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Optimizing Operational Efficiency and Productivity of The HD785 Heavy Equipment: Reducing Empty Stop Time (EST) and Increasing Speed Through Fleet Matching at PT PPA'S MIP Site, North Pit (March–October 2025)

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Abstract
This study addresses the critical challenge of optimizing heavy equipment productivity in coal mining operations, particularly focusing on reducing Empty Stop Time (EST) and improving haul truck speed to enhance operational efficiency. At PT Putra Perkasa Abadi (PT PPA) Site MIP, baseline data in March 2025 revealed significant inefficiencies, including high EST (3.5 minutes), low average speed (18.7 km/h), and suboptimal Matching Factor (1.25), resulting in reduced productivity and failure to meet production targets. The objective of this research is to improve fleet performance through a structured Quality Control Circle (QCC) approach using the Plan-Do-Check-Action (PDCA) cycle. The research employed a quantitative and applied methodology utilizing real-time data from the Fleet Management System (FMS), combined with root cause analysis and fleet matching calculations. Improvement interventions included operator coaching systems, updated procedures, dynamic fleet matching, haul road maintenance, and infrastructure enhancement. The results demonstrate significant performance improvements: EST decreased to 1.0 minute, average speed increased to 22.6 km/h, and Matching Factor improved to 0.99. Consequently, productivity rose from 91.22 to approximately 113.9 BCM/hour, and production achievement exceeded targets. Financial analysis indicated a substantial revenue gain with a high return on investment. In conclusion, integrated behavioral, technical, and infrastructural interventions effectively enhance mining productivity, providing a scalable model for operational optimization in similar mining environments.

INTRODUCTION

The mining industry demands rigorous management of heavy equipment productivity, particularly for overburden removal activities where dump trucks play a central operational role. The Komatsu HD785-7, a rigid-frame 91-ton-payload haul truck commonly deployed in Indonesian coal mine operations, is subject to multiple performance indicators that directly influence cycle time, fleet matching, and overall production output (Supono & Mansur, 2025; Putra et al., 2024). Among these indicators, Empty Stop Time (EST) — defined as the duration a hauler remains stationary in empty condition, typically queuing at the loading point — and travel speed are recognized as two of the most impactful variables in determining hauler productivity (Riyandi & Wibowo, 2020; Tanamal et al., 2023).

At PT Putra Perkasa Abadi (PT PPA) Site MIP, located in South Kalimantan, the overburden removal operations at Pit Utara rely on a fleet of HD785 dump trucks paired with

Komatsu PC2000 and PC1250 excavators. In March 2025, monitoring data from the Fleet Management System (FMS) revealed that average EST had reached 3.5 minutes per cycle — more than twice the operational standard of 1.5 minutes — while the average empty travel speed was only 18.7 km/h against the planned target of 22.0 km/h (Sidinra et al., 2021; Tanamal et al., 2026). The Fleet Matching Factor (MF) recorded 1.25, indicating excessive queuing at the loading face, and monthly productivity of the HD785 fleet was limited to 91.22 BCM/hour. Consequently, the total overburden production for March 2025 reached only 1,004,108 BCM — 72.07% of the planned target of 1,393,200 BCM.

The significance of fleet matching in controlling hauler waiting time has been documented extensively in the mining engineering literature. Andriansyah et al. (2023) demonstrated that mismatches between loading equipment cycle time and hauler fleet size generate systematic queuing at the loading face, inflating EST and reducing effective working hours. Similarly, Fratama et al. (2025) confirmed that the Match Factor method provides a systematic framework for quantifying the numerical balance between loader capacity and hauler requirements for a given haul distance, enabling supervisors to adjust fleet composition in response to dynamic operational changes.

Haul road condition is another critical determinant of truck speed. Studies by Arsyad et al. (2024) and Huby & Doirebo (2025) confirmed that substandard road geometry — including inadequate drainage, low International Roughness Index (IRI) scores, and insufficient cross-fall — significantly impairs hauler speed and increases fuel consumption. At Site MIP, road quality assessment using the IRI method revealed an average score of 56% across the three segments of the PTD (Pit-to-Disposal) road, well below the 80% threshold required for optimal haul operations.

