

The SIGAP Mechanic Program (Safe, Initiative, Agile, Secure, And Professional) to Enhance Occupational Safety Culture and Prevent Accidents at PT Antareja Mahada Makmur Workshop

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ABSTRACT:

The SIGAP Mechanic Program is an initiative to improve the occupational safety and health (K3) culture, implemented in the workshop area of PT Antareja Mahada Makmur at the Jobsite Mifa Bersaudara. This program emerged from a high number of unsafe actions and a history of incidents with the potential to cause serious accidents. Through a systematic approach based on the QCC method, the team identified problems, analyzed root causes, and set goals to foster a more disciplined, safe, and professional work culture. The improvement process involved safety training, strengthened communication between supervisors and mechanics, implementation of 5Rs, increased compliance with personal protective equipment (PPE) usage, continuous inspections, and creation of a WhatsApp-based reporting system to expedite follow-up on findings. All activities took place during the June–July 2025 period and involved synergy between the SHE and PLANT departments. Evaluation results showed a significant increase in K3 compliance, a reduction in unsafe actions, an improved assessment score for the mechanical team, and zero incidents during the program period. This improvement positively impacted quality, safety, cost efficiency, and worker morale. In addition to eliminating potential injuries, the program succeeded in reducing operational risks and driving cost efficiencies in accident handling. Ultimately, the implementation of SIGAP Mechanics proved effective in building a strong and sustainable K3 culture.

Keywords: SIGAP Mechanics; K3 Culture; Safe Behavior

INTRODUCTION

Occupational Safety and Health (K3) is a main aspect that must be fulfilled in every mining activity. The mining industry is known as a high-risk sector because it involves the use of heavy equipment, mechanical activities, hazardous energy, and dynamic working conditions. In Indonesia, the implementation of K3 is regulated in Law No. 1 of 1970, Government Regulation No. 50 of 2012 concerning SMK3, as well as the Regulation of the Minister of Energy and Mineral Resources regarding mining safety. The implementation of a good K3 system is not only aimed at protecting the workforce but also at maintaining the sustainability of production and the company's operational efficiency. Research by Syahputra (2019) shows that consistent implementation of K3 can significantly reduce the number of work accidents in the mining industry.

Mine workshop areas tend to have higher work risks due to tool maintenance activities, the use of mechanical equipment, welding, LOTO work, and direct interaction of workers with machines and tools that have the potential to cause injury. Accidents in the workshop area are mostly triggered by unsafe actions such as not using PPE, the use of damaged tools, and disorders in work procedures (Chinniah, 2015; Sehsah et al., 2020). Rahmawati's research (2020) confirms

that unsafe action is the dominant cause of mechanical accidents in the industrial environment, where 80% of accidents can be prevented through educational and supervision interventions.

In an effort to eliminate these potential risks, companies need to build a strong safety culture in the work environment. Safety culture includes the attitudes, values, and behaviors of workers that reflect concern for safety aspects. According to Hidayat & Kusuma (2021), a safety culture cannot be formed through rules alone but must be grown through training, safety communication, worker participation, and setting an example by supervisors. Therefore, the K3 culture program is one of the effective strategies in improving safe behavior in mechanical workers (Agustina, 2024; Ayu et al., 2021; Dewangga et al., 2025; Sayuti et al., 2024).

Previous research on occupational safety programs in industrial settings has demonstrated varied approaches to improving safety culture, yet gaps remain in understanding integrated interventions that combine multiple modalities (Benson et al., 2024; Bondebjerg et al., 2023; Cooklin et al., 2017). Studies have primarily focused on isolated interventions rather than comprehensive programs. Research by Gholamnia et al. (2015) emphasized the importance of systematic evaluation of unsafe behaviors through safety sampling methods, highlighting that behavioral monitoring alone, without corresponding interventions, yields limited improvement in safety outcomes. Similarly, Santoso (2022) demonstrated that K3 training in workshop areas significantly enhances worker competence, yet noted that training effects tend to diminish over time without reinforcement mechanisms. Widodo (2020) documented the critical role of 5R (Ringkas, Rapi, Resik, Rawat, Rajin - Sort, Set in Order, Shine, Standardize, Sustain) implementation in hazard control within workshop environments but acknowledged challenges in sustaining 5R practices without continuous monitoring and motivation systems. Putra (2018) found that safety communication significantly reduces unsafe actions in workplaces, demonstrating that supervisor-worker communication channels are essential for safety culture development, yet implementation barriers include time constraints and communication skill deficiencies among supervisors.

