JTIP Journal of Trade & Industrial Policies
Vol 01, No. 01,
Spring & Summer 2026

Examining the Deficiencies of Iran's Mining Supervision System and Proposing Reform Measures Based on Comparative Studies

Hamed Molladavoodi[1], Faculty Member, Department of Mining Engineering, Amirkabir University of Technology (Corresponding author)

Karamali Arabsalehi Nasrabadi[2], M.Sc. in Mining Engineering, University of Tehran

Yahya Bahmani[3], M.Sc. in Mining Engineering, Amirkabir University of Technology

Mohammad Amin Nabi Sarvestani[4], M.Sc. in Industrial Engineering, Isfahan University of Technology

Amir Soheil Zamani[5], B.Sc. in Materials Science and Engineering, Amirkabir University of Technology

https://doi.org/10.22034/jtip.2026.740994

| Received: 15 May. 2026 | Accepted: 01 September. 2026 |

Abstract

The mining sector, as a major driver of economic development, plays a crucial role in supplying raw materials, creating employment opportunities, fostering regional development, and generating economic value added. Given the non-renewable nature of mineral resources and their status as public assets and national wealth, the establishment of an effective supervisory system for mining activities is essential. This study aims to identify and assess the shortcomings of Iran's mining supervisory system and to propose appropriate reform measures. The research employs a qualitative approach based on document analysis, a review of relevant laws and regulations, an examination of existing supervisory structures, and a comparative analysis of mining oversight systems in Australia, China, and the United States. The findings reveal that Iran's mining supervision framework faces several challenges, including the multiplicity of responsible institutions, overlapping mandates, limited human and financial resources, inadequate information infrastructure, ineffective field inspection practices, and insufficient use of emerging technologies. The comparative analysis indicates that effective supervisory systems are characterized by clearly defined responsibilities, risk-based oversight, standardized inspection procedures, data-driven management systems, rigorous qualification assessments, balanced incentive and enforcement mechanisms, and sustainable resource allocation for regulatory bodies. Accordingly, this study recommends clarifying supervisory responsibilities, developing integrated mining information systems, establishing a risk-based inspection framework, strengthening institutional technical capacity, expanding the use of advanced monitoring technologies, and enhancing enforcement mechanisms. Implementing these reforms could improve governance, transparency, safety standards, environmental protection, and the sustainable exploitation of the country's mineral resources.

Keywords: Mining Governance, Risk-Based Inspection, Mine Safety, Environmental Protection

1. davoodi@aut.ac.ir
2. karamali.arabsalehi@gmail.com
3. ybahmani@aut.ac.ir
4. nabi.sarvestani@gmail.com
5. asoheil.zamani@gmail.com

چکیده

بخش معدن به مثابه پیشران توسعه اقتصادی، نقشی محوری در تأمین مواد اولیه، اشتغال‌زایی، توسعه منطقه‌ای و خلق ارزش‌افزوده دارد. با توجه به تجدیدناپذیری ذخایر معدنی و ماهیت آن‌ها به‌عنوان انفال و ثروت ملی، استقرار نظام نظارتی کارآمد ضرورتی انکارناپذیر است. پژوهش حاضر با رویکرد کیفی، مبتنی بر تحلیل اسناد و قوانین و مطالعه تطبیقی نظام نظارت معدنی در کشورهای استرالیا، چین و آمریکا، به آسیب‌شناسی سیستم نظارت بر معادن ایران و ارائه راهکارهای اصلاحی می‌پردازد. یافته‌ها نشان می‌دهد چارچوب نظارتی کشور با چالش‌هایی بنیادین از جمله تعدد نهادهای متولی، تداخل وظایف، تنگنای منابع مالی و انسانی، ضعف زیرساخت‌های اطلاعاتی، ناکارآمدی بازرسی‌های میدانی و عدم بهره‌گیری از فناوری‌های نوین مواجه است. در مقابل، تحلیل تطبیقی بیانگر آن است که نظام‌های نظارتی پیشرو بر تفکیک شفاف مسئولیت‌ها، نظارت مبتنی بر ریسک، استانداردسازی بازرسی‌ها، حاکمیت داده‌ها، ارزیابی دقیق صلاحیت‌ها و سازوکارهای متوازن تنبیهی تشویقی استوارند. بر این اساس، اصلاحاتی چون شفاف‌سازی وظایف حاکمیتی، ایجاد سامانه‌های یکپارچه اطلاعاتی، استقرار نظام بازرسی ریسک‌محور، ارتقای ظرفیت فنی و به‌کارگیری فناوری‌های هوشمند پایش پیشنهاد می‌شود. تحقق این اصلاحات می‌تواند حکمرانی، شفافیت، ایمنی، حفاظت از محیط‌زیست و صیانت از بهره‌برداری پایدار از ثروت‌های معدنی کشور را به میزان چشمگیری ارتقا بخشد.

