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Research Article

Development of an Evaluative Tool for Occupational Health Service Contractors in Mining Based on CSMS

Christian Sipayung[1]

1. Program Magister Terapan Keselamatan dan Kesehatan Kerja, Universitas Gadjah Mada, Yogyakarta, Indonesia; sipayungchristian75@gmail.com

Corresponding Author, Email: sipayungchristian75@gmail.com (Christian Sipayung)

Abstract

Occupational health service contractors play a key role in ensuring occupational safety and health (OSH) in high-risk industries, especially in remote operational areas. However, the selection process for contractors at PT. ABC Indonesia relies heavily on an administrative approach and lacks a comprehensive, structured, and risk-based evaluative instrument. This can affect the quality of occupational health services and contractor independence in supporting company operations. This study aims to develop a valid, objective, and applicable evaluative instrument for assessing the feasibility of occupational health service contractors based on the Contractor Safety Management System (CSMS). The research uses a Research and Development (R&D) approach in two stages: content validation using the Content Validity Index (CVI) method, with input from six experts in OSH, contractor management, and occupational health services, and the determination of priority weights using the Analytical Hierarchy Process (AHP). The instrument was based on eight CSMS domains, operationalized into 24 indicators. The results show that all indicators had high content validity with i-CVI and S-CVI/Ave values of 1.00. AHP results indicated that the most dominant criterion in determining contractor feasibility was Leadership and Top Management Commitment, followed by planning, risk control, and emergency preparedness. The final instrument is valid, consistent, and suitable for use in contractor selection at PT. ABC Indonesia. This study aims to improve the objectivity of the contractor selection process and enhance OSH service quality and operational safety in the mining industry.

Keywords: Contractor Safety Management System (CSMS), Occupational Health Service Contractors, Content Validity Index (CVI), Analytical Hierarchy Process (AHP), Occupational Safety and Health.

INTRODUCTION

The mining industry is a sector with high occupational safety and health (OSH) risks, particularly in operational areas located in remote regions. The geographical conditions, limited access to external healthcare facilities, and the potential for work-related accidents and occupational diseases necessitate the availability of a reliable and standardized occupational health service system. In this context, occupational health service contractors play a strategic role as an extension of the company's function in providing medical, promotive, preventive, curative, and emergency services.

However, the process of selecting occupational health service contractors in many mining companies is still administrative in nature and lacks support from a structured and risk-based evaluative instrument. Adopting a more risk-based approach to safety and health management could address this gap and improve the overall effectiveness of contractor selection (Umar & Arifin, 2025). The contractor feasibility assessment is generally limited to document completeness checks, without in-depth evaluation of operational readiness, human resource competency, OSH management systems, and medical emergency response capabilities. This highlights the need for a more structured and risk-based evaluation system, such as CSMS, to better assess contractor capabilities (Rizki et al., 2024). This condition may lead to low contractor independence and excessive dependence on the company's internal units (Tualeka et al., 2023).

The Contractor Safety Management System (CSMS) has been widely adopted as a framework for evaluating technical contractors in high-risk industries (Anaraki & Manshour, 2025; Frantzeskaki et al., 2019). Furthermore, recent studies emphasize the use of web-based systems to enhance the operational efficiency and safety of contractors, highlighting the need for continuous improvements in contractor management (Usman & Rokhmat, 2025). However, the application of CSMS specifically for occupational health service contractors is still relatively limited and not supported by standardized assessment instruments. Several studies emphasize that structured CSMS implementation has been proven to enhance safety and reduce work-related accidents in mining operations by improving contractor compliance, risk management, and performance monitoring (Amalina & Larasati, 2020). The integration of systems like the Mining Safety Management System (SMKP) also supports this improvement in operational safety and compliance (Ernawati & Haryanto, 2025). Moreover, previous studies have shown that the adoption of CSMS in mining companies contributes to improved safety standards and overall operational safety (Sudrajat et al., 2026). Therefore, this study aims to develop an evaluative instrument for the feasibility assessment of occupational health service contractors based on CSMS that is valid, objective, and applicable to support the internal selection process of mining companies.