However, these previous studies reveal a critical research gap: most existing interventions implement single-modality approaches (training only, communication only, or inspection only) rather than integrated, multi-component programs that address safety culture from multiple dimensions simultaneously (Marie et al., 2025; Xue et al., 2025). Furthermore, limited research has explored the effectiveness of technology-enabled safety reporting systems, particularly mobile messaging platforms like WhatsApp, in enhancing real-time incident reporting and follow-up in industrial settings. The SIGAP Mechanic Program (Safe, Initiative, Agile, Secure, And Professional) to Enhance Occupational Safety Culture and Prevent Accidents at PT Antareja Mahada Makmur Workshop addresses these gaps by presenting a novel integrated approach that uniquely combines five complementary components: (1) comprehensive safety education and training; (2) structured safety communication enhancement between supervisors and mechanics; (3) systematic 5R implementation with continuous reinforcement; (4) routine inspection protocols with accountability mechanisms; and (5) WhatsApp-based real-time reporting system for immediate hazard identification and response. This multi-component integration, grounded in the

QCC methodology and PDCA cycle, represents an innovative approach to safety culture development that has not been adequately documented in previous literature, particularly in mining workshop contexts.

The novelty of this research lies in several key aspects: First, the program integrates multiple intervention modalities into a cohesive system where each component reinforces the others, creating synergistic effects that exceed the sum of individual interventions. Second, the incorporation of WhatsApp as a reporting medium represents an innovative use of ubiquitous mobile technology to overcome traditional barriers to safety reporting, including accessibility, immediacy, and ease of documentation. Third, the competitive team-based structure (six teams with assessment-based evaluation) introduces gamification elements that enhance engagement and motivation beyond conventional compliance-driven approaches. Fourth, the program specifically targets the mechanical workshop environment in mining operations—a high-risk context that has received insufficient attention in safety culture research compared to production or extraction areas. Finally, the systematic documentation of quantitative outcomes (percentage improvements in compliance, reduction in unsafe actions, assessment score changes) provides empirical evidence for program effectiveness that can inform similar interventions across the mining industry.

The specific research objectives of this study are: (1) to identify and analyze the root causes of unsafe behaviors and inadequate safety culture in the mechanical workshop environment through systematic problem identification methods; (2) to design and implement a comprehensive, multi-component safety culture intervention program based on identified root causes; (3) to quantitatively measure changes in safety compliance, unsafe action frequency, and overall safety culture indicators following program implementation; (4) to evaluate the effectiveness of integrated interventions combining training, communication, 5R implementation, inspections, and technology-enabled reporting; and (5) to document best practices and lessons learned for potential replication in similar industrial workshop settings. The implications of this research extend beyond the immediate organizational context: Successfully demonstrating that integrated, multi-modal interventions can achieve substantial improvements in safety culture (42.4% improvement in compliance, 82.2% reduction in unsafe actions) provides actionable evidence for mining companies and other high-risk industries seeking to enhance workplace safety. The documented approach offers a replicable model for safety culture transformation that addresses both technical and behavioral dimensions, potentially contributing to industry-wide reduction in occupational injuries and fatalities.

Based on these conditions and needs, PT Antareja Mahada Makmur Jobsite Mifa Bersaudara developed the SIGAP Mechanic Program, which is a learning-based, competition, inspection, and safety reporting program that aims to improve the K3 culture for workshop mechanics. The program is structured using the Quality Control Circle (QCC) approach and the PDCA cycle, which emphasize root cause analysis and implementation of continuous improvement. With this program, it is hoped that there will be an increase in K3 compliance, a reduction in unsafe actions, and the creation of a safe and productive work environment.

