Mineral Economics
https://doi.org/10.1007/s13563-025-00543-5

ORIGINAL PAPER

Scoping review: competitive and comparative advantages in the midstream mineral industry

Andri Budhiman Firmanto[1] · **Dermawan Wibisono**[1] · **Manahan Parlindungan Saragih Siallagan**[1] · **Mohammad Zaki Mubarok**[2]

Received: 15 January 2025 / Accepted: 15 August 2025

Abstract
This study conducts a scoping review using Scopus to address gaps in academic literature on competitive advantages in the mineral industry. It screens articles, analyzing themes such as strategic management, innovation, sustainability, and policy influence. The paper aims to summarize existing research, identify key insights, and pinpoint gaps for future academic exploration. It finds that competitive advantage strategies in mining focus on strategic approaches, resource utilization, innovation, sustainability, and policy impact. The study recommends future research directions, including refining methodologies, exploring innovation's role in comparative advantage, longitudinal studies on sustainability, sector-specific analyses, and examining policy effects. By highlighting current knowledge and suggesting future avenues, this research guides forthcoming scholarly investigations in the mineral industry.

Keywords Systematic literature review · Strategic management · Competitive advantage · Comparative advantage · Mining industry

JEL classification L72 · M16 · O32

Background

The mineral industry plays a critical role in the global economy, though its direct contribution to global GDP remains relatively modest. According to global economic estimates, the mine stage of production accounted for approximately 1.2% of world GDP in 2016, down from a peak of 1.9% in 2011 (Löwer and Bringezu 2019). However, in mineral-dependent developing countries, such as Mongolia, Botswana, and several Sub-Saharan African economies, mining has contributed as much as 8–25% of national GDP, particularly during the 2000–2010 commodity boom (World Bank 2013). Despite its modest share in global terms, the industry's strategic value lies in its role as a foundation for downstream sectors, supporting employment, infrastructure, export earnings, and broader economic development—especially in resource-rich nations.

The global mineral market exhibits diverse growth patterns across different segments and regions. The Industrial Minerals Market is projected to reach 2,377.7 million tonnes in 2023, with a compound annual growth rate (CAGR) of 2.8% through 2030. Meanwhile, the global Mineral Supplements Market, valued at USD 15 billion in 2022, is expected to expand at a CAGR of 3.3% from 2023 to 2030. This growth is primarily driven by technological advancements in mining and processing, increasing urbanization, and worldwide infrastructure development (Kharad 2023), although the sector operates under strict governmental regulatory oversight (EPA 2023).

✉ Andri Budhiman Firmanto
andri_budhiman@sbm-itb.ac.id

Dermawan Wibisono
dwibisono@sbm-itb.ac.id

Manahan Parlindungan Saragih Siallagan
manahan@sbm-itb.ac.id

Mohammad Zaki Mubarok
zaki.mubarok@itb.ac.id

[1] School of Business and Management, Institut Teknologi Bandung, Indonesia, Bandung, Indonesia

[2] Faculty of Mining and Petroleum, Institut Teknologi Bandung, Indonesia, Bandung, Indonesia

Published online: 29 September 2025

In this competitive landscape, understanding and leveraging both competitive and comparative advantages becomes crucial for long-term success (Thibeault et al. 2023). Competitive advantage involves firm-specific strategies and actions to establish market dominance (Prasad 2020; Salavou 2015), while comparative advantage provides a theoretical framework focusing on a country's capability to produce goods or services at a relatively lower opportunity cost than others (Xie 2019). These two concepts, though distinct, are interrelated economic principles that together explain the success of nations and firms in the global market (Gupta 2015). Each mineral possesses unique competitive advantages, shaped by various determinants including factor conditions, demand conditions, supporting industries, firm strategy, structure, rivalry, governmental influence, and chance (Hanafi et al. 2019; Porter 1990).

Recent literature highlights a growing recognition of the strategic role played by midstream activities—such as refining, processing, and value addition—in shaping both competitive and comparative advantages in the mineral industry. However, most existing studies still center on upstream extraction or macro-level trade dynamics, often overlooking the midstream segment where firm capabilities and national policy instruments critically interact. For example, Shatunov (2023) examined revealed comparative advantages in Russia's mineral sector using value-added metrics but focused primarily on extraction activities. Similarly, Mamina and Maganga (2020) found that the lack of adequate factor endowments hinders mineral beneficiation in Zimbabwe, but did not explore firm-level strategies at midstream stages. In the other hand, Firmanto and Wibinoso (2025) emphasized the need for policy refinement to enhance value addition in Indonesia, yet acknowledged the scarcity of integrated analyses combining both types of advantage within the midstream value chain. This gap is further reinforced by broader GVC research, which underscores the importance of logistics, digitization, and value-added trade in shaping comparative advantage, yet offers limited sector-specific insights for the mineral industry (Yang et al. 2024). Thus, there remains a pressing need for systematic inquiry that links comparative trade potential with firm-level strategies and policy instruments in the mineral midstream sector.

The existing literature reveals a notable research gap in the integrated analysis of competitive and comparative advantages within the mineral industry, particularly across different stages of the value chain. While studies on competitive advantage emphasize firm-level strategies, innovation, and operational performance (Firmanto and Wibisono 2025; Diana et al. 2015), and those on comparative advantage focus on resource endowments and trade positioning (Mamina and Maganga 2020; Maqbool et al. 2020), there is limited scholarship exploring how these two dimensions interact dynamically—especially within the midstream segment, such as refining and processing. Midstream activities play a crucial role in shaping value addition and industrial upgrading, yet they are often underexplored in current research (Firmanto and Wibisono 2025). Moreover, the segmentation of literature into either economic or strategic lenses creates a fragmented understanding that lacks a unified framework for evaluating competitive positioning across firms and nations. This underscores the need for a systematic literature review that bridges theoretical silos and places greater emphasis on midstream mineral activities as a strategic locus for advantage creation.

