schedule of the operator:

SHIFT	GROUP	Shift Start	Average Time Finish	Shift Finish	Trailer Idle
1	1	04:00	13:00	16:00	3 hours
	2	05:00	14:00	17:00	3 hours
	3	06:00	15:00	18:00	3 hours
2	1	14:00	01:00	04:00	3 hours
	2	15:00	02:00	05:00	3 hours
	3	16:00	03:00	06:00	3 hours

It means that there is 3 hours trailer idle every shift, waiting for the operator from the next shift to come. This is a waste and non-value add activity. Based on the interview with Road Maintenance Head confirms that the main problem of road maintenance is the bad weather. They do the maintenance in the hauling road every day from 6:00 to 18:00. The road inspection is carried out three times a week. The report is based on certain categories and reported in the quantitative above. They evaluated the road condition of yesterday compared to the condition today in each 100 meters along the 100 kilometers hauling road from ROM to Kelanis.

Based on interview with the Plant Maintenance Prime Mover confirms that the main problem of cycle time under agreed parameter is that the external factor: road condition and pothole. That caused tires damage and other components such as shock absorber. BS, Plant Maintenance Vessel confirms that the service period for vessel is in every 30,000 km, 60,000 km, 120,000 km, 240,000 km and

480,000 km when the vessel is in recondition. Prime mover maintenance is in every 72 hours working hours. We conduct external analysis as below:

No	Porters' Five Forces		Analysis
1	Supplier Power	Low	<ul style="list-style-type: none"> <li>- Coal reserves Based on the Minister of Energy and Mineral Resources (ESDM) in July 2021, Indonesia total coal reserves still approximately 38.84 Billion Tons.</li> <li>- Detonator and Fuel supply Minister of Energy and Mineral Resources (ESDM) revealed that oil reserves in Indonesia will be for the next 9.5 years, while explosives for Indonesia PT Amarta Karya (Persero) was established in October 2021 and officially inaugurated by the President on 20 April 2022.</li> </ul>
2	Threat of New Entry	Low	AI is a subsidiary of AEI with subsidiaries vertically integrated businesses in the mining energy sectors, and EGAT International Company Limited (EGATi), which is a subsidiary company of EGAT, a state-owned electricity company of Thailand. The specific product produced by AI make it difficult for new entrants to be able to compete with affordable prices.
3	Buyer Power	High	In the 2Q22, global market conditions are unfavorable to seaborne coal prices. The European Union's (EU) announcement in April to ban Russian coal imports from 10 August 2022 have triggered European buyers to switch away from Russian coal towards alternative high CV material from South Africa and Colombia. Strong imports from India market contribute to increase in sub-bituminous and low-rank coal prices in the quarter as well as a rebound in Indonesian coal exports.
4	Threat of Substitution	High	According to the International Energy Agency, global energy growth is by renewable energy. Advantages of clean energy technologies such as emission hydrogen driven by policy in the United States for clean energy.
5	Competitive Rivalry	High	In late 2022, the International Monetary Fund projected a global economic growth of 2.7% for 2023, slower growth than 3.2% of 2022. The macroeconomic backdrop suggests that global activities will remain tepid and weigh on seaborne demand. An oversupply scenario appears likely.

Based on table above, we can conclude that the threat of substitution and competitive rivalry are high. Therefore, AI must maintain the number of customers and their sustainability. We also conduct SWOT-TOWS analysis as below:

<p><b>WOT - TOWS</b></p>	<p style="text-align: center;"><b>Strength</b></p> <ol style="list-style-type: none"> <li>1. Qualified and reliable mining support by experienced mining other employee with good Adaro</li> <li>2. High quality of coal resource reserves</li> <li>3. Excellence business process 9001:2015, ISO 14001:2004, 45001:2018 and OHSAS 18001:2007</li> <li>4. Fund sufficiency</li> </ol>
	<p style="text-align: center;"><b>S-O Strategies</b></p> <p>S1, S2 – O1, O3                  Securing long-term contract with chip customers. Customers supply security, while AI can ensure sustainability of mining operations the volume certainty under contract.</p>
<p style="text-align: center;"><b>Opportunity</b></p> <p>Ukraine war caused customer return to high coal demand. This results in the higher Average Selling Price.                  Heavy equipment availability by the contractor                  High index of coal price market                  Officially operating under a Special Mining Business License</p>	
<p style="text-align: center;"><b>Threat</b></p> <p>DMO regulations by the government                  High price of fuel or ammonium nitrate/explosive                  Contractor fees ask for increase.                  People demonstration                  Fleet management by BUMA - contractor under target                  Bad weather/ La Nina                  Greener energy requirement                  Export Banned last Jan by the government.</p>	<p style="text-align: center;"><b>S-T Strategies</b></p> <p>S1, S2 – T1, T8                  Continuously strive to maintain a portion for Domestic customer 25% Domestic Market (DMO) to maintain cap price government compliance</p>

From Table above, we find that AI need to ensure the sustainability of mining operations by delivering coal sales to the customer as contracted. Therefore, AI coal hauling is a very important factor of it.

### Business Solution

In order to maintain the company profitability and long-term sustainability, AI must deliver the coal sales to the customer as contracted. Therefore, there are two business solutions for this case based on the analysis above:

- a. Increase the trailer travel speed by improving the coal hauling road construction and maintenance.
- b. Increase the coal hauling productivity by adding 1 (one) shift of coal trailer.