This study presents a structured eight-step Quality Control Circle (QCC) improvement program, following the Plan-Do-Check-Action (PDCA) methodology, implemented at PT PPA Site MIP between March and October 2025. The program targeted simultaneous reduction of EST to below 1.5 minutes and improvement of average speed to above 21.0 km/h, with an ultimate goal of optimizing MF to approximately 0.95 to maximize fleet productivity while minimizing unnecessary queuing. The research contributes to the body of knowledge on practical fleet management optimization in active coal mining operations, with quantified financial outcomes demonstrating the return on investment of the implemented measures (Febriyani et al., 2022; Sugarbo & Helmi, 2025).

METHOD

This research employed a Quality Control Circle (QCC) framework an applied continuous improvement approach widely adopted in Indonesian mining operations structured around the eight-step PDCA cycle. The study was conducted at PT Putra Perkasa Abadi (PT PPA) Site MIP, Pit Utara, South Kalimantan, covering the period from March to October 2025. Primary data were collected from the Fleet Management System (FMS) via the MOCO platform, which captures real-time telemetry data including EST, travel speed, payload, and cycle time for each individual HD785 unit (Sidinra et al., 2022; Riyandi & Wibowo, 2020).

Data Collection

Daily EST and speed data were extracted from the MOCO FMS dashboard for all active HD785 units across both Shift 1 (day) and Shift 2 (night). A sample data collection on

March 10, 2025 involving all units across four excavator fleets (E52010, E52012, E1232, E1234, E1236) recorded shift-average EST values of 3.25 minutes (Shift 1) and 3.37 minutes (Shift 2). Haul road quality was assessed using the International Roughness Index (IRI) methodology across three 300-meter segments (STA 0–300, 300–600, 600–900) of the PTD Block 3 road, evaluating five parameters: road width (badan jalan), cross-fall, drainage, surface condition, and bund wall height (Arsyad et al., 2024).

Root Cause Analysis

A fishbone (Ishikawa) cause-and-effect diagram was constructed to systematically identify root causes of high EST and low speed across four categories: Man, Method, Machine, and Environment. Five dominant root causes were validated through field verification: (1) absence of structured manpower assignment for operator deviation management; (2) lack of formal procedures for EST deviation handling; (3) absence of real-time distance-based fleet matching calculation; (4) no designated parking area for HD785 units at shift start; and (5) absence of a dedicated Person-in-Charge (PIC) and support equipment for haul road maintenance.

Fleet Matching Calculation

The Matching Factor (MF) is the primary analytical tool used to determine the optimal number of haulers (NH) for a given loader-hauler configuration. The formula used, as referenced in Fratama et al. (2025) and Simamora et al. (2025), is:

Where: MF = Matching Factor; NH = Number of Haulers; CT_loader = Loader Cycle Time (min); CT_hauler = Hauler Cycle Time (min)

$$MF = (NH \times CT\_loader) / CT\_hauler$$

An MF of 1.0 represents perfect synchronization; MF > 1.0 indicates hauler queuing (excess haulers), while MF < 1.0 indicates loader waiting. Target MF was set at 0.95 to account for minor operational variabilities. Hauler productivity (PTY) was calculated using the Komatsu performance formula (Putra et al., 2024):

Where: PTY = Productivity (BCM/hour); CT_hauler = Cycle time in minutes; Payload = 91 tons; Fill Factor = 0.90; Swell Factor = 1.18

$$PTY = (60 / CT\_hauler) \times Payload \times Fill\ Factor \times Swell\ Factor$$

Road Quality Assessment (IRI Method)

Road quality was quantified using the International Roughness Index (IRI) scoring rubric on a 1–5 scale across five parameters. The composite Road Quality Index (RQI) was computed as the weighted sum of parameter scores:

Where: RQI = Road Quality Index (%); Wi = Weight of parameter i (%); Si = Score of parameter i (1–5)

$$RQI = \Sigma (Wi \times Si)$$

Parameter weights were: road width (25%), cross-fall (25%), drainage (25%), surface condition (15%), and bund wall (10%). An RQI score below 80% triggers mandatory road maintenance or repair according to the GMP (Good Mining Practice) standard applied at the site (Hariastuti & Rahman, 2025).

Grader Productivity for Maintenance Planning

To calculate the required maintenance equipment capacity for the 900-meter PTD road using a GD825 grader, the following productivity formula was applied (Santoso, 2024):

Where: QA = Grader area output (m²/hour); V = Operating speed (km/h) = 7; Le = Effective blade width (m) = 3.5; Lo = Overlap (m) = 0.45; E = Efficiency factor = 0.85

$$QA = V \times (Le - Lo) \times 1000 \times E$$

RESULTS AND DISCUSSION

Baseline Performance (March 2025)

Table 1 summarizes the key performance indicators recorded at the start of the improvement program in March 2025. The data confirm that all three primary metrics — EST, speed, and MF — deviated significantly from their respective operational targets.