The aim of this systematic literature review is to examine how competitive and comparative advantages manifest and interact specifically within the midstream segment of the mineral industry, particularly focusing on processing, refining, and value addition stages. Recognizing that strategic considerations vary significantly across the value chain—for example, "make or buy" decisions in exploration differ fundamentally from those in smelting—this review narrows its analytical lens to the midstream, where firm-level strategies and national industrial policies converge. This focus is guided by three primary research questions: (1) How do competitive and comparative advantages influence success in the midstream mineral industry? (2) What are the key factors and mechanisms that enable firms and nations to develop and maintain these advantages? and (3) What are the significant gaps in current understanding of these advantages in the midstream mineral sector? By analyzing peer-reviewed articles published between 2013 and 2023, this study seeks to identify key themes, patterns, and gaps in the current understanding of these advantages (Cappellari et al. 2019; Jia et al. 2014; Prinsloo and Hofmeyr 2022). The review encompasses various aspects including strategic management, innovation, sustainability, policy frameworks, and market dynamics, providing a holistic view of how these elements contribute to success in the mineral industry. Through addressing these research questions, this study aims to provide a comprehensive understanding of both the theoretical foundations and practical applications of competitive and comparative advantages in the mineral sector.

Literature review

The theoretical foundation of this review is grounded in the dual perspectives of comparative advantage and competitive advantage, complemented by Porter's Five Forces and Diamond Model frameworks. Comparative advantage provides a macroeconomic view, explaining how nations benefit from producing goods with the lowest opportunity cost, which is particularly relevant in resource-abundant

mineral economies (Xie 2019; Fliess et al. 2017). Competitive advantage, meanwhile, centers on firm-level strategies to outperform rivals through innovation, operational efficiency, and responsiveness to market conditions (Salavou 2015; Prasad 2020). Porter's Five Forces enrich this analysis by assessing the industry's structural competitiveness through factors such as supplier power, buyer power, competitive rivalry, threat of new entrants, and substitute products—each of which directly affects the profitability of mining firms (Gupta 2015). Additionally, Porter's Diamond Model explains how national conditions—like factor endowments, demand conditions, related industries, and government—shape long-term industry competitiveness (Hanafi et al. 2019).

Previous studies have typically examined either competitive or comparative advantage in isolation, resulting in a fragmented understanding of success factors in the mineral sector. Research on competitive advantage has focused on firm strategy, innovation, and risk management within the framework of Porter's Five Forces, highlighting how mining firms respond to external pressures (Diana et al. 2015; Ilinova and Dmitrieva 2017; Vasilev 2016). In contrast, studies on comparative advantage emphasize natural resource endowments, trade patterns, and institutional efficiency at the country level (Bas and Kunc 2009; Maqbool et al. 2020). Few have integrated these perspectives to explain how firms and countries co-evolve advantages in the mineral industry, creating a gap in literature that this review aims to address. By synthesizing these theoretical lenses, this study contributes a more holistic view of how structural, strategic, and institutional forces interact to shape competitive outcomes in the global mineral economy.

Methods

Search strategy

The systematic literature review was conducted using the Scopus database, employing a comprehensive search approach with carefully selected keywords targeting critical aspects of the mining industry's competitive landscape, as shown in Fig. 1. The research focused on key conceptual domains including competitive advantage, comparative advantage, and the broader mining industry context, specifically concentrating on minerals and metals. The following search string was applied in the Scopus database: TITLE-ABS-KEY ("competitive advantage" OR "comparative advantage" OR "competitive advantage perspective" OR "revealed comparative advantage" AND "mining company" OR "mining industry" OR "coal" OR "mineral" OR "metals"). This strategic keyword selection aimed to capture a holistic view of the current academic discourse surrounding competitive dynamics in mining sector research.

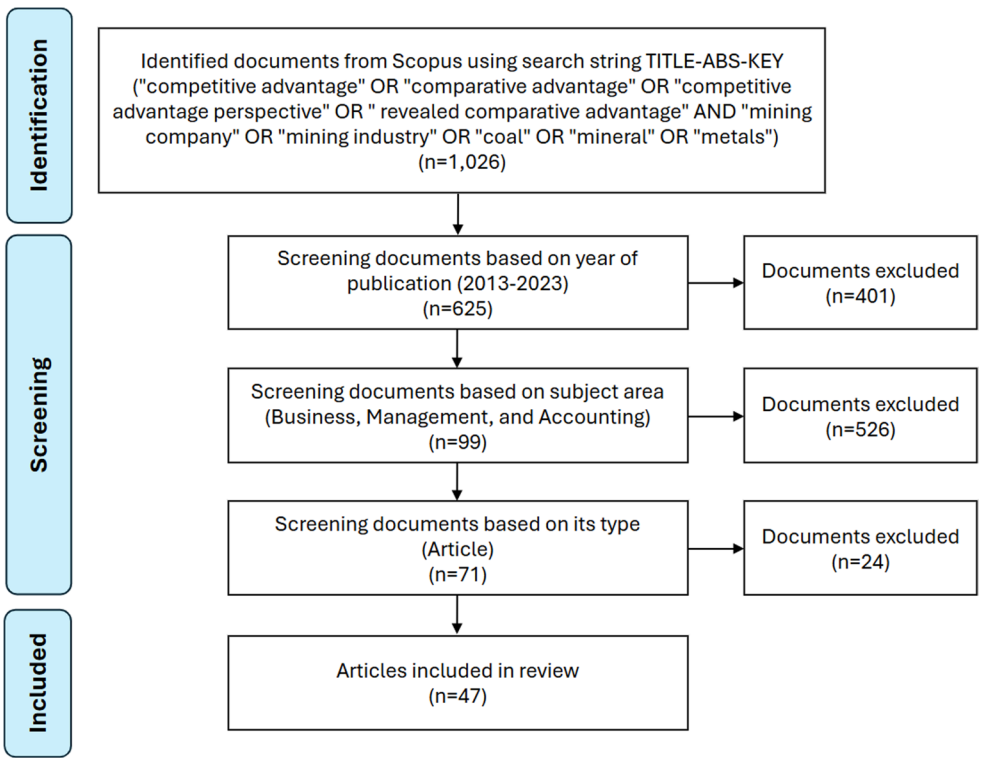

Fig. 1 Scoping review flow chart

Selection process

The initial search yielded a total of 1,026 academic documents from the Scopus database. To enhance relevance and reflect recent developments in the mining sector, a temporal filter was applied, limiting the selection to publications from 2013 to 2023, reducing the pool to 625 documents. This time frame was chosen to capture literature aligned with modern shifts in global mining strategies, economic pressures, and regulatory frameworks following recent economic transitions (Munn et al. 2018). Subsequent filtering by subject area targeted studies categorized under Business, Management, and Accounting, narrowing the sample to 99 documents. This discipline-specific filter ensured the inclusion of studies grounded in strategic and economic analysis, rather than technical or purely geological perspectives, which fall outside the scope of this review. Further refinement to include only peer-reviewed journal articles ($n=71$) prioritized methodological rigor and academic credibility by excluding grey literature such as conference papers and editorials.

