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Comparative Analysis of Mined Reserve Tonnage on "M" Hill Between Mine Plan and Mining Realization

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ABSTRACTS

In mining activities, there is often a discrepancy between the plan and actual conditions in the field; if not identified early, this discrepancy will undoubtedly have the potential to cause losses if it continues to repeat itself. This study aimed to determine the factors driving the difference between the mine plan and mining realization. This research uses Pit design data, mine progress measurement data, material movement data, and two mine plan data, namely the backup plan model resulting from detailed exploration and the backup plan model data from the input drill results. From the results of the mine plan research, the closest to realization is the plan using input drill data with an average material movement difference of 10% and the difference in mined ore reserves an average of 12%. In comparison, detailed exploration data with an intermediate material movement difference of 12% to 42% and the contrast in mined ore reserves is 52% on average. The presence of overcuts influences this and the use of different densities.

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INTRODUCTION

To achieve optimal production, mining planning is carried out (Dzakir et al., 2022; Jafar, 2016; Yogi Pranata et al., 2017). To maintain the continuity of production, mining planning is carried out in the mining stages. Mining phasing provides information about locations to be mined in the future according to production targets (Febrylian, 2013; (Thamsi, 2017; Thamsi et al., 2021).

In mining activities, there is often a discrepancy between the plan and actual conditions in the field, this discrepancy was found after a work meeting was held regarding comparative analysis between the mine plan and the realization of mining. Non-conformities that often occur include overcut (excess excavation), undercut (lack of excavation), and over stripping (stripping beyond the specified target position). If not identified early, this discrepancy can occur repeatedly and continue every month, and will potentially cause losses to the company (Ibrahim, 2014; Anwar et al., 2020, 2021).

The frequent occurrence of data discrepancies between mineral deposits and the realization when mining is carried out makes it important to conduct research on the factors that cause these differences. Therefore, researchers are interested in conducting research with the aim of knowing the factors that cause the difference between mine plans and mining realization (Afriandi, 2015; Dewanti, 2015; Mustika, 2016; Widodo, 2015).

METHODS

The method of data processing is done with the help of software on a computer (computing). Using Surpac 6.3 mining software assistance to calculate reserve tonnage using backup model block data using model block tools then report using topographical artist mining survey data which limits the model block at the top and pit design or pit limit limits the model block at the bottom, it can be the volume is known from the topography of the mine progress and the pit design or pit limit then the volume is

multiplied by the density to determine the tonnage, while to determine the mined production using mining survey data at the beginning of mining topographical artists limiting the model block at the top and mining survey at the end mining topographical artists, the volume between the initial topography and the final topography can be known, then the volume is multiplied by the density to determine the tonnage.

RESULTS AND DISCUSSION

M hill

Bukit M is a mining front that started producing ore in August 2015 to November 2015 in the first period then continued in April 2016 until now. The mining method used at Bukit M is the open-pit mining method, ie all mining activities are carried out above the earth's surface and are in direct contact with the outside air by means of an open pit, namely open-pit mining by digging ore deposits down to form a basin or pit. The limit of active mining openings on Bukit M is 4.77 Ha. can be seen in the following image:

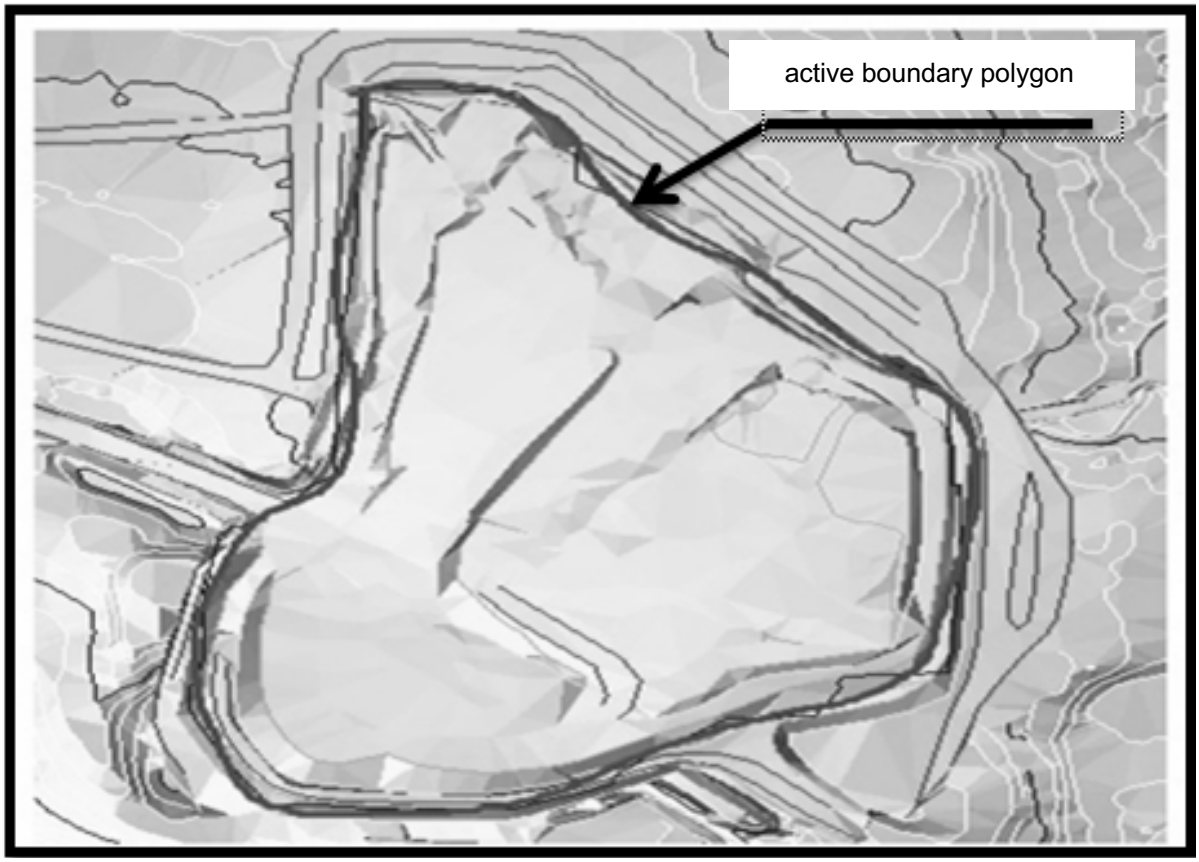

Figure 1. The area of the hill mining opening M

Reference Data

1. Reserve block model year 2015
    - EMD cadangan spare block model filename: pmlbmgu1_nth.dm source: Exploration Mine Development (EMD)

    b) Inpit drill spare block model
    filename: new-bm.mdl
    source: Exploration, Mine Plan, & Survey (EMPS)
2. Pit Design

    Pit design Bukit M, file name: pml9n-pid6-clip.dtm, source: Exploration, Mine Plan, & Survey (EMPS).

    3. Measurement of M Hill Mine Progress
    a) Period 1: date: 02 September 2015 – 27 November 2015
    b) Period 2: date: 27 November 2015 – June 2016

4. Material Movement Data (Actual)
a) Period 1: September – November 2015
b) Period 2: April – June 2016

M Hill Reserve

Reserves are calculated using the detailed exploration block model (EMD) and the input drill block model (EMPS) using the same mine progress survey parameters on 02 September 2015 and the Bukit M pit design with the name pml9n-pid6-clip.dtm. Reserved research area locations can be seen in the table below:

Table 1. Hill M Reserve detailed exploration model

M Hill Reserve September 2015				
Range Ni	Volume	Tonnes	Ni	Density
0.0 -> 1.29	62,526.00	112,523.00	1	1.8
1.3 -> 1.49	14,775.00	26,150.00	1.4	1.77
1.5 -> 1.79	12,415.00	21,635.00	1.7	1.75
1.8 -> 1.99	30,940.00	52,722.00	1.9	1.7
≥ 2.0	43,327.00	73,682.00	2.2	1.7
Grand Total	163,983.00	286,713.00	1.5	