Table 1. Baseline Performance Indicators — HD785, March 2025

Performance Indicator	Actual (March 2025)	Standard/Target	Gap
Empty Stop Time (EST)	3.5 min	1.5 min	−2.0 min
Average Travel Speed	18.7 km/h	22.0 km/h	−3.3 km/h
Matching Factor (MF) – Average	1.25	0.95	+0.30
MF Shift 1	1.18	0.95	+0.23
MF Shift 2	1.32	0.95	+0.37
HD785 Productivity (PTY)	91.22 BCM/h	122 BCM/h	−30.78 BCM/h
OB Production (BCM)	1,004,108	1,393,200	−389,092 BCM
OB Achievement (%)	72.07%	100%	−27.93%
Road Quality Index (IRI)	56%	≥80%	−24%

Source: MOCO FMS Data, March 2025

The MF of 1.25 indicates that the number of haulers assigned to each excavator fleet was, on average, 25% in excess of the ideal matching requirement. This surplus created systematic queuing at the loading face, extending hauler dwell time in the empty condition (Andriansyah et al., 2023; Riyandi & Wibowo, 2020). Simultaneously, the substandard road condition — with an IRI composite score of 56% — constrained truck speed, particularly in the STA 300–600 segment where drainage had not been properly formed (IRI drainage score = 2) and spoil was beginning to accumulate on the road surface. Ramdani (2025) identified similar road-speed interactions in large excavator operations, noting that even short-haul distances with poor road quality substantially degrade effective cycle performance.

Root Cause Analysis

Table 2 presents the five dominant root causes identified through the fishbone analysis and validated through field verification. All five were classified as dominant — requiring immediate corrective action — based on the gap between actual conditions and the desired ideal state.

Table 2. Dominant Root Causes of High EST and Low Speed

No.	Factor	Root Cause	Actual Condition	Ideal Condition
1	Man	No structured operator deviation management	Only a few supervisors handle deviations; no reward system	Small group system with dedicated supervisor per group
2	Method	No formal EST deviation-handling procedure	Existing procedures do not address EST/speed deviation tiers	Tiered procedure: coaching → warning letter → escalation
3	Method	Fleet matching not updated in real time	Fleet setting based on static plan; not adjusted per haul distance change	Dynamic fleet card updated at each front/disposal shift
4	Environment	No dedicated truck parking area	HD785 units park along active haul road, causing congestion at shift start	Designated parking bay enabling orderly shift-start departure
5	Environment	No dedicated road maintenance PIC or support fleet	Spoil accumulation, inadequate drainage, insufficient compaction	Dedicated GL + GD825 + D85 + PC200 + compactor assigned to PTD

Source: Field Investigation and FMS Data Analysis, 2025

Haul Road Quality Assessment — Before and After

The IRI assessment was conducted across three road segments before and after the improvement interventions. Table 3 presents the pre- and post-improvement IRI scoring results.

Table 3. IRI Road Quality Assessment — PTD Block 3 (Before vs. After Improvement)

Parameter	Weight	STA 0–300 (Before/After)	STA 300–600 (Before/After)	STA 600–900 (Before/After)
Road Width (Badan Jalan)	25%	2 / 4	2 / 4	2 / 4
Cross-fall	25%	3 / 4	3 / 4	3 / 4
Drainage	25%	4 / 4	2 / 4	4 / 4
Surface Condition	15%	3 / 4	3 / 4	3 / 4
Bund Wall	10%	3 / 4	3 / 4	3 / 4
Road Quality Index (RQI)	100%	56% / 80%	52% / 80%	60% / 80%
Average RQI		56% (Before)		80% (After)

Source: IRI Field Assessment, Site MIP, 2025

The most critical pre-improvement deficiency was observed in the STA 300–600 segment, which received a drainage score of only 2 ("does not flow") and had the lowest overall RQI of 52%. This segment corresponded directly to the road section where truck speed data showed the greatest reduction relative to adjacent segments. Post-improvement, all segments achieved an RQI of 80%, meeting the GMP standard threshold. The improvement was achieved through appointment of a dedicated three-person Group Leader (GL) roster for haul road maintenance (HRM PTD), supported by a GD825 grader, D85 dozer, PC2000 excavator, and VS43 compactor — all operating on a dedicated day/night shift schedule (Tikupadang, 2023; Chadarisman & Rakasiwi, 2025).