Following these automated filters, a manual screening of titles and abstracts was conducted to assess the relevance of each document to the review's core themes. This final step resulted in the selection of 47 articles that addressed the strategic dynamics of competitive or comparative advantage in the mining or mineral industries. The inclusion criteria were carefully defined to focus the review on studies that (1) were written in English; (2) published in peer-reviewed journals; and (3) directly examined competitive or comparative advantage within the context of mining. These criteria were selected to ensure accessibility, academic quality, and thematic alignment with the review's objective of understanding how advantage is created and sustained in the sector. Studies that combined economic and strategic frameworks were particularly prioritized, as they offered insights into both firm-level and country-level performance.

Conversely, the exclusion criteria removed documents that would dilute the analytical focus or compromise the review's methodological clarity. Non-journal sources such as conference papers, book chapters, and theses were excluded due to variability in peer-review standards and limited reproducibility. Studies that dealt exclusively with technical, engineering, or geological aspects of mining were also excluded, as they lacked a strategic or economic framing necessary for analyzing competitive dynamics. Additionally, articles not written in English were omitted to ensure consistency and avoid translation bias during interpretation. Screening was conducted independently by two reviewers, and any disagreements regarding inclusion were resolved through discussion to maintain objectivity and methodological transparency (Arksey & O'Malley, 2005); (Levac et al. 2010).

Quality and rigor

The research methodology emphasized strong methodological rigor through the application of transparent, systematic, and replicable protocols aligned with the PRISMA framework (Tricco et al. 2018). Predefined inclusion and exclusion criteria were consistently applied to minimize selection bias and ensure relevance to the review's central research questions. To enhance reliability, two independent reviewers conducted the screening process, with disagreements resolved through discussion to maintain intersubjective agreement. A detailed audit trail was maintained across all stages—including search strategy documentation, screening logs, and data extraction summaries—to support transparency and reproducibility. Validity was further supported by the use of a structured data extraction form that ensured consistency in the identification of themes, concepts, and study characteristics. Although formal critical appraisal was not conducted—consistent with scoping review conventions—the combination of clear criteria, multiple review stages, and systematic documentation enhances the credibility and trustworthiness of the findings.

Results

This study summarizes the dominant research themes in the literature (Fig. 2), distinguishing between two key concepts: Competitive Advantage (represented in blue) and Comparative Advantage (represented in green). The result highlights the dominance of Competitive Advantage themes in the literature, which collectively account for the majority of the research focus. The most discussed theme under competitive advantage is Strategic Decision-Making, representing 27.9% of all themes. This is followed by Sustainability and Environment, contributing 14% of the total themes, and Resources and Capabilities, which accounts for 7%. Themes such as Trade Dynamics, Market Factors, and Innovation and Technology each represent 11.6% of the total, with competitive advantage sharing an equal portion with comparative advantage for these three themes. Lastly, Policy and Economic Framework appears solely under competitive advantage, making up 4.7% of the total themes.

In contrast, Comparative Advantage themes are less frequently discussed. The most significant theme under comparative advantage is Resource and Capability Endowments, which represents 9.3% of the total themes. Additionally, Trade Dynamics, Market Factors, and Innovation

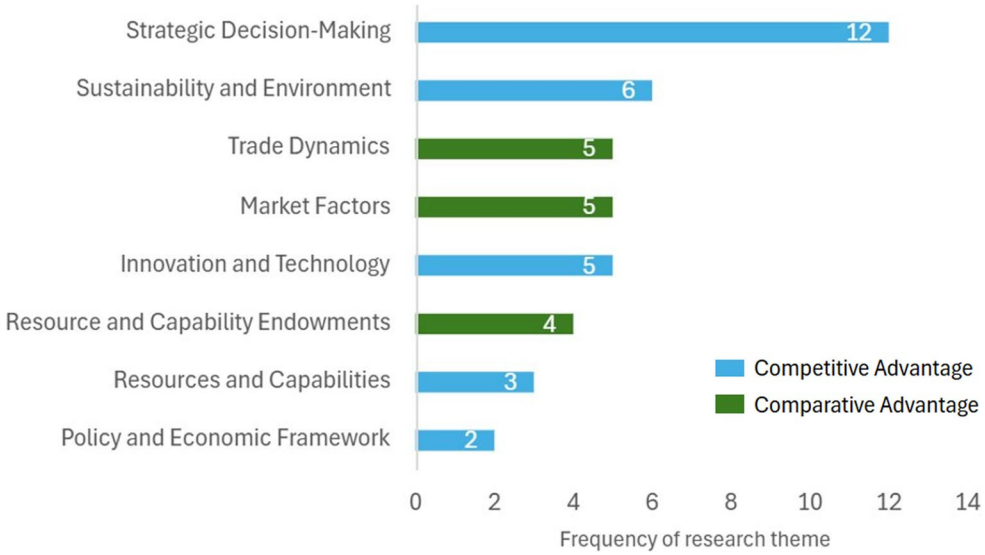

Fig. 2 Summary of the dominant research theme in the literature

and Technology are equally shared between comparative and competitive advantage, with each contributing 11.6%. This distribution demonstrates the strong scholarly focus on competitive advantage, a trend that has grown since Porter's influential works in the 1980s shifted the discourse toward firm-level strategy and industrial competitiveness (Porter 1990). Nonetheless, comparative advantage remains particularly relevant for mineral-rich developing countries that lack domestic capital or technological capabilities to develop their resources independently. In these contexts, comparative advantage is often realized through foreign direct investment arrangements, joint ventures, or state-led policy interventions aimed at fostering industrial upgrading (Shatunov 2023; Mamina and Maganga 2020; Yang et al. 2024). Thus, while the literature predominantly emphasizes competitive strategies, the relevance of comparative advantage persists in shaping development pathways in lower-income, resource-endowed economies.