Table 2. M Hill Reserve Inpit drill model

M Hill Reserve September 2015				
Range Ni	Volume	Tonnes	Ni	Density
0.0 -> 1.29	160,000.00	287,939.10	0	1.8
1.3 -> 1.49	-	-	0	1.77
1.5 -> 1.79	-	-	0	1.75
1.8 -> 1.99	3,281.00	5,590.85	1.95	1.7
≥ 2.0	172,813.00	293,886.20	2.47	1.7
Grand Total	336,094.00	587,416.15	1.29	

Mined Reserve Production

Mined reserve production is the amount of laterite nickel ore that has been excavated or mined expressed in tons, to determine the tonnage of mined ore production based on planning, it can be determined using Surpac 6.3 software using block model data, pit design (pit limit), and mining progress. Meanwhile, to determine the actual tonnage of mined ore production using a weighbridge, by weighing the dump truck when it is loaded and when it is empty when it goes to the stockyard and when it returns from the stockyard.

Table 3. Production of Bukit M detailed exploration model

Production of Bukit M detailed exploration model (EMD) is expressed in units of Ton						
Type Material	2015			2016		
	Sep	Okt	Nov	April	Mei	Juni
Waste	26012	28198	36792	19459	14036	6983
Ore	18.334	14.727	10.999	11.202	13.574	8.781
Tot Mat Move	44.346	42.926	47.791	30.661	27.610	15.765

Table 4. Production of Bukit M model Inpit drill

The production of Bukit M Model Inpit drill (EMPS) is expressed in units of Ton						
Type Material	2015			2016		
	Sep	Okt	Novr	April	Mei	Juni

Waste	53.141,58	53.424,11	44.424,71	12.652,41	20.244,58	18.839,16
Ore	9.831,17	21.787,97	28.698,82	18.070,07	23.913,65	18.598,42
Tot Mat Move	62.972,75	75.212,07	73.123,54	30.722,48	44.158,23	37.437,58

Table 5. Real Production of Bukit M (Actual

Bukit M Real Production (Actual) expressed in units of Ton						
Type Material	2015			2016		
	Sep	Okt	Nov	April	Mei	Juni
Waste	47.381,04	43.372,49	48.877,30	21.641,41	22.762,62	11.826,30
Ore	29.580,76	46.481,19	28.229,08	18.161,56	26.519,57	21.245,93
Total	76.961,80	89.853,68	77.106,38	39.802,97	49.282,19	33.072,23

Movement Material Difference

Material movement difference is the amount of material movement difference in the form of waste and ore between mine plans (based on detailed exploration drilling and based on Inpit drill with mining realisation.

Based on Tables 3, 4, and 5, material movement from detailed exploration, material movement based on Inpit drill, and actual material movement of mining at Bukit M from September 2015 to November 2015 and April 2016 to June 2016 are stated in table 6 as follows:

Table 6. Material movement movement

Material movement (expressed in tons)						
Ket	Sep	Okt	Nov	April	Mei	Juni
Eksplorasi detail	44.346,00	42.926,00	47.791,00	30.661,00	27.610,00	15.765,00
Inpit drill	62.972,75	75.212,07	73.123,54	30.722,48	44.158,23	37.437,58
Aktual	76.961,80	89.853,68	77.106,38	39.802,97	49.282,19	33.072,23

In table 6, it is known that the planning closest to actual mining is planning based on input drill, which can be seen in the following graph:

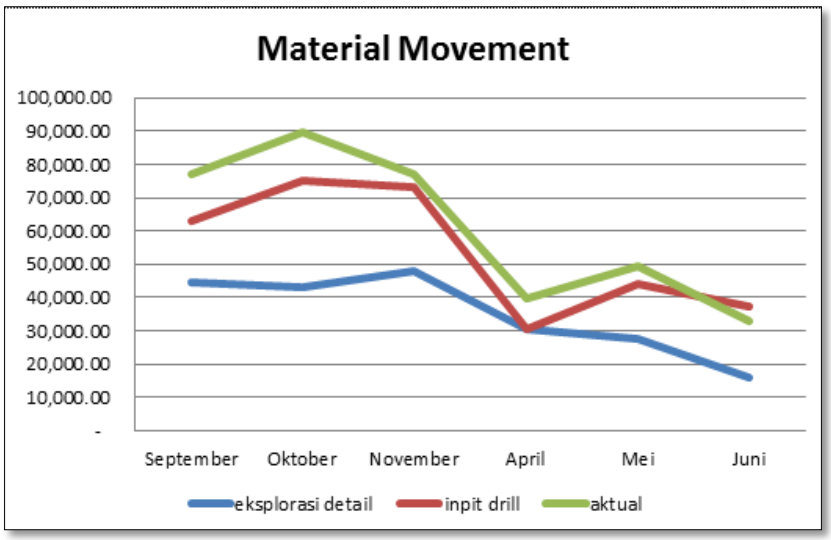

Figure 2. Material Movement Chart

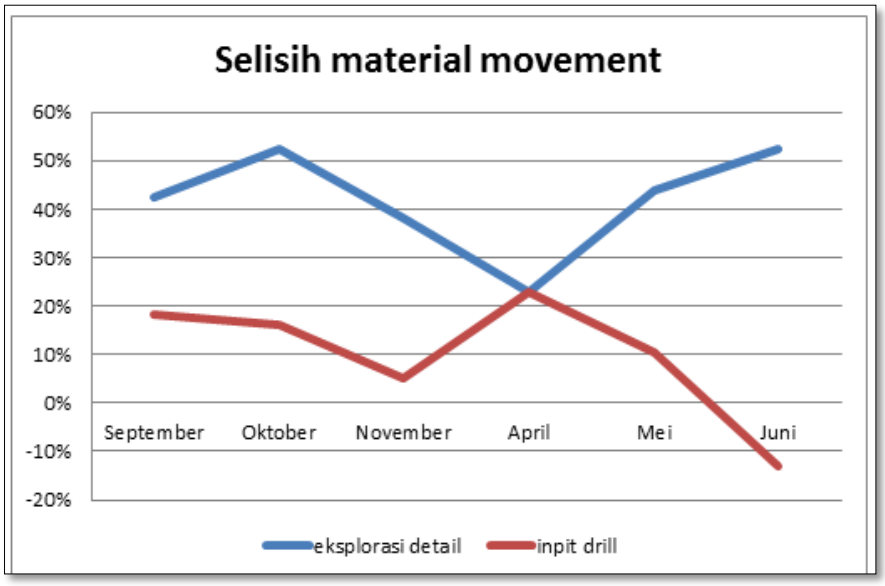

Figure 3. Material Movement Difference

From the graph above, the input drill has the slightest difference, where the monthly average difference is 10%. In comparison, detailed exploration with an average monthly difference of 42% shows that the input drill has the closest material movement difference actual.

Mined Ore Production Difference

The difference in Ore mined is the amount of difference in Ore mined between the mine plan (based on drilling carried out by Exploration Mine Development and based on drilling carried out by the Exploration, Mine Plan, & Survey work unit) and mining realisation.

Based on Tables 3, 4, and 5, it can be seen the number of ore mined from detailed exploration, the number of ore mined based on the Input drill, and the actual number of ore mined at Bukit M from September 2015 to November 2015 and April 2016 to June 2016 respectively. As stated in table 4.7 as follows:

Table 7. Mined ore production in Bukit

M Hill Mined Ore Production (expressed in tons)						
Ket	Sep	Okt	Nov	April	Mei	Juni
Eksplorasi detail	18,334.00	14,727.00	10,999.00	11,202.00	13,574.00	8,781.00
Inpit drill	9,831.17	21,787.97	28,698.82	18,070.07	23,913.65	18,598.42
Aktual	29,580.76	46,481.19	28,229.08	18,161.56	26,519.57	21,245.93

In table 4.7, it is known that the planning closest to actual nickel ore (ore) mining is planning based on the input drill carried out by the Exploration, Mine Plan, & Survey (EMPS) work unit, which can be seen in the following graph:

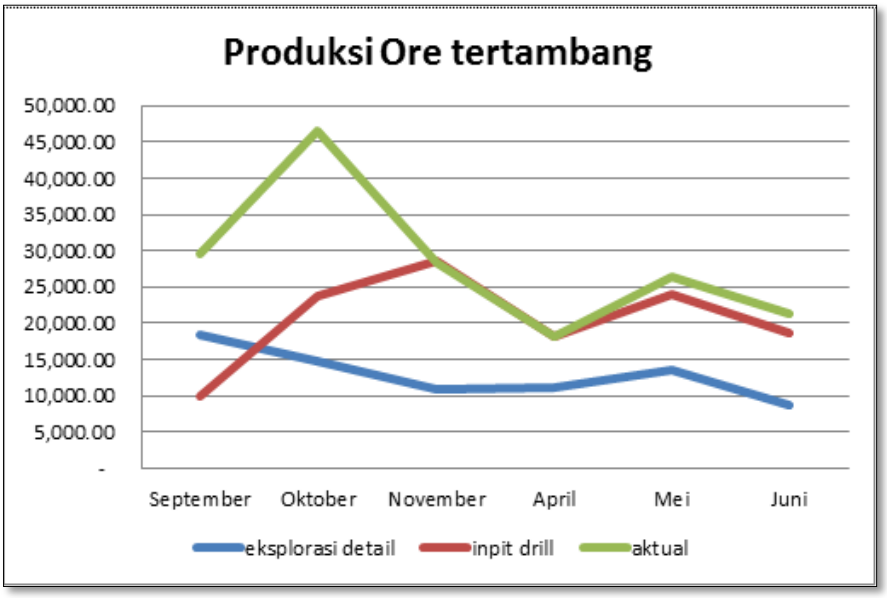

Figure 4. Material Movement Difference.

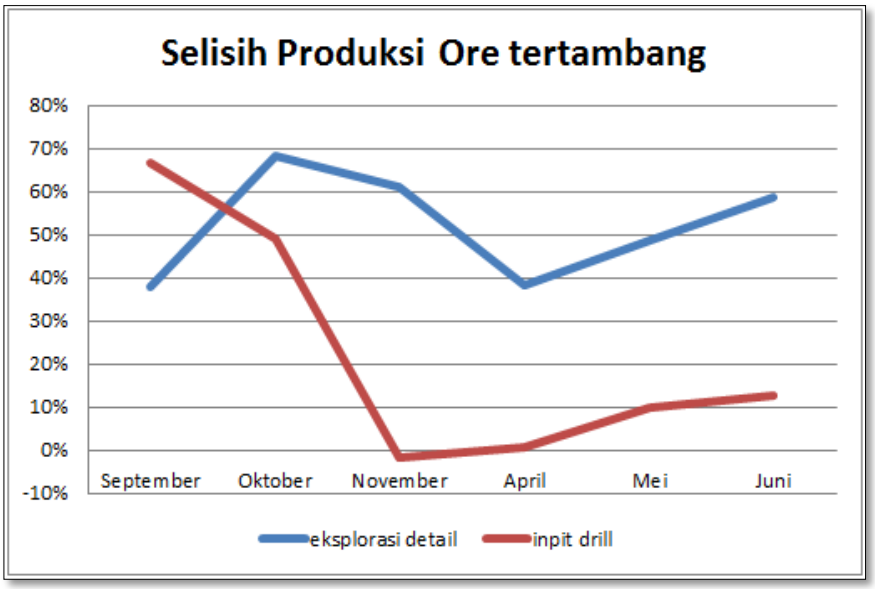

Figure 5. The difference in Material Movement.

Factors Causing Mine Plan Incompatibility and Mining Realization

1. The occurrence of excavation that exceeds the planned elevation (Overcut). The hole exceeds the designed elevation limit, as seen in the A-A' and B-B' cross sections (see Appendix P). The overcut can be seen in Figure 7, where the overcut is marked with a red circle. The actual mining conditions often occur overcut or overstriding because visual conditions in the field usually indicate ore deposits outside the planned mining limits or the planned mining elevation limits, which causes more ore tonnage in actual mining compared to mining plans.
2. There is a difference in density used to calculate the tonnage, where the mine plan uses a different density in each range of Ni levels, namely Ni 0.0-1.3 using a density of 1.80 Ni 1.3-1.5 using a density of 1.77 Ni 1.5-1.8 using a density of 1.75 Ni 1.8->2.0 using a density of 1.70. Meanwhile, the density loose used to calculate the tonnage mined uses a density of 1.58.