METHOD

This study used mixed methods, combining quantitative and qualitative data to produce a comprehensive analysis. Quantitative data were obtained through measurements of the frequency of unsafe actions, SIGAP Mechanic assessment results, and K3 inspection recaps before and after the intervention. Meanwhile, qualitative data were obtained through field observations, interviews, and documentation of activities. This design allowed researchers to assess intervention effectiveness directly, compare conditions before and after the program, and understand factors influencing mechanical safety culture in the workshop. Thus, the study design provided a comprehensive overview of the K3 culture program's implementation and impact on improving occupational safety.

The population comprised all objects involved in the study. In this study, the population consisted of employees from PT Antareja Mahada Makmur Jobsite Mifa Bersaudara in the Plant Department who were members of the SIGAP Mechanic teams—six teams, each with four members (one leader and three mechanics). Thus, the total population was 24 people.

Data collection involved both primary and secondary data. Primary data were gathered through analysis of initial and final study results from the population. Secondary data included the company's profile, business processes, mining safety performance reports, and supporting literature related to relevant theories.

Several data collection techniques were employed, including direct observation of the population. Data were also collected through interviews and assessments using a predetermined questionnaire. Secondary data were obtained via literature review. Additionally, the process was supported by specific instruments, with the SIGAP Mechanic program assessment form serving as the primary tool.

Data analysis employed a mixed-methods approach to achieve a comprehensive understanding of the SIGAP Mechanic program's effectiveness. Quantitative data were analyzed by comparing pre- and post-intervention conditions using pre-post analysis techniques. Numerical data—such as unsafe action frequency, SIGAP Mechanic assessment results, and KTA/TTA report numbers—were processed into percentages, trend graphs, and calculations of increases or decreases. These measurements were used to evaluate the intervention's impact on safe behavior and K3 procedure compliance. This quantitative analysis provided an objective depiction of changes during program implementation.

In addition to quantitative analysis, qualitative data from field observations, interviews with mechanics and supervisors, and activity documentation were analyzed using thematic analysis techniques. This process involved data reduction, presentation, and conclusion-drawing to identify behavioral patterns, implementation barriers, and workers' perceptions of safety culture. Qualitative results were then triangulated with quantitative data to enhance finding validity. This approach ensured that program evaluation went beyond numbers to consider non-technical factors—such as motivation, attitudes, and work environment—that greatly influenced K3 culture success. Thus, the data analysis provided a comprehensive assessment of the SIGAP Mechanic program's effectiveness and sustainability.

The research model was an action research model oriented toward continuous improvement. This model emphasized active involvement of researchers and workers in problem identification, solution design, intervention implementation, and result evaluation to produce real field changes. In this study, the action research model was applied through a participatory approach involving mechanics, supervisors, and SHE teams as both subjects and partners in the safety improvement process. This model enabled researchers to integrate observation, training, education, inspection, and evaluation activities directly to enhance K3 culture in the workshop.

This study also adopted the PDCA (Plan–Do–Check–Action) model as the primary framework for managing intervention stages. In the Plan stage, the research team analyzed root causes of unsafe actions using fishbone diagrams and 5 Whys. The Do stage involved implementing the SIGAP Mechanic program, including training, safety education, K3 communication, and routine inspections. The Check stage focused on evaluating behavior changes and measuring unsafe action reductions, while the Action stage was used to develop further improvements and standardize procedures. The PDCA model's integration into this action research made the process more systematic, measurable, and impactful for improving mechanical safety culture.

RESULTS AND DISCUSSION

Identify the Initial Problem and Root Cause

PT Antareja Mahada Makmur Jobsite Mifa Bersaudara has determined that it is a coal mining company that has implemented an integrated policy system such as Mining Occupational Safety and Health Policy, Living Environment, Quality, Energy and Information Security). The company also makes several considerations in formulating applicable policies. These considerations are related to laws and regulations related to the company's business processes and the current state of the company's environment.

