INDONESIAN JOURNAL OF MULTIDISCIPLINARY SCIENCE

P-ISSN: 2808-5957
E-ISSN: 2808-6724

Implementation of six sigma to improve SPIP (Facilities, infrastructure, instalations, and equipment) management at PT Berau Coal

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Keywords:

SPIP
Commisioning
BeComline
Six Sigma
DMAIC

ABSTRACT

The commissioning submission process is a significant safety program where contractors must pass a feasibility test to receive an operation feasibility sticker (SKO), ensuring that the unit is safe and ready for operation. The current commissioning process is lengthy and hindered by personnel competence issues and ineffective processes. The research aims to find out how to improve the SPIP management process to be more effective in supporting operational activities at PT Berau Coal but while maintaining mining safety management. A structured approach consisting of multiple phases is outlined, starting with an in-depth analysis of the current SPIP process. The findings are disseminated through formal presentations and reports, aiming to improve efficiency and effectiveness, evaluate centralization feasibility, and develop actionable recommendations for PT BERAU COAL. The proposed solution is to centralize the Commissioning process, improving people, processes, and technology, and eliminating detected waste and defects.

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INTRODUCTION

PT BERAU COAL, an Indonesian coal mining firm under the Sinarmas Mining Group, uses open-pit mining techniques with the assistance of 215 mining service businesses, 2,203 heavy equipment units, and 20,685 personnel (PT BERAU COAL, 2019). From 14,340,000 metric tons in 2009 to 32,350,000 metric tons in 2019, the capacity to produce coal has continued to rise.

Work safety is one of the aspects of the Minister of Energy and Mineral Resources' (ESDM) Regulation No. 26 of 2018 about the Implementation of Good Mining Practices and Supervision of Mineral and Coal Mining (Abd Karim & Sejati, 2021; Amin & Fachruddin, 2022; Andreono & Darnis, 2023; Anggoro & Simorangkir, 2019; Hadi et al., 2023; Hidayah, 2020; Nasir et al., 2023; Sapulete et al., 2022; Suryaningsi, 2020; Thamrin et al., 2023), which PT BERAU COAL operates under as a government contractor. As a result, PT BERAU COAL is responsible for overseeing the mining safety of all mining contractors and employees. Furthermore, in compliance with the Directorate General of Mineral and Coal Decree No. 06.E/37/04/DJB/2019, dated August 15, 2019, concerning the Circular Letter of Company Obligations Related to the Follow-up of Deadly Mining Accidents, the company is requested to temporarily cease all field operations until the outcomes of the accident investigation have been thoroughly investigated and/or until operational activities are guaranteed to be conducted safely and securely.

Every IUP company (in this case PT BERAU COAL) or IUJP (contractor of PT BERAU COAL) is obliged to manage mining safety, both K3 and operational safety, including planning a budget for its management and reporting it to the government. Especially regarding operational safety management, every company is required to ensure the suitability of all Facilities, Infrastructure, Installations, and Equipment (SPIP) in proper condition and ready for use to prevent accidents and support operational activities (Daniel, 2023; Fauzian, 2023; Hamdan et al., 2023; Harywibowo & Hariadi, 2022; Mapanta et al., 2024).

Commissioning or feasibility testing is the inspection and testing of equipment, machines, vehicles/units, infrastructure and other facilities, before they are operated/used in PT's operational areas. Permit & Commissioning (P&C) section of PT BERAU COAL is a section of PT BERAU COAL which

carries out tests on facilities, infrastructure, installations and equipment and provides operational feasibility stickers (SKO) as a sign that the facilities, infrastructure, installations and equipment have been completed and is suitable for use in the PT BERAU COAL operational area. The implementation of SPIP feasibility checks currently also involves a 3rd Party (Technical Inspection Service Provider) whose task is to carry out testing in accordance with existing regulations and after that the IUJP owner company (contractor) will verify the test results that have been carried out by the 3rd party including the requirements set by PT BERAU COAL so that the test results will later become one of the requirements to be submitted to PT BERAU COAL for re-verification regarding their suitability. After that, if it is declared feasible, the SPIP can be operated in the PT BERAU COAL operational area as proven by the unit's suitability sticker. The process carried out regarding SPIP management is quite long from the initial process until it is declared feasible, so there is potential delay or there are costs that arise because the process is still not optimal in its implementation.