1. Introduction

The mining and mineral industries sector constitutes one of the fundamental pillars of economic development in many countries around the world. It plays a significant role in supplying raw materials for various industries, generating employment opportunities, developing infrastructure, increasing foreign exchange earnings, and fostering economic growth. In countries endowed with abundant mineral resources, this sector not only satisfies domestic demands but also serves as a strategic advantage for participation in international markets and for enhancing economic competitiveness. Iran, owing to its considerable diversity of mineral resources and its position among countries possessing valuable mineral reserves, has substantial potential for the development of mining activities and related industries. This potential can contribute significantly to reducing the economy's dependence on oil revenues, promoting the development of less-developed regions, and increasing value added throughout the production chain)Islamic Republic of Iran, 1998(.

Mineral resources, under the Iranian legal framework, are regarded as public wealth, and their exploitation should be undertaken in a manner that serves the public interest and advances the country's sustainable development. Given the non-renewable nature of mineral reserves, the proper management of these resources is of critical importance. Unsound exploitation practices, excessive extraction, the wastage of mineral reserves, non-compliance with technical and environmental requirements, as well as the absence of effective oversight, may reduce the economic benefits derived from these resources and impose irreversible costs on future generations. Therefore, maximizing the economic value of mineral reserves necessitates the establishment of an efficient system for planning, management, and supervision across all stages of mining activities, from exploration and extraction to mine closure and the rehabilitation of mining sites Islamic Republic of Iran, 1998).

Supervision of mining activities constitutes one of the most important governance instruments within the mining sector. The objective of such supervision extends beyond merely monitoring the performance of mining operators; it also encompasses ensuring the sustainable and responsible exploitation of mineral reserves, safeguarding workers' health and safety, protecting the environment, preventing the infringement of the rights of the government and local communities, and enhancing transparency and accountability within the sector. Effective supervision can contribute to the accurate identification of mineral potential, verification of the reliability of exploration outcomes, monitoring of extraction volumes, reduction of mining accidents and human casualties, prevention of environmental degradation, and the proper collection of government royalties and related revenues. Conversely, weaknesses in the supervisory system may facilitate the provision of inaccurate information, lead to technical and financial violations, reduce operational efficiency, increase environmental damage, and ultimately undermine public trust in the management of the country's mineral resources (Zeinolinejad Ferdowsieh et al., 2023).

The importance of supervising mining activities is not confined to Iran; in many resource-rich countries, particularly developing nations, it constitutes one of the principal challenges of mining sector governance. International experiences indicate that factors such as shortages of skilled human resources, financial constraints, inadequate information infrastructure, a lack of transparency in contracts and performance reporting, conflicts between economic objectives and safety and environmental requirements, as well as the fragmentation of supervisory responsibilities, are among the most significant barriers to the establishment of effective regulatory systems. In response to these challenges, many countries have sought to enhance the efficiency and effectiveness of mining supervision through the adoption of emerging technologies, the development of integrated information systems, the promotion of data transparency, the strengthening of independent regulatory institutions, and the formulation of comprehensive supervisory standards (Smith & Rosenblum, 2011).

In Iran, the expansion of mining activities and the increasing number of active mines in recent years have further highlighted the need to reconsider and reform existing supervisory mechanisms. The current framework for overseeing mining activities is distributed among several governmental and professional bodies, including the Ministry of Industry, Mine and Trade, the Iranian Mining Engineering Organization, the Ministry of Cooperatives, Labour and Social Welfare, the Department of Environment, and the Forests, Rangelands and Watershed Management Organization. Each of these institutions is responsible for specific functions related to licensing procedures, supervision of mining operations, occupational safety and health, and environmental protection. Nevertheless, existing studies and assessments indicate that Iran's mining supervisory system faces a number of significant challenges, including the multiplicity of responsible institutions, overlapping or ambiguous mandates, limitations in human and financial resources, weaknesses in field inspection practices, the

absence of comprehensive and integrated guidelines, insufficient utilization of emerging technologies, and the existence of certain institutional and operational conflicts. In some instances, these challenges have diminished the effectiveness of supervisory processes and hindered the achievement of their intended objectives (Islamic Republic of Iran, 2013).

Furthermore, an assessment of the current situation indicates that supervisory mechanisms in the areas of mining safety, environmental protection, and technical mining operations are confronted with several shortcomings. The occurrence of mining accidents, deficiencies in the continuous monitoring of environmental impacts, the considerable reliance on operators' self-reporting of production data, and the limited scope of field inspections are among the issues that underscore the necessity for reform and improvement of the existing supervisory system. At the same time, the advancement of emerging technologies, such as intelligent monitoring systems, satellite imagery, unmanned aerial vehicles (UAVs), and integrated information systems, has created new opportunities to enhance the accuracy, transparency, and efficiency of mining supervision. The effective adoption of these technologies could help address some of the existing challenges and strengthen the overall effectiveness of regulatory oversight in the mining sector (Babak et al., 2021; Smith & Rosenblum, 2011).

Given the strategic importance of the mining sector and the critical role of supervision in ensuring the sustainable exploitation of mineral resources, the present study aims to examine and diagnose the deficiencies of the supervisory system governing mining activities in Iran and to propose appropriate reform measures. To this end, the existing supervisory processes related to various aspects of mining activities are first analyzed, and the major challenges and regulatory bottlenecks are identified. Subsequently, through a comparative examination of the experiences of selected mining countries and an analysis of the approaches and instruments employed within their supervisory frameworks, potential capacities and best practices applicable to the enhancement of Iran's mining supervisory system are identified. Finally, based on the findings of these investigations, a set of policy and operational recommendations is proposed to improve the structure and processes of mining supervision in Iran. It is expected that the findings of this study will contribute to strengthening governance in the mining sector, enhancing transparency, improving safety and environmental protection, safeguarding mineral reserves, and increasing the efficiency of the country's mineral resource management system.