The policy also contains the essence of the Regulation of the Minister of Energy and Mineral Resources Number 1827 K/30/MEM/2018 concerning References for the Implementation of Good Mining Engineering Principles, especially Attachment IV concerning the Implementation of the Mineral and Coal Mining Safety Management System, as well as the Decree of the Director General of Mineral and Mineral and Mineral and Mineral and Coal Mining Number 185.K/37.04/DJB/2019 concerning Technical Instructions for the Implementation of Mining Safety and Mining as well as the Implementation, Assessment, and Reporting of the Mineral and Coal Mining Safety Management System in Annex II, is an important foundation in the implementation of mining safety. (Rizky, 2022).

In realizing its goals, PT Antareja Mahada Makmur sets goals, objectives, and programs that must be achieved within a certain period of time. One of the things that must be achieved is in the aspect of safety that must not exceed the threshold that has been set. In 2025 PT Antareja Mahada Makmur must be zero from several aspects of accidents such as zero first aid injuries, medical treatment injuries, lost time injuries, and even fatalities. However, danger will always be inherent in every work area. The occurrence of accidents is caused by several factors. According to Heinrich

in his research, it was found that 88% of accidents that occur in the work environment are caused by unsafe actions from humans (unsafe actions), 10% are caused by unsafe working conditions (unsafe conditions) and the other 2% are caused by God's destiny (Salim & Maldi, 2019). The International Labour Organization (ILO) also stated that work-related accidents are basically caused by three factors including human factors, occupational factors and workplace environmental factors. Based on this, it can be said that unsafe behavior is the biggest cause of accidents in the workplace (Gholamnia et al., 2015)



Figure 1. Frank E. Bird's Accident Pyramid

Based on figure 1, the accident pyramid according to the theory of Frank E. Bird illustrates the critical relationship between minor incidents and major accidents. According to this widely-accepted safety model, the pyramid demonstrates that for every major injury or fatality at the apex, there are exponentially more incidents of decreasing severity at lower levels: typically 10 serious injuries, 30 minor injuries, 600 near-misses (incidents with potential to cause injury but did not), and thousands of unsafe acts or conditions at the base. This hierarchical relationship indicates that if minor unsafe conditions and behaviors are left unaddressed and uncorrected, they accumulate and increase the probability of progression to more severe incidents, ultimately leading to peak events such as serious injuries or fatalities.

The model emphasizes a fundamental principle of preventive safety management: systematic identification and elimination of unsafe acts and conditions at the pyramid's base can prevent the occurrence of more serious incidents at higher levels. This theoretical framework directly supports the rationale for the SIGAP Mechanic program, which targets the foundation of the pyramid by addressing unsafe behaviors, enhancing safety awareness, and establishing proactive hazard identification systems before minor issues escalate into significant incidents. This is related to the cultivation of occupational safety and health aspects with the aim of instilling safe behavior habits in operational activities. To foster K3 culture, the SHE department designed a program related to the cultivation of K3 aspects. The program is in line with the results of the national working

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meeting of the SHE PPA Group department which is stated in point 12, namely: "SHE department works with the Plant department to alleviate accidents that result in injuries".