Based on the process flow in the feasibility test management procedure and the processes that have been running, an average time of 12 days is required in the process of carrying out this feasibility test, so there is a need for a better process in managing this feasibility test to reduce time delays in the process which can later be impact on the process of activities being hampered or standby cost which appears because the unit is not operating.

With a better process in SPIP management, there is a time delay in the SPIP management process which can have an impact on the activity process being hampered or standby cost which arise because the unit is not operating, it is hoped that this can be minimized. To improve this process, the Six Sigma methodology was used to see processes that could be improved, and from this method it emerged that a suitable solution to be applied in the PT BERAU COAL company at this time was to centralize the management of the feasibility testing of the unit to be centralized and accommodated entirely by PT BERAU COAL. With a better process, it is hoped that it can have an impact on the improvement of testing process flow. In the current unit feasibility testing process, there are 3 parties involved, so that with the proposed process, all processes become centralized or only involve 1 party who will carry out unit feasibility testing as a whole process, namely from PT BERAU COAL so that the process can be carried out faster than the existing process (12 days).

The research aims to find out how to improve the commissioning submission process to be more effective in supporting operational activities at PT Berau Coal but while maintaining mining safety management. The research contribution lies in balancing the enhancement of administrative efficiency with the adherence to safety standards in the mining industry.

METHOD

The research design for analyzing the SPIP management process at PT BERAU COAL is outlined in a structured approach consisting of multiple phases, starting with an in-depth analysis of the current SPIP management process. This initial phase aims to identify inefficiencies and ineffectiveness within the system by examining both internal and external factors. Internally, the research considered procedures, challenges, and stakeholder perceptions, while externally, it analyzed regulations, technological developments, and business competition. This comprehensive analysis is intended to provide a clear understanding of the current state and identify areas for improvement.