Applying the grader productivity formula: $QA = 7 \times (3.5 - 0.45) \times 1000 \times 0.85 =$ 18,147 m²/hour, the GD825 could complete six passes across the full 900-meter, 25-meter-wide road width within a single shift, providing sufficient capacity for daily maintenance cycles without disrupting active hauling operations (Santoso, 2024).

Improvement Interventions

Table 4 summarizes the five improvement interventions implemented between May and August 2025, along with the corresponding PDCA framework elements and implementation costs.

Table 4. Summary of Improvement Interventions (5W1H Framework)

No.	Problem Factor	What (Intervention)	When	Cost (IDR)
1	Man	Bapak Asuh – Anak Asuh operator grouping system; EST incorporated into IKO (Operator Performance Incentive)	Week 2–4, May 2025	—
2	Method	Updated EST/Speed deviation-handling procedure (coaching → warning → escalation)	Week 4, May 2025	—
3	Method	Real-time dynamic fleet matching card; random distance observation at each front change	Week 4 May – Week 4 June 2025	—
4	Environment	Construction of dedicated HD785 parking area (10,900 BCM fill + 6,960 m³ aggregate)	Week 4 May – Week 4 July 2025	3,150,240,000
5	Environment	Dedicated HRM PTD team + support fleet (GD825, D85, PC200, VS43)	Week 1 June – Week 2 August 2025	840,163,200

Source: QCC Improvement Plan, Site MIP, 2025

The operator grouping system (Intervention 1) was the cornerstone human-factor intervention. All 54 HD785 operators were assigned to small groups of 4–6, each supervised by a dedicated Group Leader (Bapak Asuh) responsible for daily performance coaching based on individual FMS data. EST was weighted at 20% and speed at 15% of the monthly IKO (Insentif Kinerja Operator) score, creating a direct financial incentive for operators to maintain compliant performance (Tanamal et al., 2023). This approach reflects findings by Simamora et al. (2025) that direct operator coaching linked to performance data measurably reduces idle time without requiring equipment investment.

Intervention 3 — real-time dynamic fleet matching — directly addressed the root cause of MF inflation. Prior to the improvement, fleet assignments were based on static daily plans that did not account for haul distance variations resulting from progressive mining face advancement. A dynamic fleet card system was distributed via supervisor group messaging channels at the start of each shift, and random field observations were conducted to validate operator-reported distances. This approach mirrors the dispatch optimization principles described by Riyandi & Wibowo (2020), who demonstrated that dynamic dispatch systems — even in the absence of full FMSD (Fleet Management System Dispatch) technology — can significantly reduce hauler bunching (Tanamal et al., 2026).

Monthly Performance Trend — March to October 2025

Table 5 presents the monthly progression of all four key performance indicators from March (baseline) through October 2025 (final evaluation). The data demonstrate a consistent improvement trajectory, with EST declining monotonically from 3.5 to 1.0 minute and speed rising from 18.7 to 22.6 km/h.

Table 5. Monthly KPI Trend — HD785, March–October 2025

Month	EST (min)	Speed (km/h)	MF (Average)	Productivity (BCM/h)
March (Baseline)	3.5	18.7	1.25	91.22
April	1.5	19.5	1.21	111.12
May	1.1	21.6	1.15	113.38
June	1.1	22.6	1.08	118.58
July	1.1	22.7	1.07	115.01
August	1.1	22.2	1.04	115.55
September	1.1	21.5	1.02	111.69
October	1.0	22.6	0.99	112.00
Target	≤1.5	≥21.0	0.95	≥122

Source: MOCO FMS Monthly Report, Site MIP, April–October 2025

The sharpest improvement in EST occurred between March and April 2025 (3.5 → 1.5 minutes), coinciding with the commencement of the Bapak Asuh coaching system and the initial socialization of updated procedures — interventions with zero capital cost but high behavioral impact. Speed improvements were more gradual, reaching the 21.0 km/h threshold by May 2025 following the initial haul road maintenance interventions, and stabilizing above 22.0 km/h from June onward once the dedicated HRM PTD team had completed its first full maintenance cycle. By October 2025, MF reached 0.99 — approaching the target of 0.95 — reflecting the combined effect of dynamic fleet matching and reduction in hauler queuing caused by improved road flow conditions (Febriyani et al., 2022; Arsyad et al., 2024).