Competitive advantage

Figure 3 synthesizes the dominant thematic clusters found in competitive advantage research within the mineral industry, highlighting five major domains: strategic and management, resources and capabilities, innovation and technology, sustainability and environment, and policy and economic frameworks. These themes underscore the industry's increasing focus on midstream decision-making—such as refining, processing, and value addition—where firm-level strategies like make-or-buy decisions, environmental performance, and cost-efficiency integration intersect with broader structural enablers like industrial policy and technological innovation (Porter 1985; Zahra and George 2002). While upstream activities have historically attracted academic focus, the midstream has emerged as a strategic bottleneck requiring agility, stakeholder engagement, and coordinated policy support, especially in developing economies aiming to enhance domestic value retention (Prinsloo and Hofmeyr 2022; Hanafi et al. 2019). The integration of digital platforms, sustainability goals, and localized capabilities reflects a shift from pure cost advantage to multifaceted value propositions. However, gaps remain in systematically linking these dimensions with feasibility, permitting, and regulatory compliance—key challenges unique to midstream operations (Yang et al. 2024). This focus justifies the current review's emphasis on synthesizing midstream-oriented competitive strategies that reflect both firm agency and institutional frameworks.

Strategic and management

Several studies in the realm of strategic and management research converge on similar themes, demonstrating key areas where firms can cultivate competitive advantage. The works of Hilman H. & Mohamed Z.A. (2013), and Maley et al. (2015) collectively underscore the significance of strategic decision-making in sourcing. Meanwhile, Knop (2020) analyzes the role of visual management systems, finding their significant impact on identifying production issues and building competitive advantage, especially in the automotive industry. These studies highlight the critical role of make-or-buy decisions (Hilman H. & Mohamed Z.A., 2013), outsourcing strategies (Maley et al. 2015), and visual management systems (Knop 2020) in enhancing organizational performance and competitive advantage. Each emphasizes a different aspect of strategic management, yet all converge on the idea that careful, strategic choices in operational processes significantly influence a firm's market position and sustainability.

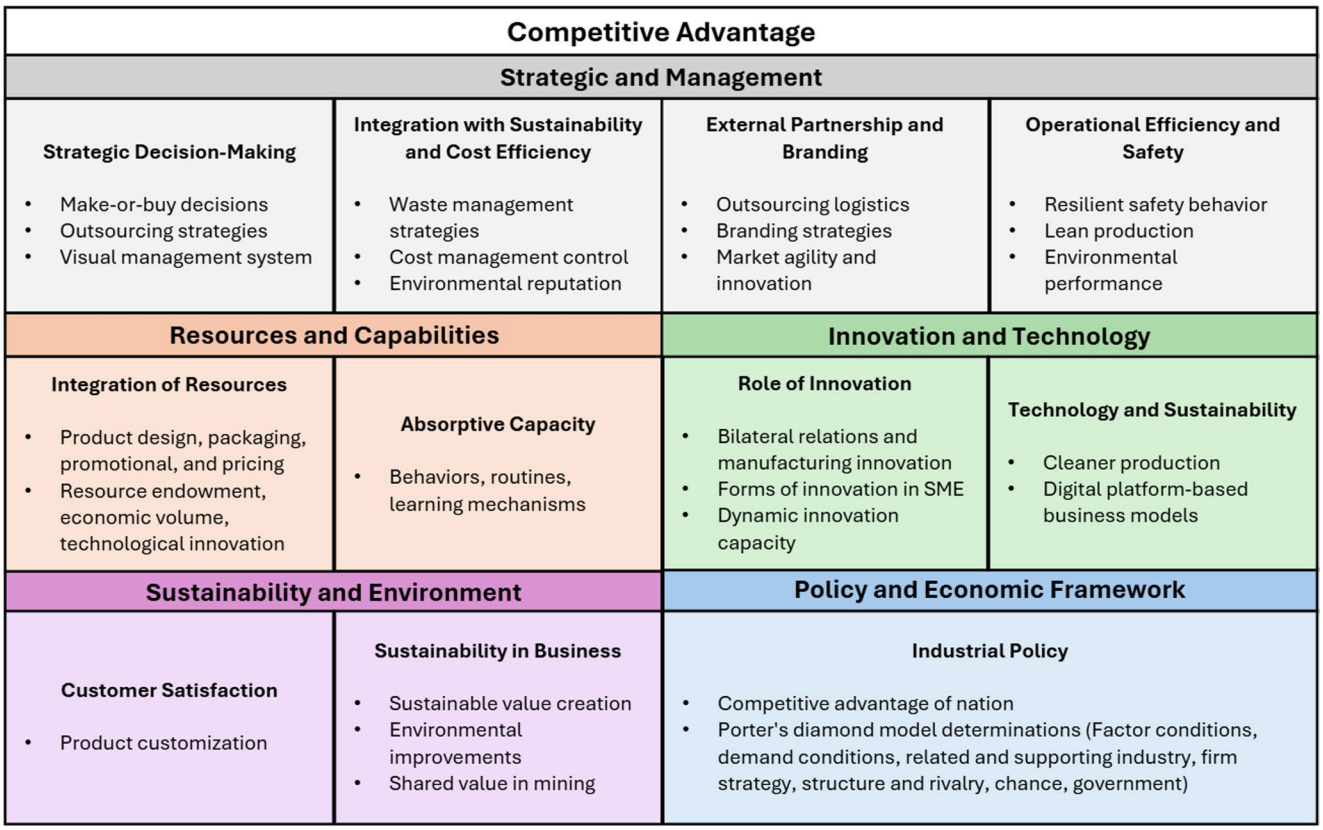

Fig. 3 Study on competitive advantage

Similarly, the research by Sellitto M.A. & Almeida F.A. (2020), da Tondolo et al. (2013), and Fernandes D.S. & Joseph G. (2020) collectively focus on the integration of strategic management with sustainability and cost-efficiency. These studies elucidate how waste management strategies (Sellitto M.A. & Almeida F.A., 2020), cost management control (Fernandes D.S. & Joseph G., 2020), and environmental reputation (da Tondolo et al. 2013), are instrumental in creating a competitive edge. They reveal a trend where environmental sustainability and strategic cost control are not just compliance requirements but key enablers of competitive advantage in the modern business landscape.