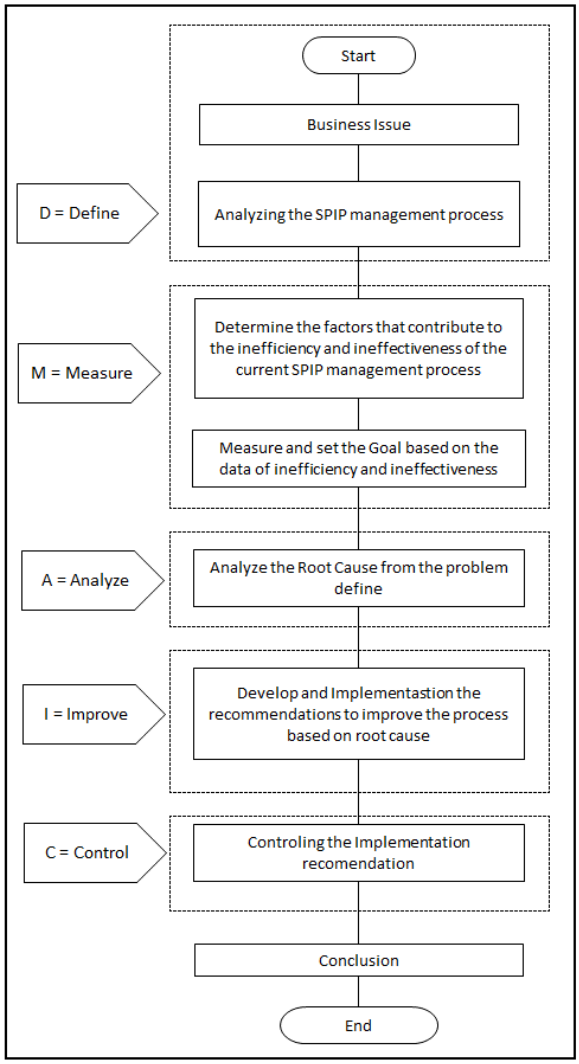

Figure 1. Research Design

Subsequent phases involve detailed steps such as determining factors contributing to inefficiencies, measuring and setting organizational goals, and conducting deep analyses to uncover root causes and success factors. The feasibility of centralizing SPIP management will be evaluated as a potential solution to enhance efficiency and effectiveness. Recommendations will be developed based on the findings, followed by the implementation and control phases where methods and procedures will be established to monitor the improvements. This includes creating a control plan document and checklist to ensure continuous monitoring and adjustments.

Data collection for this research utilized both primary and secondary sources through methods such as interviews, focus groups, and observations. Internal and external analyses will face challenges such as organizational complexity and data availability, but strategies like building good relationships with respondents and utilizing available resources will mitigate these issues. The research methodology combines qualitative and quantitative approaches to provide a thorough understanding of the SPIP management process. The findings were disseminated through formal presentations and reports, aiming to improve SPIP management efficiency, evaluate centralization feasibility, and develop actionable recommendations for PT BERAU COAL.

RESULTS AND DISCUSSION

Analysis

Define Stage

The Define stage of the unit feasibility submission process at PT BERAU COAL aims to understand and analyze existing business processes to identify discrepancies and inefficiencies. This phase involves defining the process, determining the project's scope, and pinpointing areas for improvement. A key

performance indicator for PT BERAU COAL, alongside coal production and exports, is achieving Zero Lost Time Injury (LTI), which is crucial for maintaining mining safety management. The company halts operations if a fatal accident occurs until a thorough investigation is conducted and safety is ensured. The commissioning or unit feasibility testing is a significant safety program where contractors must pass a feasibility test to receive an operation feasibility sticker (SKO), ensuring that the unit is safe and ready for operation.

In this process, various parties are involved with specific roles and responsibilities. The Permit & Commissioning section at PT BERAU COAL manages document verification, field verification, and issuance of the SKO. Contractor's plant sections ensure the unit's maintenance and safety before submission, while partner administrators prepare necessary documents and submit them for testing. The project's scope focuses on optimizing the unit eligibility application process to meet the predetermined Service Level Agreement (SLA) faster. An Input-Process-Output (IPO) diagram illustrates the submission process, aiming for approval within four days and resulting in the issuance of the SKO and operation feasibility sticker.

Measure Stage

In the Measure phase of the unit eligibility submission process, the primary goal is to identify the main problems that need improvement using historical data. A Pareto diagram is employed to pinpoint the primary causes of defects. The collected data, represented in a baseline matrix, includes metrics such as the SLA commissioning time for various processes. For instance, the average total lead time is 12 days, with a process capability (CP) of 0.33, indicating high variability and an inability to meet the specification limit of 3 days. The findings reveal that the current service process is inefficient, requiring significant improvements to reduce the average service time.

To set and monitor organizational goals, a robust measurement system is necessary. Key Performance Indicators (KPIs) are used to objectively measure business activities and project success. PT BERAU COAL leverages KPIs by analyzing data from the BeComline application database, focusing on the length and defects in the commissioning process. Historical data helps determine the percentage and trends of defects in each process. This information is visualized using Pareto diagrams to identify the primary issues, guiding targeted improvements in the commissioning process.

Analyze Stage

The Analyze stage delves into process variations, root causes, and identifies success factors critical to improving unit eligibility submissions. This stage involves collecting and analyzing data, observing field processes, and conducting brainstorming sessions with contractors and technicians. Key issues identified include rejections in the administration check, commissioning inspection, and compliance manager verification processes. Specifically, discrepancies between submitted and actual data during document submission have been noted as primary reasons for rejections.

