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REDUCING LOST TIME DUE TO SHIFT CHANGES FROM 7.00 HOURS TO 4.60 HOURS FOR THE PERIOD OF FEBRUARY – JULY 2024 TO INCREASE PRODUCTION ACHIEVEMENT AND OVERBURDEN PRODUCTIVITY OF PC2000 AT PT ANTAREJA MAHADA MAKMUR JOBSITE MIFA BERSAUDARA

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PC2000, production, UA, change shift

ABSTRACT

The mining industry is facing the dual challenge of meeting the demand for raw materials while minimizing environmental impact and ensuring sustainable practices. As urbanization accelerates, the industry is increasingly adopting advanced technologies and methodologies to enhance efficiency and reduce waste. The purpose of the research is to analyze and implement strategies that minimize the downtime associated with shift changes in order to enhance overall production efficiency and productivity of the PC2000 machinery at the specified jobsite. The study aims to quantify the impact of reducing shift change time on production outcomes and overburden productivity, ultimately contributing to improved operational performance within the defined timeframe. The research contributes to the field of operational efficiency by providing empirical insights into the relationship between reduced shift change times and enhanced production performance in heavy machinery operations. The findings may serve as a valuable reference for similar industries aiming to optimize shift management and improve overall operational productivity, thus contributing to best practices in resource management and efficiency enhancement. Furthermore, comparative studies with other mining operations that have successfully implemented similar changes could provide a broader perspective on best practices and innovative strategies, contributing to the overall advancement of the mining industry.

INTRODUCTION

Mining is one of the oldest industries of mankind, which has been essential to improving the quality of life since the Stone Age. Today, mineral resources are at the core of many human activities, ranging from housing, household appliances, industrial equipment, and energy to high technology and space exploration (Botin, 2009). The extraction and processing of these resources have not only fueled economic growth but have also driven technological advancements, enabling societies to innovate and develop (Litvinenko, 2020; Okolo et al., 2024; Söderholm, 2020; Stiglitz & Greenwald, 2015; Teece, 2018). As urbanization accelerates and the demand for raw materials continues to rise, the mining industry faces the dual challenge of meeting this demand while minimizing environmental impact and ensuring sustainable practices (Ayuk et al., 2020; Dou et al., 2023; Mondal & Palit, 2021).

In response to these challenges, the industry is increasingly adopting advanced technologies and methodologies to enhance efficiency and reduce waste. Innovations such as automation, artificial intelligence, and data analytics are transforming traditional mining operations, enabling companies to optimize resource extraction and management (Ali & Frimpong, 2020; Firoozi et al., 2024; Pradip et al., 2019; Shimaponda-Nawa & Nwaila, 2024; Young & Rogers, 2019). Moreover, the focus on sustainability has led to the implementation of more environmentally friendly practices, including the reclamation of mined land and the reduction of carbon emissions. As the global economy becomes more interconnected, the mining sector must also navigate complex regulatory frameworks and social expectations, further emphasizing the need for responsible and ethical resource management (Akpuokwe et al., 2024; De Klerk & Swart, 2023; Hodge et al., 2022; Jackson et al., 2023; Verrier et al., 2022). Through these efforts, the industry aims to secure its role as a vital contributor to modern civilization while addressing the pressing issues of sustainability and social responsibility.

PT Antareja Mahada Makmur (AMM) is one of the subsidiaries of Putra Perkasa Abadi (PPA) which is engaged in mining services. It has 14 jobsites spread throughout Indonesia. One of the jobsites is the MIFA Bersaudara Jobsite which has been collaborating since 2023, using an open mining system (stripe mine) as well as a landfill area (disposal) using a tiered method. The main businesses carried out include overburden removal, coal getting, coal hauling, road maintenance and dewatering. Before starting coal mining activities, the first thing that is done is the stripping of top soil (top soil) and overburden (Overburden). In the overburden stripping activity, loading equipment in the form of Komatsu PC2000 excavators, transportation tools using Komatsu HD785 and CAT777 dump trucks.