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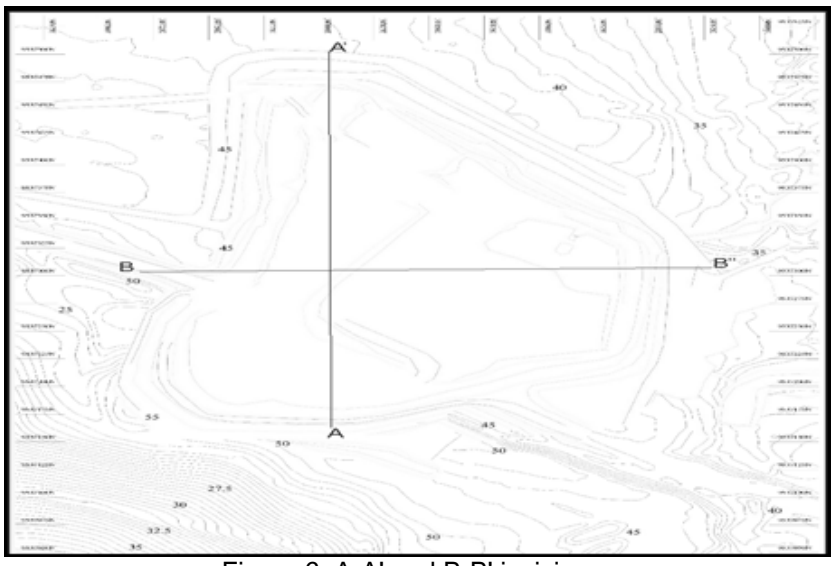

Figure 6. A-A' and B-B' incisions.

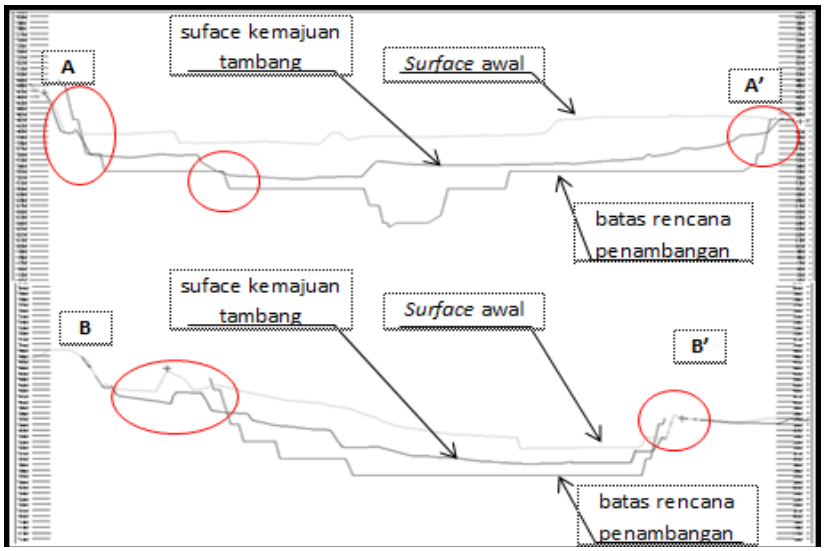

Figure 7. Overcuts.

CONCLUSION

Based on the research that has been done, it can be concluded that:

1. From the results of the mine plan research, the closest to actual mining realization is planning using input drill data with an average material movement difference of 10% and the difference in mined ore reserves an average of 12%. In comparison, detailed export data with a difference in the middle material movement is 42%, and the difference in mined ore reserves is an average of 52%.
2. In the mining realization, the tonnage of ore is more significant than planning, with an average of 10% (input drill); this is influenced by the presence of overcuts, mining activities outside the designed mining limits, and the use of different densities.

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