Figure 1 illustrates the monthly EST trend, while Figure 2 shows the speed progression. The consistent convergence toward target values across all four indicators validates the multi-intervention approach adopted in this study.

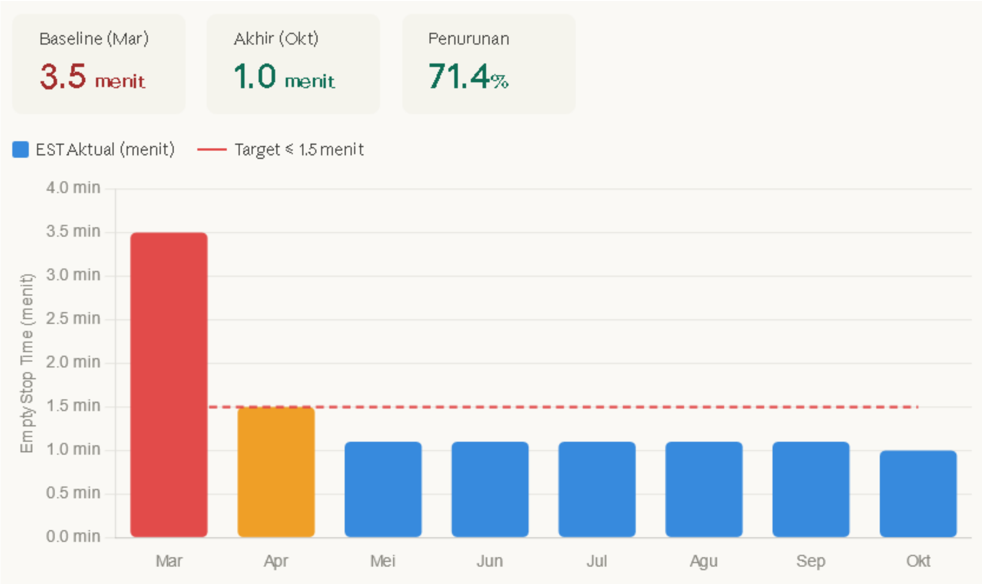

Figure 1. Monthly Empty Stop Time (EST) Trend, HD785, March–October 2025.
Sumber: Data MOCO FMS, PT PPA Site MIP, 2025