Stripping the overburden layer using 6 x PC2000 with a productivity target of 750 BCM/hour with UA PC2000 is planned at 63% per month. However, in reality, the achievement of UA PC2000 is at 55%. According to production unattainment statistical data, one of the factors that causes UA not to be achieved is the high number of lost time due to Change Shift which makes the unit operate longer. In connection with these problems, it is necessary to reduce the high number of lost time on change shifts to increase UA PC2000 in order to achieve the production targets that have been set by the company.

The purpose of the research is to analyze and implement strategies that minimize the downtime associated with shift changes in order to enhance overall production efficiency and productivity of the PC2000 machinery at the specified jobsite. The study aims to quantify the impact of reducing shift change time on production outcomes and overburden productivity, ultimately contributing to improved operational performance within the defined timeframe. The research contributes to the field of operational efficiency by providing empirical insights into the relationship between reduced shift change times and enhanced production performance in heavy machinery operations. By analyzing strategies to cut downtime from 7.00 hours to 4.60 hours, the study offers practical recommendations that can be implemented within PT Antareja Mahada Makmur, potentially leading to increased production achievement and overburden productivity of the PC2000. Additionally, the findings may serve as a valuable reference for similar industries aiming to optimize shift management and improve overall operational productivity, thus contributing to best practices in resource management and efficiency enhancement.

METHODS

The research methods and stages are carried out in the following order:

1) Literature Study: Conducted by collecting references to literature related to research, it can be from books or previous research reports.
2) Observation: Data collection by conducting direct observation at PT Antareja Mahada Makmur and data used for reference using company determination data.
3) Factors Affecting Loader Production
    a) Material Development Factor: Material development is a change in the volume of material when the material is changed from its original form. In nature, the material is found to be in a solid state so that only a few empty parts are filled with air between the grains. If the material is excavated from its original place, there will be volume development. To express the magnitude of volume development, there are two things that can be calculated, namely the Swell Factor and the Percent Swell.
    b) Bucket Fill Factor: The bowl fill factor is also known as the bucket fill factor. The bucket filling factor is the comparison between the volume of material that can be accommodated

by the bowl to the theoretical volume of the bowl (Partanto Prodjosumarto, 1995). The larger the filling factor, the greater the real capability of the tool.

To calculate the filling factor, the following equation is used (Pfleider, 1972):

$$BFF = \frac{Vn}{Vd} x100\%$$

Information:
BFF = Bucket Fill Factor
Vn = Actual volume of the load tool, m3
Vd = Theoretical volume based on the specification of the loader, m3

c) Cycle Time: Loading cycle time is used to assess the performance of a material loading system which is one of the key components of the total cycle time for material transportation in an open pit mine. Loading is one of the components of cycle time during the handling of the material (Manyele, 2017).

The loading device circulation time can be expressed in equations (Peurifoy, 2006):

$$CTm = Tm1 + Tm2 + Tm3 + Tm4$$

Information:
CTm = Total loading device circulation time (minutes) Tm1 = Time to fill the load (minutes)
Tm2 = Charged swing time (minutes)
Tm3 = Time to shed the load (minutes) Tm4 = Empty swing time (minutes)

d) Loading Pattern: To obtain results that are in accordance with the production target, the loading pattern is also a factor that affects the cycle time of the tool. The loading pattern is based on the position of the dump truck to load the results of backhoe excavation (loading excavation pattern), namely:
- Top loading: The backhoe digs by placing itself on a level or the dumptruck is one level below the backhoe. This method is only used on backhoe excavator loaders. In addition, the advantage obtained is that the operator is more free to see the tub and place the material (Figure 1).
- Bottom loading: Where the position of the truck and backhoe is at one level (both above the level). It is a loading pattern in which the position of the loading device is parallel to the position of the conveying device (the position of the loading equipment is the same as the conveying equipment). This method is used on power shovel loaders (Figure 1).