To determine the sources of process variation, data is collected from field observations and interviews. The primary issues identified are rejections during various stages of the process, such as the Administration Check, Commissioning Inspection, and Compliance Manager Verification. Observations and interviews revealed that incomplete attachments and data discrepancies during the administrative document submission process are major reasons for these rejections.

Root cause analysis is used to identify critical factors causing variations and defects. The PMBOK Guide suggests that asking "Why?" five times can help uncover root causes. Applying this method, two main root causes for administrative submission rejections were identified: incomplete document attachments and data inconsistencies. Similarly, rejections during the Commissioning Inspection process were primarily due to data discrepancies and incomplete attachments.

Further analysis revealed specific root causes for rejections at different stages. In the Administration Check process, rejections were due to incomplete attachments and data inconsistencies. In the Commissioning Inspection process, rejections stemmed from data discrepancies during inspections and incomplete attachments. Tables summarizing these findings highlight the human and method-related causes of these issues, emphasizing the need for better documentation and accurate data submission.

Key success factors for improving the process include employee involvement, the reliability of the BEATS platform, and the integration of technology. Employees, particularly P&C technicians and partner submitters, need sufficient knowledge of the commissioning process. The BEATS platform must be dependable, accessible, and capable of real-time monitoring and verification. Integrating the BEATS platform with SID will enhance the submission and verification process, ensuring seamless monitoring and timely interventions.

Business Solution

1) Appointment of Technical Supervisor as the executor of Commissioning & routine monitoring via SAP KO: In this improvement, PT BERAU COAL assigns responsibilities related to the implementation and monitoring of implementation to technical supervisors at the contractor/applicant, by utilizing their expertise to carry out control and inspection in the preparation and implementation of commissioning. Technical supervisors who will control and monitor commissioning preparation are appointed by the contractor's PJO ("Penanggung Jawab Operasi") and submitted and authorized by the KTT ("Kepala Teknik Tambang") of PT BERAU COAL. Their duties, responsibilities are to ensure the readiness of the unit to be submitted for commissioning is in proper condition and has met the safety requirements in accordance with the existing checklist. So that with the readiness check carried out by competent technical supervisors, deviations that arise during the inspection are known and corrections are made which have an impact on the absence of deviations during the commissioning inspection carried out together with PT BERAU COAL, and of course the process becomes more effective because there are no redundant activities to make repairs again.
2) Appointment of Technical Supervisor as document submitter a.n PJO: In this improvement, the contractor's PJO appoints a technical supervisor including submitting and being authorized by the KTT who is responsible for preparing the necessary documents including checking the suitability of the documents and inputting them into the BeComline application to later become a requirement in the commissioning submission. So that with the readiness check carried out by competent technical supervisors, deviations that arise during document inspection are known and corrections are made which have an impact on the absence of deviations during the inspection of commissioning documents carried out together with PT BERAU COAL, and of course the process becomes more effective because there are no redundant activities to make document corrections again.
3) Reduce administrative & commissioning errors by Internal Commissioning: With this improvement, PT BERAU COAL requires contractors to carry out commissioning or document verification first internally, which is carried out by technical supervisors who have been authorized by KTT, where in the previous process, in the absence of internal commissioning or internal document verification, there were deviations during the checking process by PT BERAU COAL which resulted in time in the repair process and made the process longer. so that with the process carried out internally, the process becomes more effective, deviations have been identified and corrected internally, so that units that will later be submitted for commissioning verification by PT BERAU COAL are feasible and in accordance with existing requirements. So that with the process carried out internally, the process becomes more effective, deviations have been identified and corrected internally, so that units that will later be submitted for commissioning verification by PT BERAU COAL are feasible and in accordance with existing requirements.
4) Simplification & standardization of inspection items: With this improvement, PT BERAU COAL revised the inspection items contained in the commissioning form. The criteria of the check items are adjusted to the requirements contained in the regulations. So that by revising the check items, the items focus on the critical items regulated in the regulations. So that by simplifying the check items, including being carried out by technical supervisors from contractors internally, the process carried out internally, the process becomes more effective because it focuses on critical items in the inspection process, so that units that will later be submitted for commissioning verification by PT BERAU COAL are feasible and in accordance with existing requirements.
5) Make scheduling commissioning: With this improvement, PT BERAU COAL instructs the contractor to make a schedule for commissioning every day. Determine the maximum load of the number of units to be commissioned, including entering additional information into the commissioning schedule such as location, time of implementation, and employees who will carry out commissioning checks. So that by making a detailed commissioning schedule, the number of units to be commissioned is known to determine the maximum load of inspection as well as the details of the unit as well as the location and the responsible PIC can be known. With the daily load of commissioning implementation that can be known, the target of commissioning implementation can be achieved and there are no more units that are delayed for the commissioning process because too many units are carried out every day.
6) Pick-up request mechanism: With this improvement, PT BERAU COAL instructs the contractor to make a commissioning schedule every day, including entering additional information into the commissioning schedule such as location, execution time, employees who will carry out commissioning checks, including providing dedicated vehicle facilities to support commissioning activities and pick up the employees involved. So that this can reduce waiting time.