METHODS

This study is applied research with a Research and Development (R&D) approach aimed at producing an evaluative instrument. The instrument development process is carried out systematically through two main stages: content validation

using the Content Validity Index (CVI) method and determination of priority weights using the Analytical Hierarchy Process (AHP).

The initial stage of the research began with a literature review of CSMS documents, OSH management system standards, and scientific references related to contractor evaluation and occupational health services. The results of the literature review were used to develop the initial draft of the instrument, which consists of eight main domains: (1) Leadership and Top Management Commitment; (2) Policy and Strategic Objectives; (3) Organization, Responsibility, Resources, Standards, and Documentation; (4) Hazards and Effect Management; (5) Planning and Procedures; (6) Implementation and Performance Monitoring; (7) Audit and Review; and (8) Emergency Response Procedure. These eight domains were operationalized into 24 assessment indicators.

The literature review specifically focused on existing frameworks such as the Contractor Safety Management System (CSMS), which has been widely adopted as a standard for evaluating contractors in high-risk industries. Studies have shown that implementing a structured CSMS significantly enhances contractor safety, risk management, and operational performance in the mining industry (Sudrajat et al., 2026). Furthermore, the integration of the Mining Safety Management System (SMKP) with a strong safety culture has been shown to improve contractor evaluation processes in mining operations (Sukadi et al., 2023). Moreover, previous studies have shown that the adoption of CSMS in mining companies contributes to improved safety standards and overall operational safety (Abd Karim & Sejati, 2021). Furthermore, the integration of the Mining Safety Management System (SMKP) with a strong safety culture has been shown to improve contractor evaluation processes in mining operations (Sukadi et al., 2023). The implementation of a risk management approach for contractors, as highlighted in the study by Vilianni & Kustiawan (2023), emphasizes the importance of systematic contractor asssessments to mitigate health and safety risks, ensuring high compliance and operational readiness.

Content validation of the instrument was carried out by six experts with experience and competence in OSH, contractor management, and occupational health services. Each indicator was assessed using a four-point scale to measure relevance. The ratings were then converted dichotomously, and the Item-level Content Validity Index (i-CVI) and Scale-level Content Validity Index (S-CVI/Ave) values were calculated (Amalina & Larasati, 2020).

The next stage was determining the priority weights of the domains using the AHP method. Experts were asked to perform pairwise comparisons between the domains using the Saaty scale (1–9) (Saaty et al., 2022). The individual assessments were aggregated using the geometric mean to form a pairwise comparison matrix. Then, eigenvector calculations and consistency testing were performed using the Consistency Ratio (CR), with an acceptance threshold of ≤ 0.10.

RESULT AND DISSCUSSION

This section presents in detail the stages and key outputs of developing an evaluative instrument for the feasibility assessment of occupational health service contractors based on the Contractor Safety Management System (CSMS), including

the results of instrument development, content validation, and criteria weighting using the Analytical Hierarchy Process (AHP).

Development of the Evaluative Instrument

The developed evaluative instrument consists of eight main CSMS domains specifically adapted for the context of occupational health service contractors in the mining industry. These eight domains include: (1) Leadership and Top Management Commitment, (2) Policy and Strategic Objectives, (3) Organization, Responsibility, Resources, Standards and Documentation, (4) Hazards and Effect Management, (5) Planning and Procedures, (6) Implementation and Performance Monitoring, (7) Audit and Review, and (8) Emergency Response Procedure.

Each domain is broken down into operational indicators that can be observed and objectively assessed. A total of 24 indicators reflect aspects of leadership, organizational governance, health human resources competency, medical facility and equipment readiness, occupational health risk control, and medical emergency preparedness. The development of these indicators was based on a synthesis of CSMS literature, OSH management system standards, and the operational needs of occupational health services in remote mining locations.