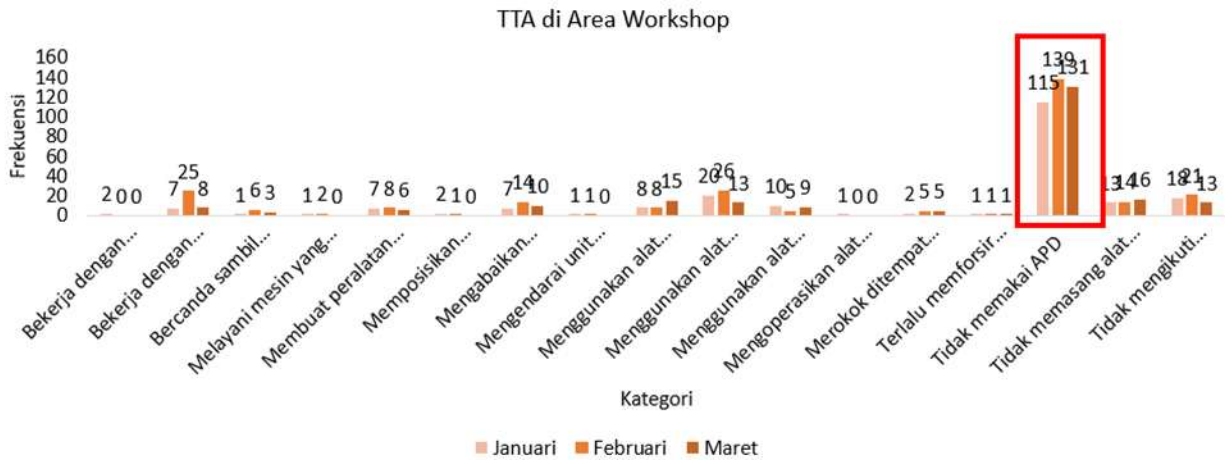


Figure 2. reports of unsafe actions

The image above is a graph containing reports of unsafe actions that occurred in the workshop area. For three consecutive periods, the highest was the reporting of unsafe acts related to the undisciplined use of PPE (Personal Protective Equipment). Based on these results, it can be concluded that there is a lack of awareness from every worker, both mechanics and supervisors in the Plant area, about small things that can support safety.

Identify the Root Cause

Determination of the root of the problem through several processes implemented. In this study, to determine or identify problems or needs related to safety aspects in the field is determined by conducting an assessment based on the form that has been made. There are 5 aspects that are assessed, including K3 Discipline, Regulation, and Administration, 5R Implementation, Safety Communication and Safety Campaign, Rescue, Work System, Skills, and Practice. From these five aspects, we can identify what things need to be fixed in the field.

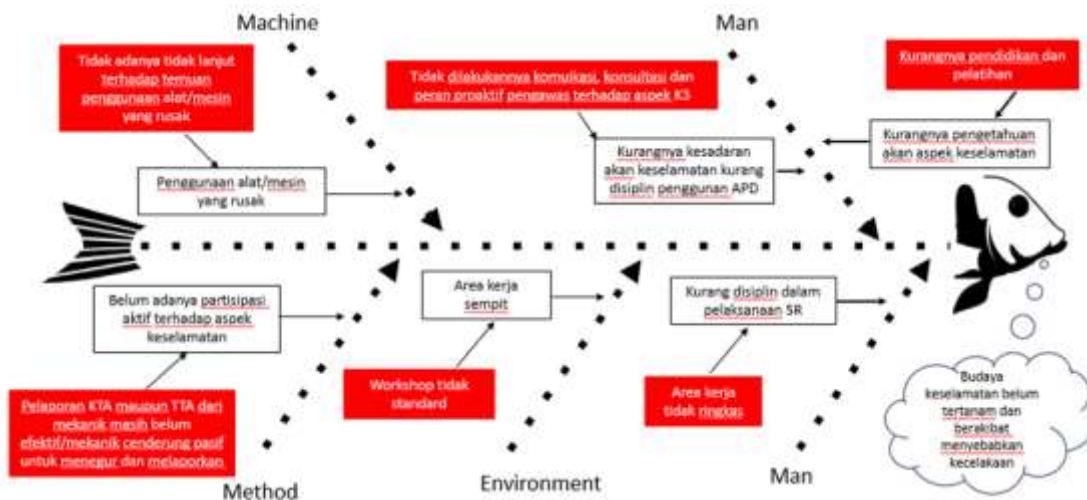


Figure 3. SIGAP Mechanical Fishbone Diagram

Based on figure 3, we can see that after the first stage of the assessment, the results were obtained that there were six root problems that occurred in the Plant's work area. The first root of the problem on the Man side is that there is still a lack of safety education and training. The second root of the problem is still on the Man side, namely the lack of communication, consultation, and the proactive role of supervisors on the K3 aspect, and the root of the problem from the last Man side is our work area that is not concise. The next root of the problem from the Machine side is the lack of follow-up on the findings of the use of damaged tools/machines. The next root of the problem is related to the reporting of KTA and TTA from mechanics who are still ineffective/mechanics still tend to be passive in reprimanding and reporting. The root of the last problem is that the workshop is not standard, but it is not chosen as a problem solving because it requires high costs and a long time. To analyze the cause and effect of the above problems we use the following table.