2. The Process of Supervising Mining Activities

The processes for supervising various aspects of mining activities in Australia, China, and the United States have been examined and analyzed in this study.

2.1. Mining Regulatory Oversight Processes in Australia

Australia is one of the world's largest mining countries and is widely recognized as having one of the most advanced systems of mining governance. Owing to its vast mineral reserves, particularly

in iron ore, gold, bauxite, and lithium, the country has established a well-structured framework for the management and supervision of mining activities. Within Australia's governance system, although the primary responsibility for the administration and regulation of mining operations rests with state governments, federal laws and policies play a complementary role in areas such as environmental protection, occupational safety, and sustainable development. Consequently, Australia's mining supervisory system represents an example of effective interaction among specialized institutions, executive agencies, and legal mechanisms. The process of granting mining licenses is managed by the relevant state mining authorities, including departments responsible for mines and petroleum resources. Various governmental bodies are involved in the regulation and supervision of mining activities in Australia, among which the Department of Mines and Petroleum holds a particularly significant role. In Western Australia, agencies associated with the mining sector operate under the umbrella of the Department of Energy, Mines, Industry Regulation and Safety (DEMIRS). The organizational structure of these entities is illustrated in Figure 1 (Government of Western Australia, 1988).

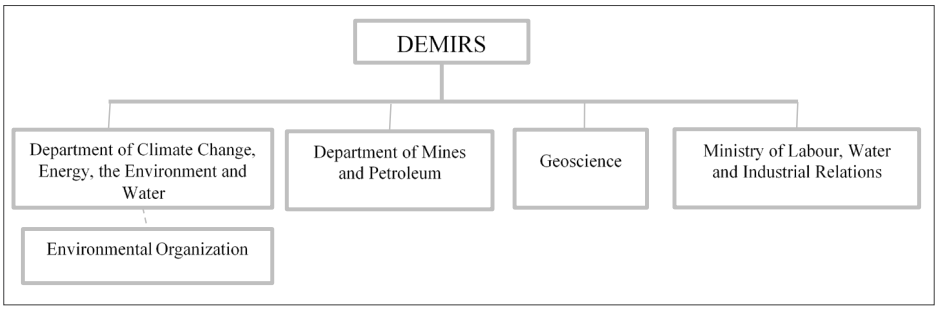

Figure 1. Relevant Organizations Involved in the Mining Sector in Australia

In Australia, the issuance of mining licenses is based on the simultaneous assessment of applicants' technical competence, financial capacity, and the environmental implications of proposed mining projects. Applicants seeking exploration and mining permits are required to submit comprehensive operational plans outlining project objectives, implementation methods, schedules, projected costs, technical capabilities, and the financial resources necessary for carrying out the proposed activities. These plans are evaluated by the relevant specialized authorities, particularly mining departments and environmental agencies, and licenses are granted only when the applicant's qualifications have been verified and the proposed project is found to comply with applicable technical and environmental requirements. One of the distinguishing features of Australia's mining supervisory system is the strong emphasis placed on the quality of technical information and the reliability of exploration and mining data. Exploration and production reports must be prepared by appropriately qualified professionals and compiled in accordance with internationally recognized standards, including the Joint Ore Reserves Committee (JORC) Code. In addition, mining operators are required to submit periodic reports detailing the progress of

operations, production volumes, exploration outcomes, and the status of mineral reserves. These reports are reviewed by government experts, and any discrepancies or deficiencies identified in the submitted information must be rectified. Oversight of mining operations in Australia is primarily undertaken by government inspectors appointed and funded by the competent regulatory authorities. These inspectors conduct field inspections, review documentation, and evaluate operators' performance at specified intervals and in accordance with the risk profile of mining activities. The selection of mines for inspection is based on criteria such as the level of operational risk, the history of non-compliance, environmental sensitivity, the type of mineral being extracted, and the period elapsed since the previous inspection. This risk-based approach enables supervisory resources to be directed toward mining operations where the likelihood of violations or accidents is greater (DMIRS, 2024; Government of Western Australia, 1988).

In the area of mine safety, Australia has adopted a relatively stringent regulatory framework. All mining projects are subject to safety risk assessments prior to commencement, and mining operators are required to develop and implement risk management plans, emergency response procedures, and measures aimed at protecting the health and safety of the workforce. Safety inspections are conducted on a regular basis and in proportion to the level of risk associated with each mining operation. Safety violations are classified according to their severity, and corresponding enforcement measures have been established for each category of non-compliance. These measures include financial penalties and, in cases involving serious breaches, criminal sanctions. This regulatory approach has contributed to making compliance with safety requirements one of the principal priorities of mining companies operating in Australia (Government of Western Australia, 2022).