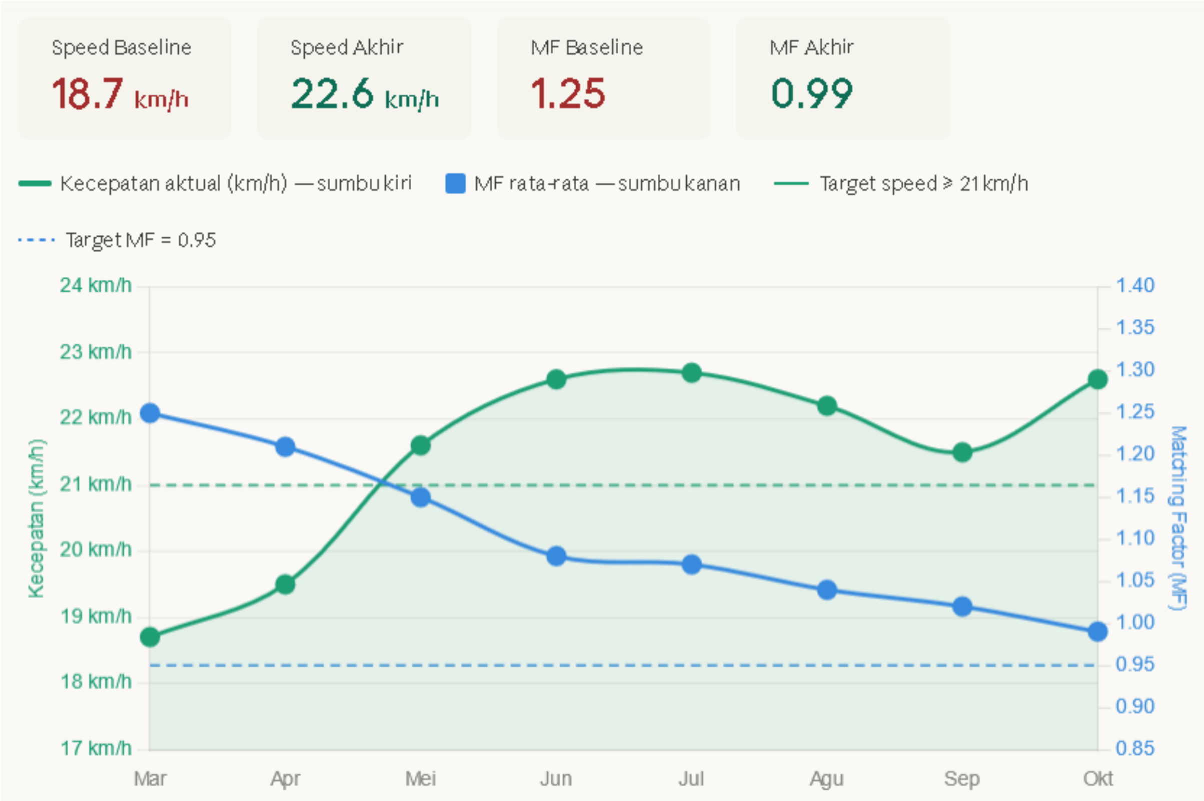

Figure 2. Monthly Average Speed and Matching Factor Trend, HD785, March–October 2025.
Source: Data MOCO FMS, PT PPA Site MIP, 2025

Financial Performance Analysis

The economic impact of the improvement program was quantified by comparing actual post-improvement productivity against the March baseline. Table 6 presents the monthly gain in total BCM production attributable to the productivity improvement, and the corresponding estimated revenue (calculated at a standard overburden removal rate of IDR 33,617 per BCM).

Table 6. Monthly Revenue Gain from HD785 Productivity Improvement, April–October 2025

Month	PTY (BCM/h)	Baseline PTY (BCM/h)	Gain (BCM/h)	No. HD	EWH (h)	Production Gain (BCM)	Revenue Gain (IDR)
April	111.12	91.21	19.91	26	7,575.6	150,830	5,067,894,586
May	113.38	91.21	22.17	26	9,721.4	215,499	7,240,761,310
June	118.58	91.21	27.37	26	10,249.4	280,550	9,426,476,537
July	115.01	91.21	23.80	26	8,686.4	206,778	6,947,737,011
August	115.55	91.21	24.34	26	9,364.4	227,885	7,656,926,677
September	111.69	91.21	20.48	26	8,449.3	173,008	5,813,079,316
October	112.00	91.21	20.79	26	9,243.6	192,185	6,457,426,207
TOTAL						1,446,735	48,610,301,644

Source: Production and FMS Records, Site MIP, 2025

Table 7. Total Investment Cost Summary

Cost Component	Description	Total Cost (IDR)
Parking Area Construction	10,900 BCM fill material + 6,960 m^3 aggregate	3,150,240,000
HRM Support Fleet Rental	PC200 (480h) + D85 (240h) + Compactor (480h) + GD825 (540h)	840,163,200
TOTAL INVESTMENT		3,990,403,200

Source: Cost Control Report, Site MIP, 2025

The total opportunity revenue gain of IDR 48.61 billion against a total investment cost of IDR 3.99 billion yields a Return on Investment (ROI) of approximately 1,118% over the seven-month post-improvement period. This exceptionally high return reflects the leveraged nature of fleet productivity improvements in large-scale mining: small improvements in per-unit cycle efficiency, multiplied across 26 active HD785 units and thousands of operating hours, compound into substantial production volume gains (Hariastuti & Rahman, 2025; Sugarbo & Helmi, 2025).

Notably, three of the five interventions (operator grouping, procedure update, and dynamic fleet matching) carried zero capital investment cost, relying entirely on organizational redesign and information system improvements. This finding aligns with the conclusion of Tanamal et al. (2023) that Fleet Management System data, when actively leveraged by supervisors for real-time decision-making, can deliver productivity improvements comparable to equipment additions but without associated capital expenditure.

Environmental and Safety Implications

The reduction of MF from 1.25 to 0.99 implies a reduction in unnecessary hauler operating hours in idle or queuing status. Excessive idling is a primary contributor to fuel waste and associated carbon dioxide emissions in heavy equipment operations. Santoso (2024) and Supono & Mansur (2025) both established that the fuel ratio (liters per BCM) of HD785-

class trucks deteriorates significantly when operating in high-EST, low-speed conditions, as auxiliary systems remain powered and engines operate at inefficient load points during extended idle periods. The improvement program therefore contributes to PT PPA's corporate sustainability commitment to reducing carbon emissions per unit of production — aligning with the company's stated mission of responsible resource extraction (Chadarisman & Rakasiwi, 2025).

