



NATIONAL AND GLOBAL MODELS OF MANAGING INNOVATION IN THE MINING INDUSTRY: MECHANISMS OF COMPARISON AND HARMONIZATION

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ABSTRACT

Innovation management in the mining industry is a subject of growing theoretical and practical importance. From the perspective of innovation economics, two dominant conceptual traditions can be distinguished. The first derives from the Schumpeterian theory of innovation, which emphasizes the role of creative destruction, entrepreneurship, and technological upgrading as drivers of competitiveness [1]. The second is rooted in national innovation system theory, where state institutions, universities, and industry actors jointly shape innovation outcomes through policies, investments, and knowledge flows [2]. In the mining sector, which combines high capital intensity, environmental sensitivity, and strategic importance for industrial development, both models are evident in different national contexts.

Innovation management in the mining industry is a subject of growing theoretical and practical importance. From the perspective of innovation economics, two dominant conceptual traditions can be distinguished. The first derives from the Schumpeterian theory of innovation, which emphasizes the role of creative destruction, entrepreneurship, and technological upgrading as drivers of competitiveness [1]. The second is rooted in national innovation system theory, where state institutions, universities, and industry actors jointly shape innovation outcomes through policies, investments, and knowledge flows [2]. In the mining sector, which combines high capital intensity, environmental sensitivity, and strategic importance for industrial development, both models are evident in different national contexts.

Globally, resource-rich countries employ different innovation management systems. In Australia and Canada, innovation follows a market-oriented trajectory, with private companies investing heavily in automation, artificial intelligence, and environmental monitoring to increase efficiency and reduce operational risks [3]. Conversely, in China, Russia, and Kazakhstan, state-driven models prevail, where governments coordinate innovation priorities, finance large-scale R&D projects, and regulate technology transfer [4]. Both approaches have strengths: market-driven models encourage flexibility and rapid adoption, while state-driven models provide long-term stability and strategic alignment with national objectives. However, both face challenges. Market-driven systems may underinvest

in socially desirable but less profitable green technologies, while state-driven systems often suffer from bureaucratic inertia and slower diffusion of innovation [5].

For Uzbekistan, the mining sector — led by Navoi Mining and Metallurgical Company (NMMC) and Almalyk Mining and Metallurgical Complex (AMMC) — is strategically important, contributing significantly to GDP, exports, and regional development [6]. Historically, innovation management has been centralized, with strong state control over investment and technological modernization. Yet, recent reforms under the *New Uzbekistan Development Strategy 2022–2026* reflect a shift toward hybrid models that combine state coordination with market mechanisms. Initiatives include digital transformation, resource-saving technologies, ESG compliance, and the attraction of foreign direct investment (FDI) [7]. These reforms demonstrate Uzbekistan's intention to harmonize its innovation management system with global practices.

The theoretical challenge lies in constructing an integrated model of innovation management for the mining sector that simultaneously reflects national priorities (strategic resource use, employment, ecological protection) and global trends (Industry 4.0, carbon neutrality, ESG frameworks). Harmonization requires not only technology adoption but also institutional innovation.

This includes:

1. Developing adaptive regulatory frameworks that internalize ecological costs (carbon pricing, rehabilitation obligations) while supporting innovation incentives [8].

2. Mobilizing financial mechanisms such as green bonds, sustainability-linked loans, and blended finance to reduce the risks of capital-intensive innovation [9].

3. Strengthening public-private partnerships (PPP) to link state priorities with private sector dynamism and foreign expertise [10].

4. Integrating international standards and best practices, including ISO standards for environmental management and UN Sustainable Development Goals, into corporate strategies [11].

From a theoretical point of view, this hybrid model reflects the logic of institutional complementarities, where different governance mechanisms (state planning, market incentives, global norms) mutually reinforce one another. In Uzbekistan, successful harmonization depends on striking the right balance: retaining state leadership in strategic resource management while promoting entrepreneurial initiative, competition, and integration with global technological networks.

In conclusion, national and global models of managing innovation in the mining industry are not mutually exclusive but complementary. For Uzbekistan, the optimal pathway lies in hybridization: adopting global technological and sustainability standards, while embedding them into a national framework that safeguards economic sovereignty and social welfare. Such an approach ensures that the mining industry evolves from a resource-dependent sector into a driver of green growth, technological modernization, and global competitiveness.

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