In the environmental domain, Australia's supervisory system is founded upon both ex ante environmental assessment and continuous monitoring. All mining projects are required to undergo environmental impact assessments prior to the commencement of operations and, where significant environmental risks are identified, must obtain the necessary environmental approvals and permits. Throughout the operational life of a mine, periodic inspections are conducted to monitor environmental impacts, oversee waste management practices, protect water resources, and minimize pollutant emissions. Furthermore, mining operators are obligated to provide financial assurance for the rehabilitation and restoration of mining sites. In this regard, the Mining Rehabilitation Fund (MRF) was established to ensure the implementation of mine closure and post-mining rehabilitation programs. Mining companies are required to make prescribed contributions to this fund, thereby providing a financial mechanism to support the restoration of disturbed areas following the cessation of mining activities (Australian Government, 1999).

Another notable feature of Australia's mining supervisory system is its emphasis on information transparency and the simultaneous use of both incentive-based and enforcement mechanisms. Alongside substantial penalties for the submission of inaccurate information,

safety violations, and environmental damage, various incentives are also provided to encourage compliance among law-abiding mining operators. The public disclosure of selected mining-related information, the utilization of integrated information systems, and mandatory periodic reporting requirements further contribute to enhancing accountability and improving the overall quality of regulatory oversight. In general, Australia's system for supervising mining activities is founded upon four fundamental principles: first, the rigorous assessment of applicants' qualifications prior to the issuance of mining licenses; second continuous, risk-based supervision throughout the lifecycle of mining operations; third, the relative independence of inspection authorities from mining operators; and fourth, the use of transparent reporting and accountability mechanisms. Collectively, these characteristics have enabled Australia to emerge as one of the most successful international models of mining governance and regulatory oversight (Smith & Rosenblum, 2011).

2.2. The Process of Supervising Mining Activities in China

China's system for the management and supervision of mining activities is founded upon the Mineral Resources Law of the People's Republic of China. This law was enacted in 1986 by the Standing Committee of the National People's Congress and was subsequently amended in 1996 and 2009. In addition to this legislation, a series of implementing regulations and administrative directives issued by the State Council and other relevant executive authorities further complement the legal framework governing mineral exploration and mining operations (National People's Congress of the People's Republic of China, 2009).

Supervision of the mining sector in China is carried out through the coordinated efforts of several governmental institutions. The Ministry of Natural Resources, as the principal authority responsible for mineral resource management, oversees the registration and administration of mineral rights, the issuance of exploration and mining licenses, the supervision of extraction activities, and the sustainable management of mineral resources. The Ministry of Ecology and Environment is responsible for assessing and monitoring the environmental impacts of mining activities and collaborates with the Ministry of Natural Resources in the review and approval of mining projects. In addition, the Ministry of Emergency Management and the National Mine Safety Administration are responsible for formulating safety standards, conducting mine inspections, and overseeing compliance with safety requirements. The Ministry of Commerce also performs functions related to the trade and export of mineral products (National People's Congress of the People's Republic of China, 2009; International Comparative Legal Guides, 2025).

China's mining supervisory system is founded upon four principal pillars: the issuance of mining licenses, the supervision of exploration and extraction activities, oversight of mine safety, and monitoring compliance with environmental requirements. Within this framework, applicants seeking to engage in mining activities are required to submit technical, financial, environmental, and safety documentation, and the necessary permits are granted only after

the completion of evaluation procedures and the receipt of the requisite legal approvals. Furthermore, throughout the operational life of a mine, periodic inspections, continuous reporting obligations, and the use of electronic monitoring systems are employed to ensure compliance with applicable legal and technical requirements. Overall, China's mining supervisory system is characterized by a centralized, multi-sectoral, and continuously monitored approach, in which resource management, environmental protection, workforce safety, and the sustainable exploitation of mineral reserves are addressed simultaneously (National People's Congress of the People's Republic of China, 2009;

2.3. The Process of Supervising Mining Activities in the United States

Supervision of mining activities in the United States is carried out through a combination of federal and state institutions, each of which is entrusted with specific responsibilities relating to licensing procedures, environmental protection, occupational health and safety, oversight of mining operations, and the collection of mineral-related revenues. The principal federal agencies involved in the governance and regulation of the mining sector include the Department of the Interior, the Environmental Protection Agency (EPA), the Department of Labor, and the Department of Agriculture. Figure 2 illustrates the major governmental institutions involved in the governance and supervision of the mining sector in the United States (Clawson, 1979; McAteer, 1995; U.S. Environmental Protection Agency [EPA], 1997).