From a safety perspective, the construction of the dedicated parking area eliminated the practice of HD785 units parking along the active haul road prior to shift commencement. This practice had created significant safety risks: trucks parked in darkness along narrow road sections, combined with the congested departure pattern at shift start, elevated the potential for collision events. The new parking facility, equipped with inspection checklists and supervisor presence requirements, provides a structured environment for pre-shift checks and orderly departure sequencing.

CONCLUSION

This study demonstrates that a structured, multi-intervention QCC improvement program effectively addressed the behavioral, procedural, methodological, and environmental root causes of HD785 dump truck underperformance in coal overburden removal. The five interventions—operator mentorship-incentive system, formal deviation-handling procedures, real-time dynamic fleet matching, a dedicated parking area, and an IRI-based haul road maintenance team—successfully reduced Empty Stop Time from 3.5 to 1.0 minute, increased average speed from 18.7 to 22.6 km/h, and optimized the Matching Factor from 1.25 to 0.99 over seven months. As a result, HD785 productivity improved from 91.22 to 113.9 BCM/hour, and the overburden achievement in October 2025 reached 114% of the target, reversing the 72% shortfall in March 2025. This led to an estimated revenue of IDR 48.61 billion against a combined intervention investment of IDR 3.99 billion, yielding an ROI of 1,118%. Haul road quality improved from 56% to 80% across all segments, meeting GMP standards. Key conclusions include that zero-cost behavioral and procedural interventions provided immediate productivity gains, infrastructure investments were necessary for sustained improvements, and the IRI-based road quality assessment is a practical tool for prioritizing maintenance. Future research should focus on integrating Fleet Management System Dispatch (FMSD) or Onboard Fleetsafe Assist (OFA) technology for real-time fleet matching and analyze fuel consumption to quantify carbon emission reduction benefits, supporting PT PPA's environmental commitments.

REFERENCES

Andriansyah, A., Wardono, H., & Armijon, A. (2023, October). Optimalisasi produktivitas pada kegiatan pengangkutan di lokasi Tambang Batubara. In Seminar Nasional Insinyur Profesional (SNIP) (Vol. 3, No. 2). https://doi.org/10.23960/snip.v3i2.440

Armas, R. F., Aziz, M. H., & Faisal, M. (2025, October). Optimalisasi Kinerja Bulldozer D85ESS-2 melalui Analisis Troubleshooting Engine Low Power. In Prosiding Seminar Nasional Penelitian LPPM UMJ.

Arsyad, M., Norfaeda, R., Saptarini, D. L., & Asy'ari, M. A. (2024). Pengaruh perbaikan waktu hambatan terhadap produktivitas alat gali muat dan alat angkut. Jurnal Gradasi Teknik Sipil, 8(1), 53–64. https://doi.org/10.31961/gradasi.v8i1.1419

Chadarisman, A., & Rakasiwi, G. (2025). High pressure pump, eliminasi risiko K3 trucking system pada pengangkutan lumpur di pertambangan batubara: Penelitian. Jurnal Pengabdian Masyarakat dan Riset Pendidikan, 3(4), 3501–3510. https://doi.org/10.31004/jerkin.v3i4.1079

Febriyani, R., Santoso, E., Putri, K. S., & Arief, M. Z. (2022). Permodelan kombinasi peralatan mekanis dalam optimalisasi produktivitas armada di PT Semesta Centramas. Jurnal Himasapta, 7(3), 129–136. https://doi.org/10.20527/jhs.v7i3.7499

Fratama, R. P., Syahrudin, S., & Mukhtar, W. (2025). Optimalisasi alat gali muat dan angkut pada kegiatan ore getting dengan metode match factor dan metode antrian di PT. Antam Tbk UBP Bauksit Tayan, Kabupaten Sanggau, Provinsi Kalimantan Barat. Jurnal Teknologi Lingkungan Lahan Basah, 13(1), 201–223. https://doi.org/10.26418/jtllb.v13i1.88803

Hariastuti, N. L. P., & Rahman, A. (2025). Analisa penyebab keterlambatan pengiriman semen menggunakan metode DMAIC (Define, Measure, Analyze, Improve, Control) (Studi Kasus: PT. Semen Indonesia Logistik). Journal of Industrial View, 7(1). https://doi.org/10.26905/jiv.v7i1.13175