7) Determination of commissioning location: With this improvement, PT BERAU COAL instructed the contractor to make a commissioning schedule every day, including additional information into the commissioning schedule such as location, time of implementation, employees who will carry out commissioning checks, including providing special vehicle facilities to support commissioning activities and pick up the employees involved, with a predetermined area location this can eliminate confusion and delays in the commissioning process, the PIC no longer needs to look for the unit to be commissioned so that the implementation time becomes more effective and is not wasted due to finding the location where the unit to be commissioned is located.
8) Determination of time limit for corrective action (drop list by system): With this improvement, PT BERAU COAL instructs the contractor to make provisions for the time limit for repairing the Commissioning findings record, with the time limit rules for repairing findings including a list of droplists from the commissioning task list if there are corrective actions past the predetermined time limit, the contractor can better prepare the need for spare parts or the need for experts in making repairs from the commissioning findings, so that this can increase efficiency by requesting commissioning based on actual priorities that are ready.
9) Authorization to print stickers: With this improvement, PT BERAU COAL authorizes the contractor to print an operation feasibility sticker (SKO) which is used as information that the unit has passed commissioning and is suitable for use. With this delegation of authority, the waiting time that arises from the sticker printing process previously carried out by PT BERAU COAL, can be eliminated, because the contractor no longer needs to wait for the printing process carried out by PT BERAU COAL.
10) Reminder approval & WA Group feature (Quick win): With this improvement, PT BERAU COAL made improvements by adding a reminder feature to the BeComline system in HSE automation or Whatsapp, this is as information on the status of the submission when there is a reject or rejected status from P&C PT BERAU COAL when the document submission process still has deviations. With this additional feature, contractors as applicants can immediately find out if their submission is rejected or rejected, which has an impact on faster communication and approval.
11) Develop autocheck feature in BeComline: With this improvement, PT BERAU COAL made improvements by adding an auto check feature for the completeness of the commissioning application administration to ensure that the attachment documents are complete and appropriate in the BeComline Enhancement module. With this additional feature, make commissioning system settings online via the BEATS module, thereby reducing manual checks and potential errors when performing manual checks.
12) Develop online commissioning form in BEATS: With this improvement, PT BERAU COAL made improvements by adding an online form filling feature in the BeCompline application in the commissioning process, so that the commissioning process can be monitored in real time, including recording and the results of commissioning can be recorded immediately.

Evaluation and Control

Based on the temporary implementation of the corrective actions taken, the following are the results of the implementation of improvements that are collected and monitored based on the monthly report database

Table 1. Evaluation Implementation

Key Metric	Before	After	% Improvement
Process Lead Time	<3 days 21%	<3 days 100%	79%

Kepada Yth.