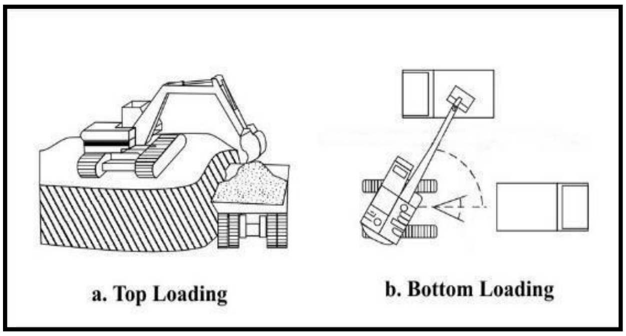

Figure 1. Top Loading and Bottom Loading Patterns

Based on the number of dump truck positions to be loaded against the excavator position (commonly called the loading pattern), namely:
- Single Back Up, i.e. the truck positions itself to be loaded in one place (Figure 2)
- Double Back Up, where the truck positions itself to be loaded in two places (Figure 2)

e) Work Efficiency: Work efficiency is the ratio of effective work time to available time.

$$We = Wt - (Wtd + Whd)$$

$$ek = \frac{Vn}{Vd} x100\%$$

Information:
We: Effective working time, minutes.
Wt: Working time available, minutes.

Whd: Avoidable obstacle time, minutes.
Wtd: Unavoidable drag time, minutes.
Ek : Work efficiency, %.

The productivity of the loader is the amount of production that can be achieved in the reality of the loader's work. The productivity of a loading device is the result achieved by a tool with a unit of BCM or tonnage (Ton) per unit of time (hour, day, or month).

PM = $\frac{3600}{CTm} x\ Kb\ x\ Bff\ x\ Ek\ x\ Sf$

Information:
PM: Loader production, BCM/Hour
CTm: Load tool cycle time , seconds
Kb: Capacity Bucket, m3
Bff: Bucket fill factor, %
Ek: Efficiency work, %
Sf: Swell factor

RESULTS

Results and Discussion

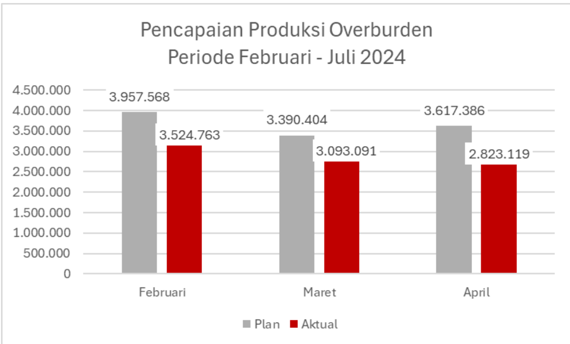

Figure 2. Production Achievement Graph

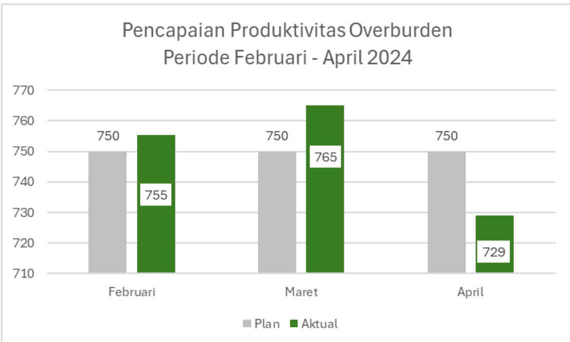

Figure 3. Productivity Achievement Graph

From the data above, the achievement of Production and Productivity has decreased far from the target in February to April. The decline in production affected UA which also experienced a decline.