Huby, G. S. W., & Doirebo, H. Y. E. (2025). Evaluation of work synchronization of loading equipment and transport equipment at PT Modern Widyatehnical Kampung Wiras, Wanggar, Nabire Regency, Central Papua Province. PROMINE, 13(1), 1–6. https://doi.org/10.33019/jp.v13i1.6115

Putra, D. A., Cahyono, Y. D. G., & Kusdarini, E. (2024, October). Analisa dan optimalisasi produktivitas alat gali muat excavator Komatsu PC1250-11R berpasangan dengan alat angkut Komatsu HD785-7 di Pit Warute PT. Bina Sarana Sukses Jobsite Antang Gunung Meratus di Kabupaten Hulu Sungai Selatan, Kalimantan Selatan. In Prosiding Seminar Nasional Sains dan Teknologi Terapan (No. 1).

Ramdani, R. R. (2025). Efisiensi dan biaya operasional excavator Hitachi EX 8000-6 di industri pertambangan. Natural Resources and Environmental Management, 3(1).

Riyandi, I., & Wibowo, M. B. (2020). Optimalisasi penggunaan alat berat dengan menggunakan Unlock System-Fleet Management System (FMS) Dispatch Modular Study Case PT Bukit Makmur Mandiri Utama Job Site Lati. Prosiding Temu Profesi Tahunan PERHAPI, 145–154.

RIZKI, A. (2021). Kajian teknis produktivitas alat angkut Komatsu HD 785-7 dengan optimalisasi travel speed pada pembongkaran overburden tambang batubara di PT.

Mandala Karya Prima Jobsite PT. Mandiri Inti Perkasa Kalimantan Utara (Doctoral dissertation, Institut Teknologi Nasional Yogyakarta).

Santoso, T. B. (2024). Optimalisasi konsumsi bahan bakar pada dump truck HD785-7 dengan metode integrated control system. ISMETEK, 17(1).

Sidinra, A., Wijaya, A. E., & Sumarjono, E. (2021). Optimasi Fleet Management System (FMS) – FOCUS guna mengurangi waktu tidak produktif (idle time) pada alat angkut. Mining Insight, 2(2), 123–132.

Sidinra, A., Wijaya, A. E., & Sumarjono, E. (2022). Optimasi Fleet Management System (FMS) – FOCUS guna mengurangi waktu tidak produktif (idle time) pada alat angkut. Mining Insight.

Simamora, A., Putrawiyanta, I. P., Iashania, Y., Wiryanto, Y. H., & Fridtriyanda, A. (2025). Analisis produktivitas excavator Komatsu PC 300 pada kegiatan coal getting di PT. Lautan Hutan Lestari Kecamatan Teweh Tengah Kabupaten Barito Utara Provinsi Kalimantan Tengah. Innovative: Journal of Social Science Research, 5(4), 8750–8762. https://doi.org/10.31004/innovative.v5i4.20924

Sugarbo, O., & Helmi, H. (2025). Correlation of coal distribution and open pit modeling in Field X, Tenggarong Seberang, Kutai Kartanegara Regency, East Kalimantan. KURVA MAS, 1(2), 47–52. https://doi.org/10.33579/krvms.v1i2.5724

Supono, A., & Mansur, A. (2025). Analisis pengaruh fuel consumption dan productivity terhadap fuel ratio pada unit dump truck HD785 di aktivitas pertambangan PT. ABC. Jurnal Valtech, 8(2), 113–124. https://doi.org/10.36040/valtech.v8i2.14663

Tanamal, T., Adhiatma, Y., Alghifar, M., Nadeak, A. A., & Fathoni, N. (2023). Implementation fleet management system with real time monitoring and controlling. Jurnal Sosial Teknologi, 3(8), 635–639. https://doi.org/10.59188/jurnalsostech.v3i8.897

Tanamal, T., Kartika, C., Jannah, S. N., & Alfitri, D. (2026). Meningkatkan achievement productivity overburden hauler HD785/CAT777 dengan penerapan Fleet Management System-Onboard Fleetsafe Assist. Jurnal Sosial Teknologi, 6(1), 403–409. https://doi.org/10.59188/jurnalsostech.v6i1.32670

Tikupadang, K. (2023). Pemeliharaan mesin heavy duty dump truck Komatsu HD 465 pada PT Semen Bosowa Maros. Paulus Mechanical Engineering Journal, 1(2), 7–12.

Wardono, H., & Armijon, A. (2023). Optimalisasi produktivitas pada kegiatan pengangkutan di lokasi Tambang Batubara.