Lastly, the works of Rahchamandi and Fallahi (2014), Naatu (2016), and Kyzy B.T. et al. (2023) bring to light the importance of external partnerships, branding, and a venturesome approach in enhancing competitive advantage. They suggest that outsourcing logistics, branding strategies, and adapting to market changes through innovative approaches are pivotal in sustaining a firm's competitiveness. These studies underscore the external aspects of strategic management, where collaboration with third parties (Rahchamandi and Fallahi 2014), brand building (Naatu 2016), and agility in response to market dynamics (Kyzy B.T. et al., 2023) are key drivers of success.

Resources and capabilities

The literature highlights that achieving and sustaining competitive advantage in the mineral sector relies not only on the availability of resources but also on how effectively firms integrate and utilize them. Quaye and Mensah (2019) emphasize that aligning product design, packaging, pricing, and promotion with innovation strategies can enhance market competitiveness in small and medium enterprises. Similarly, Shuai et al. (2023) show that resource endowments, economic scale, and technological capacity are key drivers of competitive performance in the critical minerals sector, particularly within the solar PV industry. These findings are especially relevant to the midstream segment of the mineral value chain, where firms must manage complex operations such as refining and processing. In these stages, competitive success hinges on combining operational efficiency with technological advancement and policy responsiveness.

Building on this perspective, Cappellari et al. (2019) introduce the concept of absorptive capacity, which refers to an organization's ability to recognize, assimilate, and apply external knowledge. This capability is essential for firms operating in fast-evolving environments like mineral processing, where constant regulatory, environmental, and

technological changes demand high levels of adaptability. Absorptive capacity enables firms to strengthen their internal systems while also responding effectively to shifts in market conditions and external pressures. By fostering learning mechanisms, feedback loops, and strategic agility, organizations can better leverage their resources and maintain long-term competitiveness. Collectively, these insights underscore that sustainable advantage in the mineral industry depends on both resource integration and the continuous development of dynamic capabilities.

Innovation and technology

The literature on innovation and technology for competitive advantage presents two interconnected themes: the role of innovation in driving economic growth and development, and the importance of adopting new technologies and sustainable practices for a competitive edge. Verico and Riefky (2022) and Ayinaddis (2023) emphasize the significance of innovation in economic development and business performance, with Verico and Riefky (2022) highlighting the importance of bilateral relations between Indonesia and South Korea in manufacturing innovation, suggesting that such collaborations can help countries avoid economic stagnation, while Ayinaddis (2023) extends this idea to micro and small enterprises, asserting that a strong focus on various forms of innovation is crucial for enhanced performance in the manufacturing sector.

On the other hand, Jia et al. (2014), Camargo Acuña et al. (2017), and Rohn et al. (2021) converge on the theme of integrating technology and sustainable practices into business models for competitive advantage. Jia et al. (2014) focus on cleaner production in the vanadium extraction industry, advocating for environmental sustainability as a competitive strategy. Camargo Acuña et al. (2017) discuss the dynamic innovation capacity, emphasizing the strategic use of resources and capabilities to foster innovation processes. Rohn et al. (2021) explore the success factors of digital platform-based business models, including value creation and delivery, digital transformation, and platform architecture. Collectively, these studies underline innovation as a key driver for economic progress and competitive advantage at both national and enterprise levels, while also highlighting the growing importance of sustainable practices and technological innovation in shaping competitive business strategies in the modern marketplace.

Sustainability and environment

In the sphere of sustainability and environment for competitive advantage, the literature emphasizes the integration of environmental considerations, customer satisfaction, and innovative practices in business strategies. Hannan et al. (2016) and Piyathanavong et al. (2022) both highlight the importance of understanding customer needs and expectations, suggesting that customer satisfaction and product customization are essential for differentiating a business in the market. Similarly, studies by Hariastuti N.L.P. et al. (2021), Severo E.A. & De Guimarães J.C.F. (2015), Alriksson and Filipsson (2017), and Khubana et al. (2022) collectively underscore the necessity of integrating sustainability into business models, whether it is through sustainable value creation, considering environmental sustainability in strategic development, implementing environmental improvements, or creating shared value in the mining industry. These studies demonstrate that sustainability is not just a compliance issue but a strategic opportunity that can enhance competitive advantage. Additionally, the works of Prinsloo H. & Hofmeyr K.B. (2022), Castillo et al. (2015), and Doorasamy (2015) converge on the theme of operational efficiency and safety, highlighting the impact of resilient safety behavior, lean production, and environmental performance benchmarking on organizational performance. These approaches emphasize the critical role of internal processes and safety practices in sustaining competitive advantage in various industries.

Policy and economic framework

The analysis of literature in the area of policy and economic framework highlights the significance of industrial policy and its impact on the competitive advantage of nations. The study by Hanafi et al. (2019) delves into industrial policy, specifically in the smelter industry, using the framework of the Competitive Advantage of Nation (CAN) based on Porter's diamond model. This model includes six determinants: Factor Conditions (FC), Demand Conditions (DC), Related and Supporting Industry (RSI), Firm Strategy, Structure and Rivalry (FSSR), Chance, and Government. The research underscores the importance of tailored industrial policies, suggesting that specific policy interventions such as differentiated fiscal incentives for various minerals, effective export duties, and exploration obligations can significantly enhance the competitiveness of the smelter industry.

This study highlights the pivotal role of government policies in shaping the industrial landscape and driving competitive advantage. It suggests that a nuanced and sector-specific approach to policy-making, informed by the comprehensive framework of Porter's diamond model, is crucial in fostering competitive industries. Such policies not only address the unique needs and characteristics of each sector but also align with broader economic objectives, ultimately contributing to the nation's competitive positioning in the global market.

Comparative advantage

Figure 4 illustrates that research on comparative advantage encompasses three main areas: (1) market factors, (2) trade dynamics, and (3) resource and capability endowments. Market factors research explores state-owned enterprises (SOEs), industrial policy, and trade. Research on trade dynamics within the context of comparative advantage examines revealed comparative advantage (RCA), global value chains (GVC), and international trade. Lastly, comparative advantage research on resource and capability endowments focuses on dynamic capabilities and the development of alternative resources.