KTT PT. Berau Coal
Bapak Feri Indrayana
Di Tempat

Dengan Hormat,

Bersama ini kami mengajukan permohonan penunjukkan karyawan sebagai Pengawas Operasional dan Tenaga Teknis Khusus Pertambangan PT Fajar Anugerah Dinamika.

Adapun nama karyawan, tugas dan tanggung jawab Pengawas Operasional dan kewajiban Tenaga Teknis Khusus Pertambangan PT Fajar Anugerah Dinamika sebagaimana terlampir.

Demikian kami sampaikan dan atas perhatiannya kami ucapkan terima kasih

Hormat Kami	Penunjukkan oleh PT Berau Coal
Teddy Yudha Tama	Feri Indrayana
Project Manager	Kepala Teknik Tambang

Figure 1. Appointment of Technical Supervisor as the executor of Commissioning & routine monitoring

PERMIT & COMMISIONING MONTHLY MONITORING

1 Januari

Item	Commissioning				Surat Ijin Bekerja								Ijin Masuk			
	Sarana	Prasarana	Instalasi	Peralatan Pertambangan	IBDP	IBDW	IBRT	IPPM	IBDK_Infrastruktur	IBDK_Repair/ maintenanc	IBDA_Tambang	IBDA_Marine	Karyawan	Ekspedisi	Tamu	Anak Magang
1. This Month																
a. SUBMITTED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
b. VERIFICATED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
c. APPROVED	19	0	0	112	52	216	0	14	7	0	4	0	4	51	43	1
d. REJECT_AT_VERIFICATED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
e. REJECT_AT_APPROVED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

2. SLA (days)	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
a. BC - Approval	1	2	0	0	0	0	1	2	1	2	1	2	0	0	1	2	1	2	0	0	1	2	0	0	1	2	1	2	1	2	1	2
b. BC - Process	1	2	0	0	0	0	1	2	1	2	1	2	0	0	1	2	1	2	0	0	1	2	0	0	1	2	1	2	1	2	1	2
c. MK - Submition	1	2	0	0	0	0	1	2	1	2	1	2	0	0	1	2	1	2	0	0	1	2	0	0	1	2	1	2	1	2	1	2
d. MK - Correction	1	2	0	0	0	0	1	2	1	2	1	2	0	0	1	2	1	2	0	0	1	2	0	0	1	2	1	2	1	2	1	2
3. Year to Date	19		0		0		112		52		216		0		0		7		0		4		0		4		51		43		1	

Figure 2. Monthly Report Commisioning

Control Phase

To ensure that the implementation of improvement recommendations runs smoothly, can be tracked and optimized over time, the control stage is to establish processes and procedures. PT BERAU COAL should prepare control plan documents and checklists to ensure the implementation of all improvements, as shown in chapter IV.2.

To ensure whether the three business solutions used can affect better employee adoption, SAP reporting, close follow-up, and follow-up on time, control measures must be established. After each task in this control phase is completed, a joint review must be conducted with the P&C team

To see if the improvements made can be continued. If needed, the DMAIC process can be done again. The things that must be done at the control stage are:

a. Verify and record the results of improvements in accordance with established timeframes so that they can be tracked at all times.

b. Record all feedback and lessons learned during the improvement process.

c. Reassess whether there is a need to improve the results to achieve the set objectives.

The author also outlined the critical success elements, which are represented in table 10 below and include business solutions, project completion lead time, required budget, and influence on business concerns.