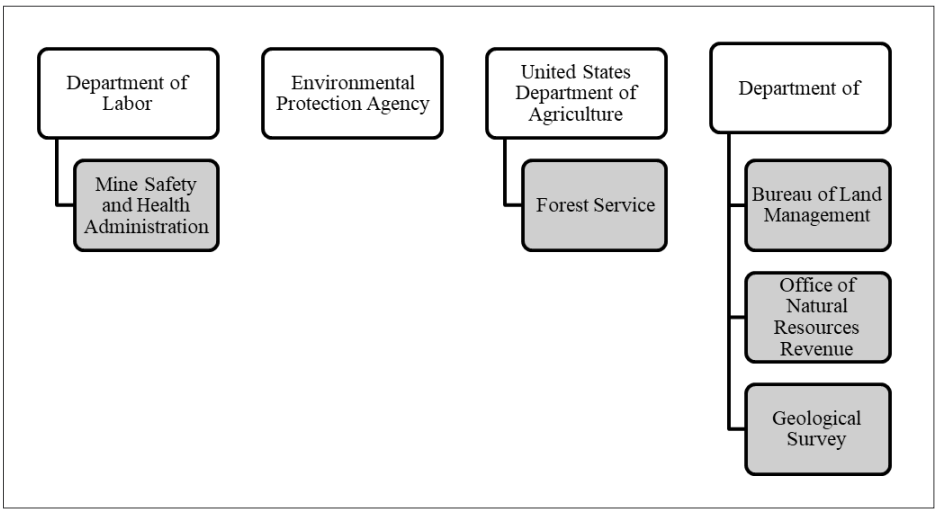

Figure 2. Relevant Organizations Involved in the Mining Sector in the United States

The Department of the Interior is the principal federal authority responsible for the management of mining activities in the United States. It exercises its regulatory and supervisory functions through several subordinate agencies, including the Bureau of Land Management (BLM),

the Office of Natural Resources Revenue (ONRR), and the United States Geological Survey (USGS). The Bureau of Land Management is responsible for issuing exploration and mining permits on federal lands, reviewing operational plans, conducting periodic inspections, and overseeing compliance with environmental requirements and mine reclamation obligations. The Office of Natural Resources Revenue is charged with supervising the collection of government revenues derived from mineral extraction, including royalties and other mineral-related payments, as well as verifying the accuracy of production reports submitted by mining operators. In addition to compiling national mineral statistics and information, the United States Geological Survey provides the specialized geological and mineral data required to support the activities of regulatory and supervisory authorities (Clawson, 1979; McAteer, 1995; U.S. Environmental Protection Agency [EPA], 1997).

In the environmental domain, the EPA is responsible for overseeing the implementation and enforcement of federal legislation, including the Clean Air Act, the Clean Water Act, and other environmental regulations applicable to mining activities. Through the monitoring of pollutant emissions, the assessment of environmental impacts, and the imposition of regulatory control measures, the EPA seeks to minimize the adverse environmental consequences of mining operations. In addition, the Department of Labor, through the Mine Safety and Health Administration (MSHA), is responsible for establishing and enforcing mine safety standards, conducting periodic inspections, and investigating mining accidents. Through these functions, MSHA plays a central role in safeguarding the health and safety of mine workers and ensuring compliance with occupational safety requirements across the mining sector (U.S. Environmental Protection Agency [EPA], 1997; Mine Safety and Health Administration [MSHA], 2020; U.S. Environmental Protection Agency [EPA], n.d).

The process of issuing mining permits on federal lands is primarily administered by the BLM. Applicants are required to submit technical and operational information relating to the proposed project, including exploration or extraction plans, environmental assessments, and land reclamation plans. For projects located within National Forest System lands, the United States Forest Service (USFS) also participates in the review and approval of proposed mining plans. Pursuant to the National Environmental Policy Act (NEPA), many mining projects must undergo environmental impact assessment procedures prior to permit issuance, and in certain cases, opportunities for public participation and comment are incorporated into the decision-making process. Following the issuance of permits, oversight of mining operations is carried out through field inspections, reviews of technical and financial reports, monitoring of the implementation of reclamation plans, and the assessment of environmental performance indicators. Mining operators are required to provide the competent authorities with information concerning production volumes, operational status, environmental management measures, and reclamation activities. Regulatory agencies, in turn, evaluate the accuracy and reliability of the submitted information through on-site inspections, integrated information systems, remote sensing technologies, and satellite imagery (U.S. Environmental Protection Agency [EPA], 1997; USDA Forest Service, 2012).

The system for supervising mineral production in the United States is founded upon the principles of continuous reporting by mining operators and the cross-verification of production and financial data. The BLM and the ONRR oversee extraction activities and the collection of government revenues through the review of production reports, the conduct of financial audits, and the reconciliation of operational and financial records. These mechanisms are intended to ensure the accuracy of reported production volumes and compliance with royalty payment obligations. In addition, the USGS plays a significant supporting role in the country's regulatory framework by compiling and disseminating official statistics on mineral production and reserves. The availability of reliable and comprehensive mineral data enhances transparency, facilitates evidence-based decision-making, and provides essential informational support for regulatory and supervisory authorities responsible for the governance of the mining sector (Office of Natural Resources Revenue [ONRR], 2020; U.S. Geological Survey [USGS], 2023)

The mine supervision system in the United States is characterized by a multi-layered and specialized structure, within which responsibilities related to safety, occupational health, and environmental protection are distributed among various federal agencies. In the area of mine safety and miners' health, the MSHA bears primary responsibility for establishing and enforcing safety standards, conducting inspections, investigating mining accidents, and implementing enforcement measures. In the environmental domain, the EPA, in conjunction with agencies such as the BLM and the USFS, oversees compliance with environmental requirements and the protection of natural resources associated with mining activities. Through this institutional arrangement, the United States seeks to balance mineral resource development with the protection of workers' health and safety and the conservation of environmental values (U.S. Environmental Protection Agency [EPA], 1997; USDA Forest Service, 2012).