Content Validation of the Instrument

Content validation of the instrument was conducted using the Content Validity Index (CVI) method, involving six experts with backgrounds in occupational safety and health, contractor management, and occupational health services. The experts were asked to assess the relevance of each indicator using a four-point scale.

The results showed that all indicators achieved an Item-level Content Validity Index (i-CVI) of 1.00. This means that all experts agreed that each indicator was relevant or highly relevant. Additionally, the Scale-level Content Validity Index based on the average (S-CVI/Ave) also reached 1.00, indicating perfect agreement among the experts on the entire instrument.

The very high CVI values indicate that the developed indicators are well-suited for the context of assessing the feasibility of occupational health service contractors and do not require substantial revision or elimination. Therefore, the instrument is considered to have excellent content validity and is suitable for use in the next evaluation stage.

Criteria Weighting Using AHP

The next stage of the research was determining the priority weights of each domain in the instrument using the Analytical Hierarchy Process (AHP). The experts were asked to perform pairwise comparisons between the domains based on their importance in determining the feasibility of occupational health service contractors.

The aggregation of individual assessments using the geometric mean produced a pairwise comparison matrix, which was then analyzed to obtain the eigenvector values as the priority weights for each domain. The analysis showed that the Leadership and Top Management Commitment domain had the highest weight compared to the other domains. This finding emphasizes that the commitment of the

contractor's leadership and top management is seen as the most crucial factor in the successful implementation of occupational health services.

The next highest priority domains are Planning and Procedures and Hazards and Effect Management. These domains highlight the importance of systematic planning and the contractor's ability to identify, control, and mitigate health and safety risks. The Emergency Response Procedure domain also received a relatively high weight, indicating that medical emergency preparedness is a critical aspect of mining operations, particularly in areas with limited access to referral facilities.

The consistency test on the pairwise comparison matrix showed that all Consistency Ratio (CR) values were below the threshold of 0.10, indicating that the expert assessments were logically consistent and the weighting results were methodologically acceptable.

Overall, the results of this study produce an evaluative instrument that is not only content-valid but also has a clear and consistent priority structure. This instrument is ready to be used as a decision-making tool in the selection and evaluation process of occupational health service contractors in the mining industry.

Discussion

The discussion in this study focuses on the interpretation of the results of developing and testing the evaluative instrument for the feasibility assessment of occupational health service contractors based on the Contractor Safety Management System (CSMS), and its relevance to the operational needs of the mining industry.

The content validation results using the Content Validity Index (CVI) show that all the developed indicators achieved i-CVI and S-CVI/Ave values of 1.00. This indicates complete agreement among the experts that these indicators are relevant, clear, and represent important aspects in assessing the feasibility of occupational health service contractors. The high validity values indicate that the instrument has effectively captured the specific characteristics of occupational health services in the mining environment, including clinical aspects, medical preparedness, and integration with the company's OSH management system.

The success of the content validation also shows that the domain-based indicator development approach was deemed appropriate by the experts. This strengthens the argument that CSMS is not only relevant for technical contractors, such as in construction or maintenance, but can also be effectively adapted for occupational health service contractors with different risk characteristics and responsibilities.

The weighting results using the Analytical Hierarchy Process (AHP) provide a deeper understanding of the priority criteria in the contractor feasibility assessment. The Leadership and Top Management Commitment domain received the highest weight compared to the other domains. This finding indicates that the success of occupational health service provision is significantly influenced by the commitment of the contractor's leadership and top management, particularly in resource provision, strategic decision-making, and enforcement of OSH standards and medical services. Without leadership commitment, the implementation of procedures and the fulfillment of standards tend to be administrative and unsustainable.

The next highest priority domains are Planning and Procedures, and Hazards and Effect Management. This reflects the importance of systematic planning and the contractor's ability to identify, control, and mitigate health and safety risks in the provision of medical services in mining areas. Occupational health service contractors are required not only to provide curative services but also to have clear procedures for identifying occupational health risks, preventing work-related diseases, and handling medical emergencies that could disrupt company operations.