Implementation Plan and Justification

Based on the proposed solution presented at the improve stage, namely centralized commissioning management, People Improvement and Process Improvement are carried out internally by PT BERAU COAL and its contractors, while technology improvement will be carried out by a third party through a procurement mechanism by PT BERAU COAL's Mine Tech Dept. Furthermore, the details of the implementation plan that will be carried out are as follows:

1. People Improvement: This involves identifying and selecting qualified individuals to take on the role of Technical Supervisor. The Technical Supervisor must have the necessary technical expertise,

experience and leadership skills to oversee the commissioning process and ensure compliance with quality standards. The contractor's PJO will appoint the competent personnel. This step will start in Week 1 untuk Week 5 February 2024

2. Process Improvement: In the implementation of this improvement, it involves PT BERAU COAL and the contractor. This process starts from the implementation of document verification and commissioning carried out internally by the contractor which is carried out by technical supervisors who have been appointed by PJO and KTT, including making schedules, determining locations, and providing dedicated units for the transportation process. PT BERAU COAL will revise the commissioning procedure related to simplifying the existing process based on the improvements that will be made. This step will begin in Week 1 until week 5 of March 2024.
3. Technology Improvement: This process starts from procurement by involving vendors who will add features to the BeComline application, then the System Management Team Dept. will coordinate with the vendor to add features according to the points specified by the user. This step will begin in the period April 2024 to February 2025.

Details of the timeline related to this business improvement can be seen in the Table 2 below.

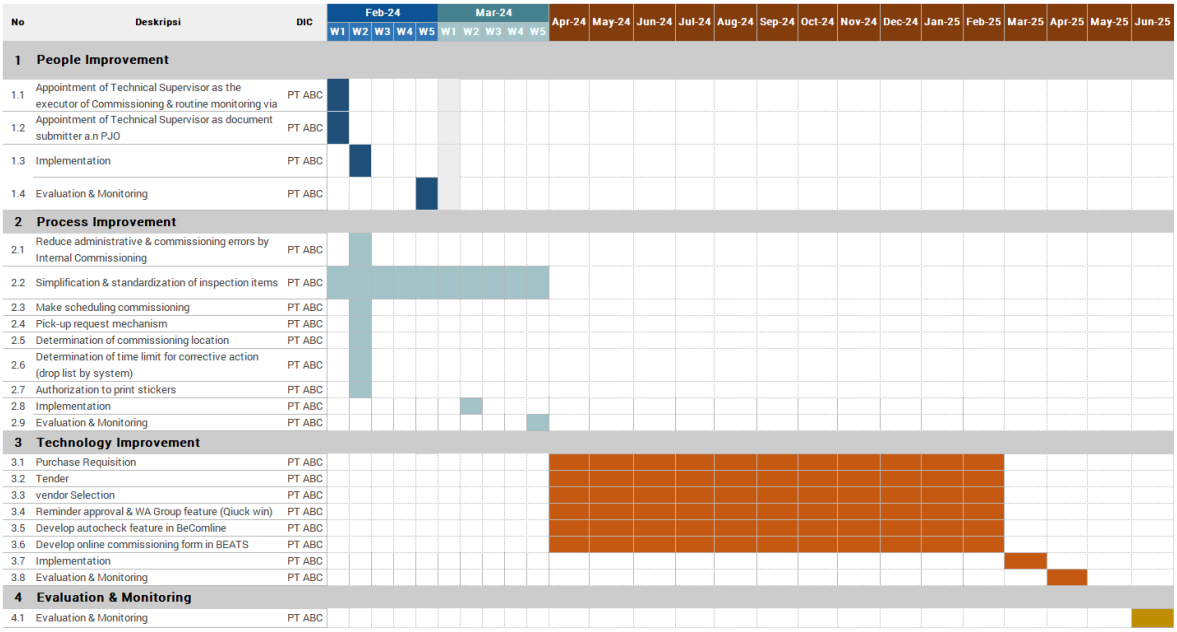

Table 2. Timeline of Business Improvement

CONCLUSION

The SPIP management process at PT BERAU COAL is criticized for its lengthy and ineffective commissioning process. To improve efficiency, the company recommends integrating technology with the BeComline application, enhancing personnel competence through features like reminder approvals and an online commissioning form. The solution aims to eliminate waste and defects, improve lead time by 79%, and ensure timely support for process simplification through a third-party implementation.

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