One of the distinguishing features of the United States' mining supervisory system is its risk-based approach to the planning and implementation of inspections. Although legislation prescribes a minimum number of annual inspections for mining operations, factors such as the history of regulatory violations, the level of operational hazards, geological conditions, the presence of hazardous substances, and registered complaints also play a significant role in determining inspection priorities. This approach enables supervisory resources to be strategically directed toward high-risk mines and operations with a history of non-compliance. Another notable strength of this system is the use of performance assessment mechanisms such as the Significant and Substantial (S&S) designation and the Pattern of Violations (POV) framework. These instruments facilitate the identification of serious violations and the detection of recurring patterns of regulatory non-compliance, thereby providing a basis for the intensification of supervisory and enforcement actions in high-risk mining operations. Furthermore, the public disclosure of selected inspection findings and regulatory violations contributes to greater transparency in the oversight process and

enhances the accountability of mining operators (McAteer, 1995; Office of Natural Resources Revenue [ONRR], 2020; MSHA, 2024).

In the environmental domain, the United States' regulatory oversight system is based on a comprehensive and coordinated body of federal legislation that encompasses all stages of the mining life cycle, from exploration and extraction to mine closure and reclamation. Mandatory environmental assessments, the control of water and air pollution, the management of mining waste, the protection of sensitive species, and the rehabilitation of disturbed lands following the cessation of mining activities constitute some of the principal components of this framework. Furthermore, mining operators are required to provide adequate financial assurances to guarantee the implementation of reclamation programs and to cover potential environmental liabilities arising from mining operations. These financial mechanisms are intended to ensure that the costs associated with environmental restoration and remediation are borne by the responsible parties rather than transferred to the public sector (U.S. Environmental Protection Agency [EPA], 1997; United States Congress, 1970)

Overall, the experience of the United States demonstrates that the establishment of an effective supervisory system in the mining sector requires the existence of clear and comprehensive legislation, independent and specialized regulatory institutions, continuous and risk-based inspections, effective enforcement mechanisms, information transparency, and coordination among responsible agencies. These components, together with ongoing training initiatives and the active participation of mining operators, play a significant role in reducing mining accidents, enhancing safety performance, and strengthening environmental protection. As such, they may serve as valuable lessons for the reform and development of mining supervisory systems in other countries. In summary, the United States' mining supervisory framework is characterized by the distribution of responsibilities among specialized institutions, the extensive use of environmental assessment tools, periodic inspections, continuous reporting systems, and the application of advanced monitoring technologies. This structure enables the simultaneous oversight of the technical, economic, safety, and environmental dimensions of mining activities, thereby contributing to a more integrated and effective system of mining governance McAteer, 1995; U.S. Environmental Protection Agency [EPA], 1997; IWG, 2023)

3. Summary of Comparative Study Findings and Their Implications for the Mine Supervision System in Iran

An examination of the supervisory frameworks governing mining activities in the countries under study reveals that, despite differences in their legal and administrative systems, certain common principles exist across all of them that play a decisive role in enhancing the effectiveness of mining oversight. The most significant finding of this comparative analysis is that the success of mining supervisory systems depends less on the number

of regulatory institutions involved and more on the clarity of institutional responsibilities, the accountability of competent authorities, the existence of well-defined standards, the provision of adequate financial resources, and the adoption of data-driven regulatory approaches (Zeinolinejad Ferdowsieh et al., 2023; Babak et al., 2021).

he first major finding of this study concerns the clear delineation of supervisory responsibilities among different regulatory bodies. In the countries examined, mine safety, environmental protection, and oversight of technical mining operations are generally entrusted to independent specialized institutions. For example, in the United States, the MSHA bears direct responsibility for supervising the safety and health of mine workers, while the EPA and other specialized agencies oversee environmental matters and land-use aspects associated with mining activities. This division of responsibilities has contributed to enhanced accountability, greater specialization, and a reduction in institutional overlap. In contrast, an examination of the current situation in Iran indicates that the fragmentation of responsibilities and the absence of a clearly identifiable accountable authority constitute some of the most significant factors undermining the effectiveness of the country's mining supervisory system (Zeinolinejad Ferdowsieh et al., 2023; Babak et al., 2021; U.S. Environmental Protection Agency [EPA], 1997).

The second major finding concerns the existence of comprehensive systems of standard-setting and inspection. In the countries examined, inspections are conducted in accordance with integrated guidelines, predefined indicators, and clearly established procedures. Inspectors are required to document all stages of the inspection process based on approved standards, and the resulting findings serve as the basis for subsequent enforcement actions. In many cases, the severity of violations, the compliance history of mining operators, and the risk level associated with individual mining operations are assessed through established evaluation frameworks and dedicated monitoring systems. These observations suggest that effective oversight depends upon the existence of standardized, measurable, and verifiable criteria that can provide a reliable foundation for regulatory decision-making and enforcement (Zeinolinejad Ferdowsieh et al., 2023; Babak et al., 2021; Mine Safety and Health Administration [MSHA], 2020)

The third major finding of this study highlights the importance of adopting a risk-based approach to inspection planning. Unlike traditional practices, in which all mining operations are inspected according to a uniform model, the countries examined employ risk-based prioritization systems to allocate supervisory resources more effectively. In these jurisdictions, factors such as the history of regulatory violations, the type of mineral extracted, mining methods, the level of safety hazards, environmental sensitivities, and records of previous accidents play a fundamental role in determining the frequency, scope, and nature of inspections. This approach ensures that limited regulatory resources are directed toward mining operations that present the highest likelihood of adverse events and regulatory non-compliance. Consequently, risk-based oversight enhances the efficiency

and effectiveness of supervisory activities by enabling regulatory authorities to focus their attention on areas of greatest concern (Smith & Rosenblum, 2011).