Table 1. Causal Analysis of Fishbone Mechanics SIGAP

No	Category	What	Why
1	Man	Lack of awareness of safety	Lack of direct communication and consultation in the field
2		Lack of basic understanding of safety aspects	Mechanics are not given continuous and comprehensive safety training
3		Work area is not compact	Failure to implement 5Rs in a comprehensive manner
4	Machine	Use of damaged tools/machines	There has been no proactive action from the user (mechanic)
5	Method	There is no active participation in the safety aspect	Mechanics tend to be passive in reprimanding and reporting





Solution Implementation and Data Analysis Results

Based on the results of the causal analysis using the fishbone method, there is a root cause of a problem that has been identified. This is a reference for improvements that will be developed in the SIGAP Mechanics program. The following are the corrective actions taken based on the results of the root cause analysis of the problem.

Table 2. Solution Implementation and Data Analysis Results

Alternative Solutions	Outcome Opportunities	Implementation
Continue to provide education and socialization directly/indirectly to mechanics on safety aspects	Safety communication is carried out continuously, both direct and indirect	

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<p>Providing education and training related to safety aspects</p>	<p>Implementation of comprehensive education and training</p>	
<p>Conducting education and reminders related to the implementation of the 5Rs</p>	<p>Delivery of <i>training materials</i> in accordance with the expected knowledge competencies</p>	
<p>Conducting routine inspections of workshop areas and following up on findings on related PICs</p>	<p>The implementation of inspections is carried out routinely and follow-up on findings</p>	
<p>Create a WhatsApp group as a medium for reporting and follow-up on the findings of TTA and KTA</p>	<p>KTA and TTA reporting and follow-up are carried out in an effort to reduce the potential for incidents</p>	

After implementation, a quantitative analysis was carried out which showed a positive trend related to increasing awareness and knowledge of safety aspects. The trend was obtained from the results of the comparison of the first and second assessments during the SIGAP Mechanics program. The following is a graph of the difference in results from the two assessments carried out.

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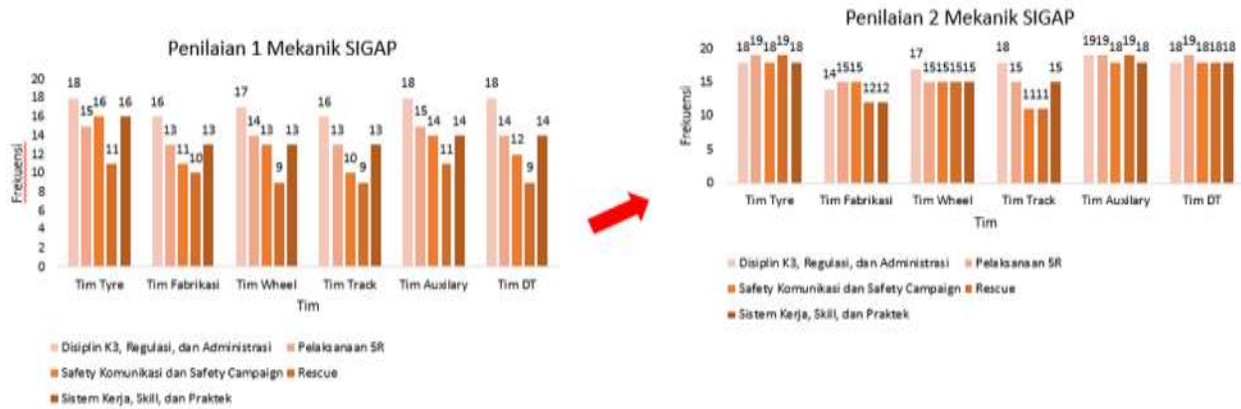


Figure 2. Comparison Chart of Assessment 1 and 2 of SIGAP Mechanic Program

The picture above is a graph of the results of assessments 1 and 2 of the SIGAP Mechanic program. The assessment carried out on these 5 aspects has a total score of 20. In assessment 1, there are still scores from the assessment results that are still fluctuating from each team and each aspect of the assessment. Then after the first assessment was carried out, several root problems were obtained, and treatment was given to reduce the problem so that the results of the second assessment were obtained. In this assessment, it can be seen that there is a significant increase in each item. Then after the total assessment results were obtained, each team got a score above the threshold. The value is stated in the following graph