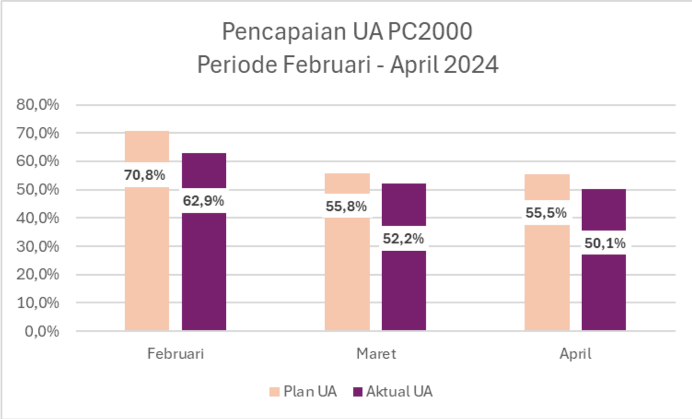

Figure 4. UA Achievement Graph

From the chart, it can be seen that UA has decreased from the target that has been set by the company, there are several things that can affect low UA.

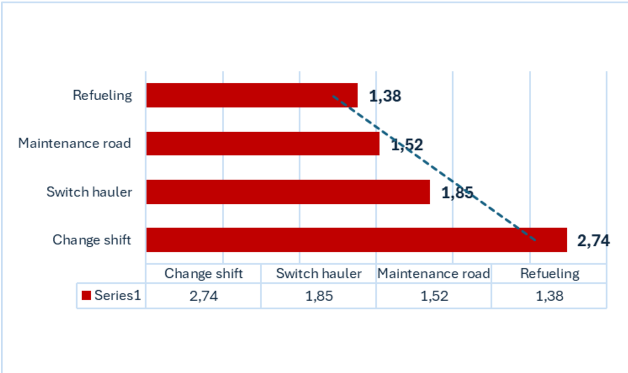

Figure 5. UA unattainment prolumbus

The biggest contributor to the problem of UA not being achieved is change shift, change shift, . Shift activities include operators/employees getting off the pick-up bus and then going to the unit to be operated. For big digger operators such as PC2000, operators will be escorted back using LV/elf to the front where the unit is located. In February, March, and April, the actual change shift is still high and the average lost volume due to lost time is 1,586.56 BCM with the calculation of the OB rate of 23,000 per BCM, the loss obtained is IDR 145,963,352.

Through the results of field observations carried out directly, there are several factors that can affect the length of the Change Shift, namely:

1) Lack of concern between supervisors and operators regarding lost time from change shift activities
2) Many operators take the wrong bus
3) There is no corresponding bus departure schedule yet
4) Delay in the delivery of PC2000 operators to the front
5) HD queues a lot when exiting/entering the unit parking
6) Narrow parking/change shift area

From several factors above, the research team is looking for corrective actions that can reduce lost time due to change shifts. The improvement action is carried out on an ongoing basis, to increase employee awareness about the importance of starting on-time operations in order to reduce the time lost due to shift shifts by holding socialization to employees during P5M about the importance of being on time at the start of operations. This not only aims to increase productivity and production, but also can increase the achievement of UA PC2000.

Table 1. Implementation of Improvement Ideas

No	Activity	Evidence
1	Socialization to operators and supervisors about the impact of lost time due to shift changes	
2	Making hull numbers and stickers on buses	
3	Coordination with team HCGA regarding bus departure schedules	
4	Coordinating with the eng team regarding the creation of a wider parking lot	
5	Arrange the parking of the unit in line and in order to make it easier to get out	

Through the implementation of the improvement idea which has been carried out for 1-2 months, slowly UA PC2000 began to increase and achieve the company's target in tandem with its production and productivity.