The fourth major finding of this study concerns the pivotal role of information systems and data-driven approaches in the oversight process. In leading mining jurisdictions, a substantial proportion of supervisory activities is based on the continuous collection of information, self-reporting by mining operators, centralized databases, and the cross-validation of data from multiple sources. In addition to conducting field inspections, these countries employ intelligent monitoring tools to identify deviations from approved operational plans, detect regulatory violations, and assess the performance of mining operators. In contrast, weaknesses in data infrastructure and the lack of information integration in Iran have limited the capacity of regulatory authorities to verify the accuracy and reliability of information submitted by mining operators. As a result, deficiencies in data management and interoperability constitute significant obstacles to the development of a more effective and evidence-based mining supervisory system (Zeinolinejad Ferdowsieh et al., 2023; Smith & Rosenblum, 2011).

The fifth major finding highlights the importance accorded to the technical and financial qualifications of applicants seeking to engage in mining activities. In the countries examined, the assessment of applicants is not based solely on individual characteristics or formal eligibility requirements; rather, it encompasses a comprehensive evaluation of their capacity to implement the proposed mining project, their financial capability, the competence of their technical team, and the adequacy of their safety and environmental management plans. This approach ensures that only those applicants possessing the necessary resources, expertise, and organizational capacity are granted access to mining activities. Consequently, it promotes the responsible, safe, and sustainable execution of mining operations while reducing the likelihood of technical failures, safety incidents, and environmental non-compliance arising from inadequate operator capacity (Smith & Rosenblum, 2011; USDA Forest Service, 2012).

The sixth major finding of this study concerns the existence of deterrent penalty systems coupled with incentive mechanisms designed to enhance mine performance. In most of the countries examined, serious violations may result in substantial financial penalties, suspension of operations, revocation or suspension of licenses, or the intensification of regulatory inspections. Conversely, mining operations that demonstrate satisfactory performance in the areas of safety, environmental management, and regulatory compliance may benefit from incentives such as reduced inspection frequency, the award of recognized certification schemes, and access to certain administrative facilitation measures. This balanced combination of punitive and incentive-based instruments has contributed to strengthening the culture of regulatory compliance within the mining sector. By simultaneously discouraging non-compliant behavior and rewarding good performance, these mechanisms encourage mining operators to adopt higher standards of operational responsibility and continuous improvement (Zeinolinejad Ferdowsieh et al., 2023; Smith & Rosenblum, 2011; International Comparative Legal Guides, 2025).

Finally, comparative studies indicate that effective mining supervision requires regulatory authorities to have access to stable financial resources, specialized human capital, and sufficient institutional independence in the execution of their mandates. In all the countries examined, a significant portion of supervisory costs is financed by the government, and regulatory agencies rely on trained and qualified professional staff. Accordingly, any reform of the mining supervisory system in Iran should not be limited to legal and structural adjustments alone; rather, it must also address the provision of sustainable financing mechanisms and the development of the technical and professional capacities of supervisory institutions (Zeinolinejad Ferdowsieh et al., 2023; Smith & Rosenblum, 2011; Babak et al., 2021).

Based on the above findings, the proposed recommendations are designed to achieve five main objectives, namely: clarifying supervisory responsibilities, enhancing the accountability of responsible agencies, establishing a risk-based supervisory system, developing data-driven oversight mechanisms, and strengthening enforcement measures.

4. Conclusion

The mining sector, due to its strategic role in economic development, the supply of industrial raw materials, and the generation of added value, requires an efficient and effective system for the management and supervision of mining activities. Given that mineral resources are considered both public assets and non-renewable national wealth, their sustainable and responsible exploitation necessitates the establishment of precise, transparent, and accountable regulatory mechanisms across all stages of mining, including exploration, extraction, and mine rehabilitation.

An examination of the current state of the mining supervisory system in Iran indicates that, despite the existence of a legal framework and the involvement of multiple responsible institutions, the system faces several challenges, including the fragmentation of supervisory responsibilities, overlap of mandates, shortage of specialized human resources, limited financial capacity, weak information infrastructure, insufficient field inspections, and limited utilization of modern technologies. These challenges have led to reduced effectiveness of supervision, difficulties in verifying the accuracy of submitted information, an increased likelihood of regulatory violations, and a decline in the efficiency of mineral resource management.