Market factors

In examining market factors from the perspectives of environmental policy and international trade, two studies stand out for their comprehensive analysis. Macheda (2022) delves into China's strategy for carbon neutrality, emphasizing the significant role of State-owned enterprises (SOEs) in the energy sector. This study highlights how China's industrial policies and the strategic positioning of SOEs have been crucial in reducing fossil fuel consumption and fostering renewable energy advancements. On the other hand, Nurwulandari and Adnyana (2019) explore the impact of the ASEAN-China Free Trade Area on Indonesia's export commodities. By applying the New Trade Theory, their research sheds light on the varied effects of trade agreements on commodity exports, offering insights into regional economic cooperation and development. Together, these studies provide a nuanced understanding of how governmental policies intertwine with environmental goals and trade dynamics, offering a rich analysis of market factors in the context of global environmental and economic challenges.

Trade dynamics

In the exploration of trade endowments, three studies offer distinct yet interconnected insights into global trade dynamics and regional competitive advantages. Beyene (2014) provides a comprehensive analysis of the RCA of Sub-Saharan Africa (SSA) and the Middle East & North Africa (MENA) in merchandise exports. This study highlights that SSA possesses a strong RCA in ores, metals, fuels, food, and agricultural raw materials, but lags in economic integration compared to other low and middle-income countries. Conversely, MENA shows a revealed disadvantage in all sub-products except fuel exports, yet exhibits stronger global integration. The study suggests a significant potential for these regions to enhance mutual trade, especially in food, ores, metals, and agricultural raw materials. Bagaria (2022) shifts the focus to the opportunities for India in the GVC in the post-COVID-19 era. This research examines India's potential as an alternative to China for the USA in GVCs, particularly in industries like textiles, apparel, leather, chemicals, and non-metallic mineral products. The study underscores India's comparative advantage in these sectors, highlighting the shifting landscape of global supply chains due to the pandemic.

Chen et al. (2022) delve into the international coal trade, employing a complex network analysis of trade data from 1999 to 2018. Their findings reveal a steady growth in the scale of international coal trade but note a complicated transformation in trade relations, especially amidst increasing trade frictions. The study identifies major coal trading

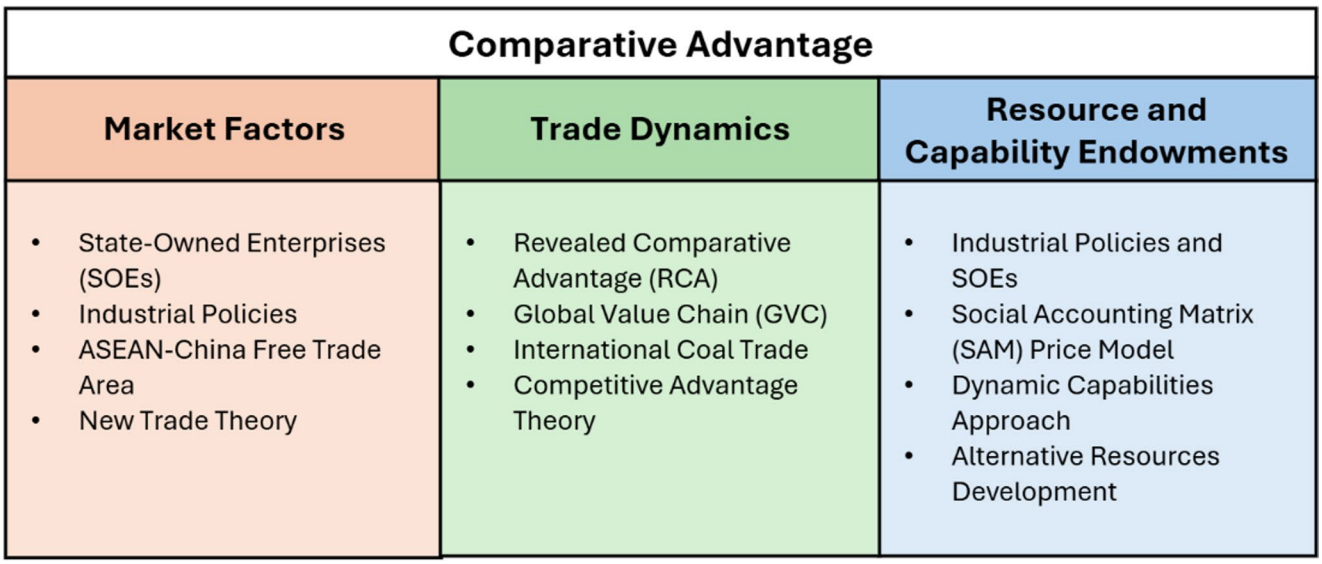

Fig. 4 Study on comparative advantage

countries like Australia, the USA, and Japan, and important trade hubs such as the USA, South Africa, and India, offering strategic insights based on competitive advantage theory. Together, these studies paint a nuanced picture of global trade dynamics, emphasizing the evolving nature of regional competitive advantages and the shifting patterns in international trade relationships in the face of economic and environmental challenges.

Resource and capability endowments

In the literature review analysis focusing on resource and capability endowments, three distinct studies offer insights into how different regions leverage these endowments for economic development and trade. Macheda F. (2022) explores China's strategy in decarbonization, emphasizing the critical role of SOEs in the energy sector. This study illustrates how China's industrial policies, combined with the strategic positioning of SOEs, effectively restrain fossil fuel consumption while fostering advancements in renewable energy. It highlights the public sector's role in driving the transition to cleaner energy technologies, despite the economic lure of coal.

In a different context, Moncarz and Barone (2020) analyze the welfare effects of rising commodity prices in Brazil. Using a Social Accounting Matrix (SAM) price model, their study reveals the impact of international commodity price increases on different household expenditure levels. It shows that while economies like Brazil can benefit macroeconomically from high commodity prices, such increases can lead to redistributive challenges, especially affecting lower-income populations.

Alonso et al. (2020) take dynamic capabilities approach to study international diversification in Western Australia. Through interviews with business and government representatives, they identify key strategies for economic diversification beyond the dominant mining industry. The study emphasizes the importance of developing alternative resources like tourism, international education, and agriculture to bolster economic development and competitive advantage. These studies collectively provide a nuanced understanding of how different regions utilize their unique resources and capabilities. They illustrate the balance between leveraging natural and economic endowments for growth while managing the socio-economic impacts and the importance of diversifying economic activities to ensure sustainable development.