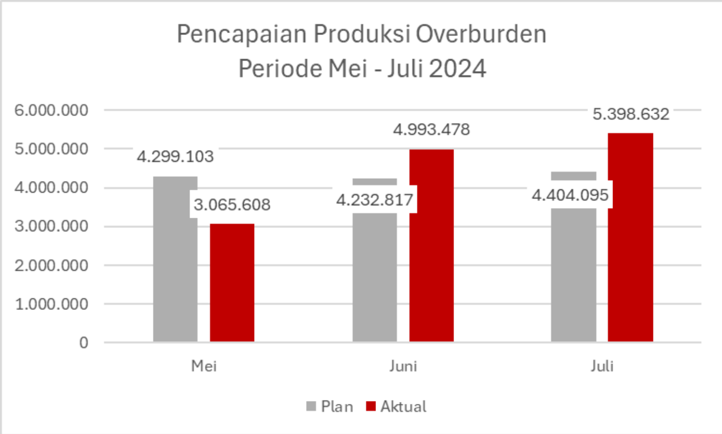

Figure 5. Increase in production after repairs

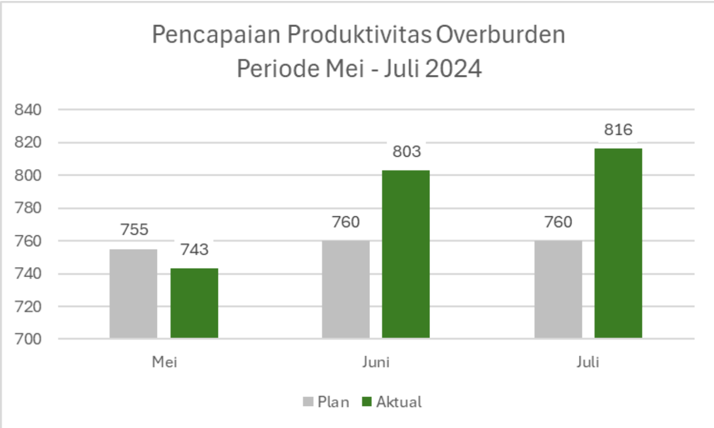

Figure 6. Increased productivity after repairs

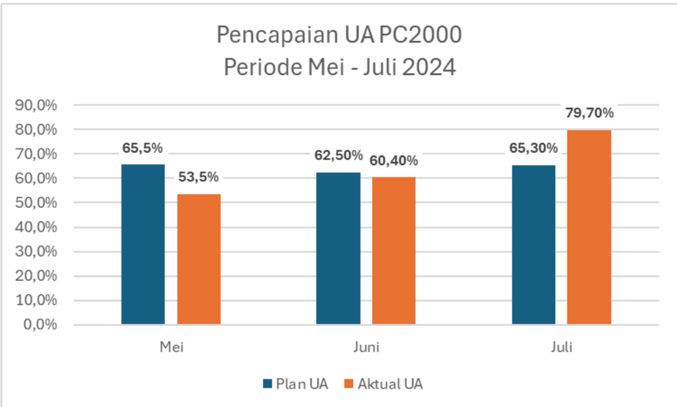

Figure 7. Increase in UA PC2000 after repairs

The increase in UA can reduce volume loss that occurs due to the loss of work time in change shift activities.

Table 2. May-July 2024 Volume Change Shift and Loss Table

Month	Plan	Current	Installment-Installment Loss Volume
May	0,17	0,25	13,31
June	4,93	6,10	(702,37)
July	5,27	7,43	(1640,97)

4,6	**(776,68)**

In the table above, the average loss volume due to change shift activities that exceeded the company's plan decreased to 776.68 BCM, a decrease of 809.88 BCM. The total profit loss decreased to IDR 71,454,284.

CONCLUSION

The study highlights that reducing time loss due to shift changes positively impacts production achievements for the PC2000 at the company, supported by improvements such as socializing the importance of timely operations, expanding shift areas, and organizing equipment parking. As a result, overburden production increased significantly, reaching 4,485,906 BCM against a plan of 4,312,005 BCM, while productivity rose from 750 to 787 BCM. Additionally, the unit availability (UA) improved from 55% to 64.5%, and volume loss due to shift changes decreased by 809.88 BCM, leading to a reduction in profit loss from IDR 145,963,352 to IDR 71,454,284. Future research could explore the long-term effects of these changes on workforce productivity and morale, and investigate the use of predictive analytics and machine learning to optimize shift management processes further. Comparative studies with other mining operations could also provide insights into best practices for enhancing overall operational efficiency.

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