### Implementation Plan & Justification

#### Increase Travel Speed by Improving the Hauling Road

As we know that travel speed is correlated with road conditions, we must improve the road conditions to increase the trailer travel speed. Therefore, we plan several activities based on the root cause below:

Root cause	Improvement Plan	How	Who	When	Where
Lack the maintenance unit	Increase the unit number: grader and vibro-roller	Increase unit maintenance	Wasco – vendor	Every working day	In the plant maintenance area
Chipseal quality	Chipseal upgrading project	Upgrading chipseal in the hauling road	Hauling road team	Dry season	In the specific area segment of hauling road
Working hours	Increase the working hours from 6-17 to 6-18 (when the sun is shining)	Add working overtime schedule and incentives	Hauling road team	Every working day	In the hauling road maintenance area In the hauling road maintenance area
Traffic man team	Expand the chipseal maintenance area so that more people in charge	Increase traffic man shift	Hauling road team		
Pothole road maintenance condition	Speed up the repairment	Increase team from 2 to 4 team	Road maintenance team		
	Increase road maintenance method	Increase evaporation time and maximize using stamper	Road maintenance team		
	Green sign installation in checkpoint after maintenance	Creating green sign	Road maintenance team		
Aggregate supply beyond the planned	Scraping base stockpile to optimize the material needed	Scraping base stockpile	Wasco	Dry season	In the stockpile km 30
Prioritization road maintenance	Adding inspection frequency of RCI	Add inspection team	Hauling road team	Every working day	In the hauling road maintenance area
	Develop application travel speed GPS	Create new application	IT vendor		

### Add Shift Coal Trailer

The trailer operator needs 4.5 hours in 1 cycle to go from stockpile/ROM to Kelanis back and forth. So, he can go 2 cycles in 1 shift with a total of 9 hours working. Their 1 shift is 12 working hours, with a payroll system consisting of 8 hours of work and 3 hours of overtime including break. The coal trailer unit has idle time (parking) in about 3 hours per change shift. Therefore, we can add 1 more shift of 1 cycle to increase productivity.

Currently, the total number of coal trailer operators is 1,200. Their shift is 6:1 means 6 days working 1 day off and 10:2 means 10 weeks working and 2 weeks off. With the total number of coal trailers of 380 per day, it is more than enough to add one more shift to go only 1 cycle between the change shift hours.

NO	Root cause	Improvement Plan	How	Who	When
1	Coal trailer idle	Negotiation Plan	Include the sniper (operator back up) to go 1 cycle during idle trailer	AI with contractor	2 <sup>nd</sup> Semester 2023
2		Add 1 shift of 1 cycle	Manage the number of backup operator trailer to do the shift	backup operator trailer	
3	Manpower		Include the sniper to the payroll system to get regular salary and schedule	HR	

### CONCLUSION AND SUGGESTION

We conclude that the root causes of the non-achievement of hauling road

productivity are cycle time that consist of road condition, trailer travel speed and change shift. The most suitable solutions to increase cycle time by increasing the travel speed that ensuring road conditions are in a good condition, while to increase change shift productivity by add one more shift of one cycle from Stockpile/ROM to Kelanis.

The strategy to increase road conditions is to assure the road conditions are on the green color condition as the scoring criteria that is surface layer of road in a good condition, no undulation and loose surface aggregate. If this is impossible to maintain during wet season, we must make sure that aggregate base A is ready for coating surface finish. We also must ensure that in the chipseal road there are <5 pothole with small dimensions of <0.3 square meters while in non-chipseal area there are <10 pothole with small dimensions of <0.5 square meters.

The strategy to increase shift that to ensure coal hauling operator is healthy, comes and works on time so that they arrive as their shift working schedule. The countermeasure is that the mine permit given only to the operator that get the certification of fit from the doctor after yearly Medical Check Up (MCU) and passed the induction process that ensures they understand the job description and Adaro Zero Accident Mindset (AZAM).

As indicated by its name, AZAM aims to protect all activities and process processes within the operations from workplace accidents, through the implementation which is focused on the measures to build safety mindset, attitude and culture among the workers, which they will practice consistently. This is stated in the Mining Safety Management System (*SMKP*) that developed to control Occupational Health and Safety (OHS) major risk by providing guidelines to identifying hazard and controlling risk in a systematic manner by involving people from the top management level to the workers.

To increase operator commitment, special incentives will be given to operators who achieve the target of 2 cycles per shift and 1 cycle 1 shift in the additional shift as the solution to this business problem. The company also ensures that the roster shift arrangements will be scheduled properly so that all operators get 6:1 means 6 days working days of 8 hours regular plus 3 hours overtime and 1 day off, and 10:2 means that 10 weeks working and 2 weeks off.

Regarding the negotiation, we suggest that the snipper can go for one cycle in the



trailer idle time, in order to increase the productivity of the snipper as well as the coal trailer.

In order to increase the travel speed, we recommend taking some actions regarding community intersections. The purpose of preventive idea so that coal trailer does not need to stop waiting for the people passing by is to build a road bridge or underground road for the community. Thus, the community and coal trailer can pass together at any time without road closures and supervision from Adaro's hauling road security.

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