Specific sector analysis

Focusing on specific industry sectors can provide more context-related insights. Figure 5 illustrates the distribution of academic papers discussing comparative and competitive advantages across four major industry sectors: metal and mining (54%), energy and resources (20%), chemical and processing (13%), and steel and metal products (13%). This breakdown highlights the significant research focus on the metal and mining sector, reflecting its critical role in industry development. These insights underscore the importance of examining sector-specific competitive strategies and comparative advantages in driving sustainable growth.

Cappellari et al. (2019) emphasize the need for comparative research among organizations in different industry segments. Hariastuti et al. (2021) propose a broader evaluation of the metal industry, even on a national or global scale, to find general implications and contributions in creating sustainable value. They note the critical impact of partnership strategies in enhancing performance and competitive edge

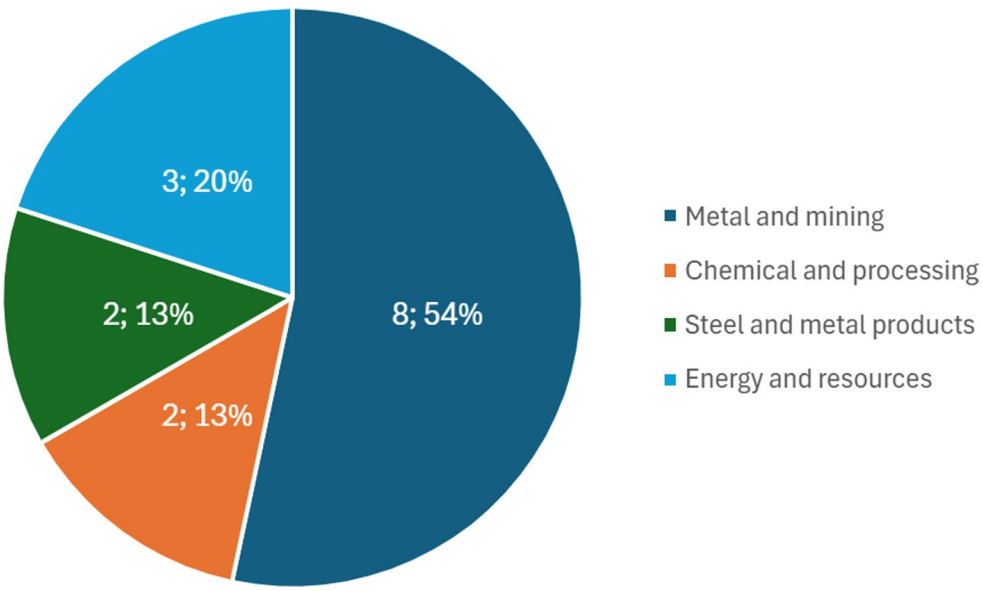

Fig. 5 Proportion of studies on specific industry sectors

for small and medium-sized enterprises in metal manufacturing. Wang et al. (2019) recommend further research in the urban mining industry from processing to manufacturing. They highlight the pivotal role of local governments in promoting the urban mining industry through the transition of industrial policies from initially preferential to more balanced ones.

In the construction sector, Fernandes and Joseph (2020) suggest research focusing on the dominance of Chinese businesses and its impact on the construction market in South Africa. These firms capitalize on both central and local governmental support in China, manage their industrial relations beyond their borders, and establish strong local networks in their operating countries. To dominate the market in the Southern African region, Chinese multinational contractors deploy a range of organizational strategies, including competitive pricing, cultivating long-term relationships with suppliers, securing funding from the Chinese government, and forming specialized subsidiary companies, and specialized sub-companies to achieve market dominance in the Southern African region.

In summary, business actors play a critical role in decision-making across these sectors. They implement strategic organizational actions such as forming long-term partnerships, securing government funding, competitive pricing, and establishing specialized subsidiaries to navigate and dominate the market. These strategies, coupled with their ability to adapt to local and international policies and leverage governmental support, underscore the significant influence business actors hold in shaping industry trends and determining the competitive landscape in their respective sectors.

Discussions

The findings of this study provide a comprehensive understanding of the prevailing research focus on competitive and comparative advantage, with competitive advantage emerging as the dominant theme in the literature. Strategic decision-making stands out as a critical factor for enhancing organizational performance and achieving market differentiation. Furthermore, the integration of sustainability and environmental considerations into business strategies highlights a growing recognition of their role in fostering long-term competitiveness. This is particularly evident in the emphasis on leveraging resources and capabilities to balance operational efficiency with sustainable practices. These insights align with broader trends such as digital transformation and innovation-driven growth, underscoring the interconnectedness of technological advancements, resource optimization, and environmental responsibility.

In contrast, research on comparative advantage, while less emphasized, offers valuable perspectives on resource endowments and trade dynamics. This strand of literature stresses the importance of utilizing natural and technological resources to enhance economic integration and drive regional development. Together, the focus on competitive and comparative advantage reflects the need for tailored strategies that align with global economic and environmental objectives.

Stakeholder	Competitive Advantage	Comparative Advantage	Future Direction
Industry	• Sustainability in Business: Emphasizes environmental improvement and shared value • Innovation & Technology: Adoption of cleaner production and digital platforms • Operational Efficiency: Lean production and environmental performance	• Resource & Capability Endowments: Leverages factor endowments and technological innovation • Trade Dynamics: Resilient supply chains support comparative export advantages	• Integrate sustainability goals into business models • Innovate with cutting-edge technologies • Develop resilient supply chains
Government	• Policy & Economic Framework: Develops industrial policies and strategic enablers • Strategic Decision-Making: Regulatory support for sourcing and outsourcing strategies	• Market Factors: Involvement of SOEs, trade agreements, and regulatory design • Trade Dynamics: Builds robust global value chain integration and national trade advantages	• Design transformative policies • Facilitate supply chain resilience and domestic production • Support knowledge-sharing platforms
Academia	• Innovation and Technology: Studies on innovation capacity and digital transformation • Resources & Capabilities: Focus on absorptive capacity and organizational learning	• Trade Dynamics: Analysis of GVC positioning and innovation in comparative advantage • Resource & Capability Endowments: Research on dynamic capabilities and alternative resource development	• Explore digitalization's impact • Investigate integration of sustainability and strategies • Study regional innovation