The comparative study of the mining supervisory systems in Australia, China, and the United States demonstrates that the effectiveness of mining oversight depends primarily on the existence of transparent and specialized institutional structures, a clear delineation of responsibilities, the establishment of risk-based supervisory systems, the utilization of integrated information systems, the application of advanced monitoring technologies, the enforcement of effective regulatory measures, and the availability of sufficient independence and resources for regulatory authorities. Furthermore, the experience of these countries

indicates that effective supervision is not limited to field inspections alone; rather, it is based on a combination of reliable data, continuous reporting, intelligent monitoring, and robust accountability mechanisms.

Accordingly, reforming the mining supervisory system in Iran requires a revision of existing structures and processes, clarification of the responsibilities of relevant authorities, development of integrated mineral information systems, establishment of a risk-based supervisory framework, strengthening the technical capacities of regulatory institutions, and expanding the use of technological tools such as intelligent monitoring systems, remote sensing, and drones. Moreover, the introduction of a balanced system of incentives and penalties, enhancement of information transparency, and provision of sustainable financial resources for supervisory functions can further improve the efficiency and effectiveness of the system.

In summary, achieving good governance in the mining sector and ensuring the sustainable exploitation of national mineral resources depends on the establishment of an integrated, data-driven, accountable, and standards-based supervisory system. Such a system, in addition to safeguarding mineral resources and public interests, can contribute to improving mine safety, strengthening environmental protection, enhancing economic transparency, and increasing public trust in the management of the country's mineral resources.

References

- Australian Government. (1999). Environment Protection and Biodiversity Conservation Act 1999 (Cth). Commonwealth of Australia.
- Babak, B., Behdari, E., Maghsoudi, I., & Sadegh Ahmadi, M. (2021). The necessity of supervising the implementation, amendment, and consolidation of environmental and natural resources laws and regulations to remove production barriers in mining activities. Majles Research Center of the Islamic Republic of Iran.
- Clawson, M. (1979). Federal Land Policy and Management Act of 1976 in a broad historical perspective. Arizona Law Review, 21, 585–598.
- Department of Energy, Mines, Industry Regulation and Safety. (2024). Annual report 2023–24. Government of Western Australia.
- International Comparative Legal Guides. (2025). Mining laws and regulations: China 2025. Global Legal Group.
- Islamic Republic of Iran. (1998). Mines Act of 1998 and its subsequent amendments. Islamic Consultative Assembly, Tehran, Iran.
- Islamic Republic of Iran. (2013). Executive bylaw of the Mines Act. Council of Ministers.
- Government of Western Australia. (1988). Mining Act 1978. Government Printer.
- Government of Western Australia. (2022). Work Health and Safety (Mines) Regulations 2022 (WA). Government of Western Australia.
- McAteer, J. D. (1995). The Federal Mine Safety and Health Act of 1977: Preserving a law that works. West Virginia Law Review, 98, 1105–1130.
- Mine Safety and Health Administration. (2020). MSHA handbook series. U.S. Department of Labor.
- Mine Safety and Health Administration. (2024). Monthly impact inspection results. U.S. Department of Labor. Retrieved from https://www.dol.gov/agencies/msha/resources/reports/monthly-impact-inspection-results
- Ministry of Natural Resources of the People's Republic of China. (2024). Measures for the Administration of Mining Right Holders' Exploration and Exploitation Information (Order No. 13). People's Republic of China.
- National People's Congress of the People's Republic of China. (2009). Mineral Resources Law of the People's Republic of China. People's Republic of China.
- Office of Natural Resources Revenue. (2020). Solid minerals reporter handbook: Production and royalty report (Form ONRR-4430). U.S. Department of the Interior.
- Smith, E., & Rosenblum, P. (2011). Enforcing the rules: Government and citizen oversight of mining. Revenue Watch Institute and Human Rights Institute, Columbia Law School. https://scholarship.law.columbia.edu/human_rights_institute/59/
- United States Congress. (1970). National Environmental Policy Act of 1969 (42 U.S.C. §§ 4321–4370h). U.S. Government Publishing Office.
- U.S. Environmental Protection Agency. (1997). EPA's national hardrock mining framework (EPA Publication No. 833-B-97-003). U.S. Environmental Protection Agency.
- U.S. Department of the Interior, Interagency Working Group on Mining Laws, Regulations, and Permitting. (2023). Recommendations to improve mining on public lands. U.S. Department of the Interior. https://www.doi.gov/sites/default/files/mriwg-report-final-508.pdf
- U.S. Environmental Protection Agency. (n.d.). Mineral mining and processing effluent guidelines. https://www.epa.gov/eg/mineral-mining-and-processing-effluent-guidelines
- U.S. Department of Agriculture, Forest Service. (2012). Federal hardrock mineral prospecting permits final environmental impact statement. U.S. Department of Agriculture, Forest Service.
- U.S. Geological Survey. (2023). Mineral commodity summaries 2023. U.S. Geological Survey. https://doi.org/10.3133/mcs2023
- Zeinolinejad Ferdowsieh, E., Foroumand, L., & Sedaghati, K. (2023). The role of the government in the management and supervision of mines in the Iranian legal system. Iranian Journal of Mining Engineering, 18(58), 36–48. https://doi.org/10.22034/ijme.2022.549297.1907 (in Persian)