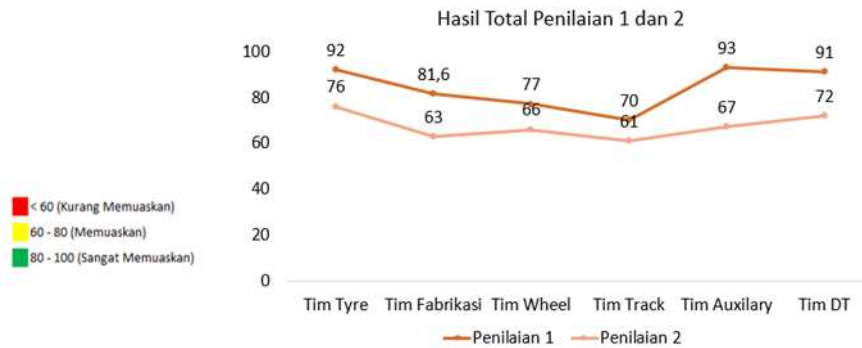


Figure 3. Total Assessment Results 1 and 2

The continuous treatment of treatment also affects bad habits related to safety aspects. This is characterized by a habit that slowly begins to form from small things. The following is data on the decrease in the findings of unsafe actions and lack of use of PPE before being given treatment and after being given treatment.

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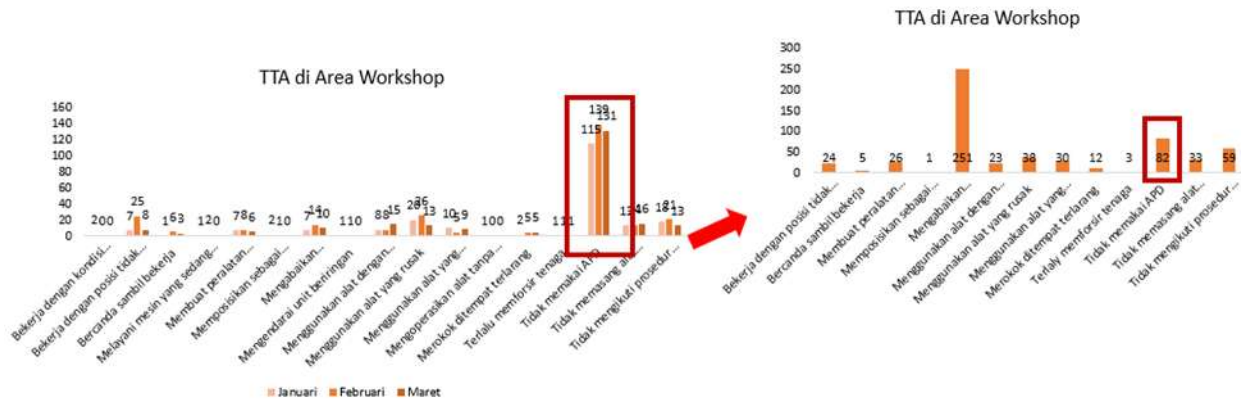


Figure 4. Reduction in Findings of Unsafe Actions Not Using PPE

CONCLUSION

This research on cultivating safety and work habits among mechanics and group leaders at PT Antareja Mahada Makmur Jobsite Mifa Bersaudara through the SIGAP Mechanic Program (Safe, Initiative, Agile, Secure, and Professional) demonstrated positive impacts, including increased knowledge via program assessments, a reduction in unattended minor findings from pre-program levels to zero incidents during implementation, and enhanced overall safety culture supporting good habits. These outcomes fostered a sense of security and comfort for mechanics and supervisors in the Plant Department during operational processes. For future research, longitudinal studies could track the program's long-term sustainability of zero-incident rates and habit retention beyond 12 months, while exploring scalability to other high-risk mining departments or integrating digital gamification tools for broader engagement.

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