The significant weight of the Emergency Response Procedure domain emphasizes that emergency preparedness is a crucial aspect in the context of remote mining locations. The limited access to external referral healthcare facilities requires contractors to have a reliable medical emergency response system, including competent medical staff, equipment availability, and coordination with the company's emergency response system. This finding is in line with the high-risk characteristics of the mining industry, which requires prompt and accurate medical responses.

Overall, the results of this study show that the developed evaluative instrument functions not only as an initial selection tool for contractors but also as a continuous evaluation tool for the performance of occupational health service contractors. With clearly defined priority weights for each domain, companies can conduct more objective, transparent, and risk-based assessments. Furthermore, this instrument can be used as a basis for contractor development, helping contractors understand their strengths and weaknesses that need improvement.

Thus, this discussion affirms that the integration of CSMS in the feasibility assessment of occupational health service contractors is a relevant and applicable approach to improving the quality of occupational health services and supporting operational safety in the mining industry.

Research Limitations

This study has several limitations. First, the number of experts involved was relatively limited, although it met the minimum recommendations for CVI and AHP validation. Second, the research was conducted in the context of a single mining company, so generalizing the results should be done cautiously. Further research with field implementation tests and empirical reliability analysis is highly recommended.

Table 1. Evaluation Instrument for Feasibility Assessment of Occupational Health Service Contractors Based on CSMS

Code	Question	Documentation Evidence	Yes/No	Notes
K1	LEADERSHIP AND TOP MANAGEMENT COMMITMENT			
K1-1	How does senior management ensure individual involvement, understanding, and commitment of the entire organization to OSH and operational performance,	• Evidence of involvement in the development of OSH Policy or Commitment Letter. • Evidence of senior management site visits (photos, attendance, inspection/GEMBA reports).		

	while building a positive compliance culture?	• Evidence of leading or attending OSH meetings (Minutes of Meeting). • Objective, Target, and OSH Program documents for the current year. • Evidence of socialization of OSH Objectives, Targets, and Programs to all employees. • OTP Monitoring Plan (Objective, Target, Program).	
K2	POLICY AND STRATEGIC OBJECTIVES		
K2-1	Does the company have a corporate policy document related to OSH (if yes, please attach), who is fully responsible, and how is compliance with and communication of the policy carried out in the organization?	• Corporate/OSH policy signed, stamped, and dated by top management. • Organizational structure signed, stamped, and dated by top management. • Evidence of socialization of Corporate/OSH policy to all employees, e.g., attendance list or photos posted in office areas.	
K3	ORGANIZATION, RESPONSIBILITY, RESOURCES, STANDARDS AND DOCUMENTATION		
K3-1	How is management involved in operational and OSH activities, including setting goals, monitoring performance, and conducting communication and meetings related to OSH in the organization?	• OSH Objective / Operational Objective, Target, and Program (for First Audit). • Organizational structure of the company signed and stamped by the unit head (First Audit). • Documentation of OSH communication (for Re-audit), such as: 1. MoM of OSH Meeting and attendance list 2. MoM of P2K3 Meeting and attendance list 3. MoM of Safety Toolbox Talk and attendance list 4. Supporting photos if available • SOP P2K3. • P2K3 organizational structure along with job descriptions of the Chairman, Secretary, and Members. • P2K3 meeting schedule. • Safety Toolbox Talk schedule.	
K3-2	Have all managers and supervisors at every level	• Evidence of attendance at safety leadership training.	

	who plan, monitor, estimate, and perform work received OSH training according to their responsibilities?	• Certificates / Licenses (training or courses previously attended). • Evidence of attending OSH seminars.	
K3-3	What arrangements has the company made to ensure that all employees, including new employees and subcontractors, have basic knowledge of OSH operations, understand OSH policies and practices, and maintain up-to-date knowledge?	• SOP for internal OSH training. • Internal OSH training schedule. • Training attendance list. • Safety Induction Program and materials. • OSH training materials. • Training matrix for all positions. • Training certificates. • Vendor/subcontractor qualifications.	
K3-4	How does the company identify operational locations requiring special training to address specific hazards (such as radioactive materials, asbestos, explosives, diving, etc.)?	• Hazard Identification, Risk Assessment, and Control documents. • Special or mandatory training programs and certification (if applicable). • Photocopies of related certificates.	
K3-5	Does the company use subcontractors for this work? If yes, explain the subcontractor selection procedure regarding OSH, and how does the company assess contractors to ensure their compliance with OSH policies and standards?	• Company SOP related to assigning work to subcontractors/contractor selection. • Evidence of implementing the subcontractor SOP, if any. • Evidence of subcontractor performance evaluations. • List of subcontractors used.	
K3-6	What OSH regulations or industry standards are used for the work being done, and how does the company ensure that these standards are met and consistently monitored?	• Work equipment manual (if available). • Company certifications, such as SMKP, SMK3, ISO 9001, ISO 45001, etc. • List of relevant OSH regulations. • Legal Compliance Checklist & supporting documents. • Evidence of reporting to the Ministry of Manpower.	
K4	HAZARDS AND EFFECT MANAGEMENT		
K4-1	Does the company have procedures for identifying, assessing,	• Company SOP for hazard identification, risk assessment, and risk control actions.	

	monitoring, and preventing hazards and their impacts? If yes, please attach a list of hazardous materials along with sub-index	• SOP for Job Safety Analysis (JSA). • Hazard Identification, Risk Assessment, and Control documents or similar. • MSDS (Material Safety Data Sheet) documents.	
K4-2	What system does the company use to monitor worker exposure to chemicals or other physical factors?	• There is a program for monitoring exposure to physical and chemical factors at the workplace and PCM measurement results if the company has a work area/workshop. • Results of workplace condition inspections if no specific work area exists (e.g., working at the company's office). • JSA conducted before starting work.	
K4-3	How does the company communicate potential hazards in the work to workers, such as chemicals, noise, radiation, etc.?	Evidence of communication of potential hazards, such as: 1. Warning signs or safety signs 2. Safety briefing attendance document before work starts 3. MoM of P2K3 Meeting 4. Notices posted on bulletin boards	
K4-4	How does the company manage the procurement and distribution of Personal Protective Equipment (PPE) and work clothing, both standard and special, including ensuring PPE meets employee needs, providing training on its use (materials and follow-up), and implementing programs to ensure PPE is used and maintained properly? Please include a list of PPE used for this work.	• SOP for Personal Protective Equipment (PPE). • PPE stock records. • Standards used (ANSI, etc.). • Evidence of PPE handover to employees. • PPE matrix according to job/workplace. • Evidence of PPE usage training (training attendance list). • Training materials/modules. • Evidence of PPE inspections (based on company SOP). • Observation Card.	
K4-5	How does the company manage environmental aspects, including	• Company SOP for waste management, including hazardous waste	

	systems for identifying, classifying, reducing, and handling waste; waste disposal procedures; and spill reporting procedures? Please attach details of environmental equipment, the number of accidents causing environmental damage over $10,000 in the last 24 months, along with reports sent to the government, and mention who is responsible for coordinating environmental issues and their experience.	management/disposal, if applicable. • Spill reporting procedure. • Copies of reports sent to the government. • Reporting procedure. • List of related equipment. • Organizational structure. • Record of experience of the person responsible.	
K4-6	Does the company have an industrial health program? If yes, please explain the components or activities included in the program.	• Pre-employment health check, including a complete physical exam, fitness test, chest X-ray (if applicable), routine laboratory tests, and other necessary exams (PERMENAKER, 2018). • Medical Check-Up results. • Evidence of BPJS Employment and Health payments.	
K4-7	Does the company have a policy regarding drug and alcohol use in the organization? If yes, please attach a copy.	• Company policy on drug and alcohol abuse in the workplace signed by the director. • Or page referencing this subject (e.g., in the employment contract).	
K5	PLANNING AND PROCEDURES		
K5-1	Does the company have OSH procedures and manuals? If yes, please attach copies. How does the company ensure that the procedures and practices applied in the field are consistent with existing OSH objectives and policies?	• OSH Manual documents. • List of the company's SOPs, along with copies of each SOP.	
K5-2	How does the company ensure that facilities and equipment used at the worksite, both by	• List of work equipment owned by the company. • Equipment inspection and maintenance programs	

	employees and at other locations, are registered, certified according to regulations, inspected, monitored, maintained properly, and always in good working condition?	(Maintenance Schedule). • Equipment inspection forms (Maintenance Record). • Equipment certification and calibration programs.	
K5-3	What arrangements does the company have in place to prevent vehicle accidents?	• OSH Transport SOP. • Vehicle inspection evidence. • Periodic vehicle service schedule. • Attach photocopies of driver's license (SIM) and vehicle registration (KIMPER). • Photos of fire extinguishers and first aid kits in vehicles.	
K6	IMPLEMENTATION AND PERFORMANCE MONITORING		
K6-1	What arrangements does the company have for monitoring and overseeing OSH performance, including mechanisms for reporting results and findings to management and field employees? In addition, has the company ever received recognition for OSH performance achievements?	• Documents showing OSH implementation monitoring, e.g., job descriptions for supervisors, safety officers, etc. • OSH performance records based on the OSH Program included in the Objectives, Targets, & OSH Program. • Meeting schedules and speakers. • Evidence of meeting discussions (Minutes of Meeting). • Attach proof of awards received.	
K6-2	Has the company ever received warnings, notifications, or lawsuits related to hazardous incidents or accidents from national agencies, HSE institutions, or other authorities in the last five years? If yes, please specify the number of incidents and brief descriptions.	Copy of warning letters or notices received from the government and company at the workplace.	
K6-3	How does the company document health and environmental performance?	• Health performance documentation. • Attach Contractor Performance Evaluation Report (For CSMS Re-certification).	

K6-4	Does the company have procedures for investigating, reporting, and following up on incidents, hazardous occurrences, or diseases at the workplace, and how are findings from investigations or incidents at other locations communicated to employees?	SOP for workplace accident investigation and reporting, including follow-up on corrective actions taken.	
K7	AUDIT AND REVIEW		
K7-1	How does the company's OSH audit policy describe audit standards, including audits of unsafe actions and auditor qualifications? Does the OSH plan include an audit schedule, and how is audit effectiveness assessed and how does management report and follow up on audit results?	• Internal Audit SOP and Management Review of the OSH system and performance. • Evidence of Internal Audit Reports. The audit schedule and plan are included in the Objectives, Targets, and OSH Program of the company. • Documentation of follow-up on audits performed.	
K8	EMERGENCY RESPONSE PROCEDURE		
K8-1	Is your company a member of any relevant professional or industry associations related to your business? Yes or No. If yes, please attach evidence.	• Emergency Response SOP (from field to hospital management). • Emergency Response Team structure with contact numbers for each member, signed and stamped by the company director. • Duties and responsibilities of each Emergency Response Team member. • Emergency response drill documentation. Attach evidence of membership.	

CONCLUSION

This study successfully developed a valid and consistent evaluative instrument for the feasibility assessment of occupational health service contractors based on CSMS. The instrument consists of eight domains and 24 indicators that have been content validated and weighted using AHP. This instrument is suitable for use as a decision-making tool in the internal selection of occupational health service contractors and is expected to enhance the objectivity of the selection process and the quality of occupational health services in the mining industry.

Suggestions

It is recommended that companies integrate this instrument into the pre-qualification process for occupational health service contractors. Future research could test the reliability of the instrument and adapt it for other industries with different risk characteristics.

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