Figure 6 highlights future directions for key stakeholders—namely industry, government, and academia—by aligning their strategic roles with both competitive and comparative advantage frameworks identified in the literature,

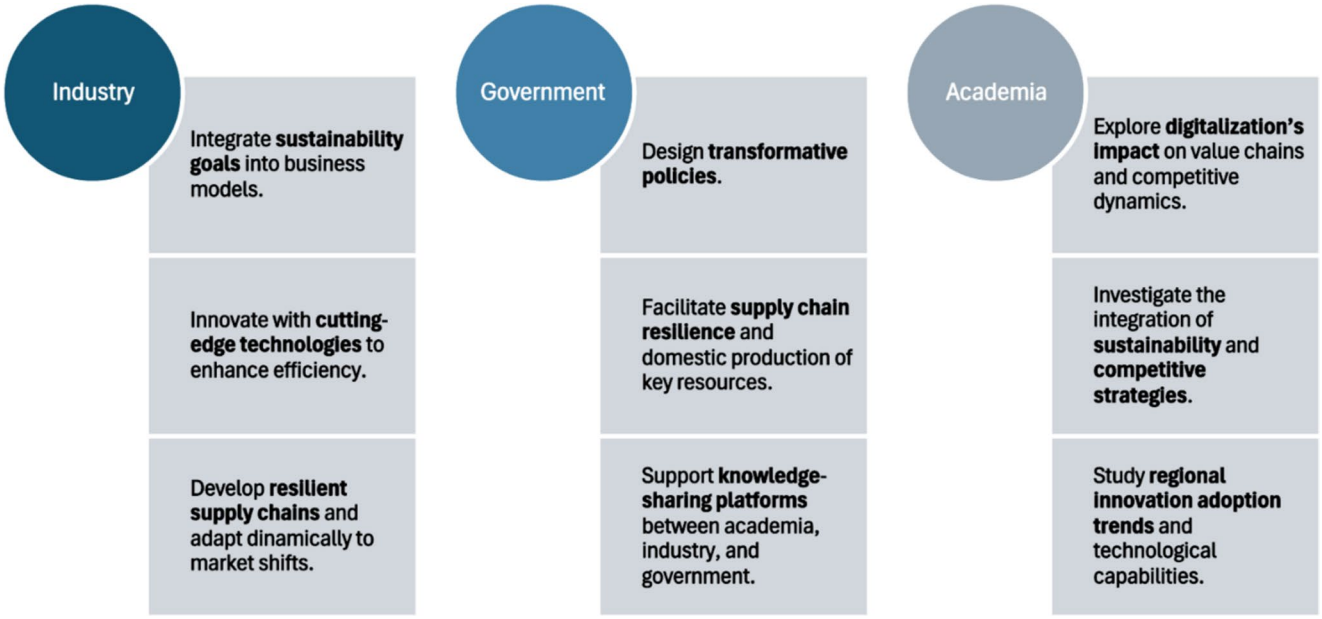

Fig. 6 Future directions for industry, government, and academia

particularly as illustrated in Figs. 3 and 4. In the industrial sector, maintaining competitiveness in the mineral industry increasingly depends on the integration of sustainability objectives into business models, the adoption of cutting-edge technologies, and the development of resilient supply chains. These practices reflect themes under competitive advantage, such as operational efficiency, innovation and technology, and sustainability in business, while also reinforcing comparative advantage through enhanced resource and capability endowments and improved trade dynamics. The incorporation of circular economy principles and adaptive supply chain systems allows firms to comply with regulatory requirements, strengthen brand loyalty, and ensure long-term viability in volatile markets.

Government institutions play a central role in facilitating the transition toward sustainable competitiveness through the design of targeted and adaptive policy instruments. Their influence is evident in competitive advantage frameworks through the development of industrial policies and regulatory mechanisms and in comparative advantage discussions through their involvement in market regulation, trade facilitation, and the strategic positioning of state-owned enterprises. Future government efforts should focus on providing innovation incentives, enhancing domestic value creation, and supporting platforms for knowledge sharing. These measures are vital to ensure economic resilience and enable fair participation in global value chains, particularly for mineral-rich developing countries seeking to maximize their comparative strength.

Academic institutions are uniquely positioned to produce empirical insights that guide practice and inform policymaking. Their role aligns with both competitive and comparative advantage through research on innovation capacity, digital transformation, absorptive capabilities, and resource development strategies. Key research priorities include examining how digitalization affects value chains, evaluating the integration of sustainability into competitive strategies, and investigating the geographic disparities in innovation adoption. By fostering collaboration across industry and government, academia can ensure that research findings are not only theoretically rigorous but also practically applicable, contributing to more strategic and sustainable decision-making across the mineral sector.

In conclusion, the coordinated actions of industry, government, and academia are essential to enhancing both competitive and comparative advantages in the mineral value chain. Embedding sustainability, innovation, and resilience across stakeholder strategies will create synergies that strengthen the sector's adaptability and contribute to a more inclusive and dynamic global economy.

Limitation and future research

This review acknowledges several limitations that may affect the depth and applicability of its findings. First, the exclusive use of Scopus as the primary database may have led to the omission of relevant studies indexed elsewhere, while the focus on English-language literature potentially excludes critical perspectives from non-English research communities. Second, although the review spans 2013–2023 to capture recent developments, it does not fully

reflect the historical evolution of competitive and comparative advantage theories, especially those that shaped early mineral development strategies. The review also did not include formal quality assessment criteria for included studies, which introduces possible inconsistencies in research rigor. Furthermore, there is limited geographic representation, with an underrepresentation of studies from developing or mineral-rich but low-research-capacity countries.

To advance future research, scholars should adopt more nuanced approaches that reflect the diversity of value chain stages—upstream (exploration, extraction), midstream (refining, processing), and downstream (fabrication, manufacturing)—as each stage involves different strategic, regulatory, and operational dynamics. For instance, while the copper industry has been extensively studied, other sectors such as rare earth elements or manganese remain underexplored despite their strategic importance. Future studies should therefore include sector-specific comparative assessments and examine how competitive and comparative advantages manifest differently across commodities and production stages.

Moreover, future research should consider longitudinal and mixed-method designs to investigate causal relationships and contextual changes over time, particularly in response to shifts in global value chains and industrial policy. The integration of sustainability strategies with firm-level decision-making, especially in midstream operations where policy and firm capabilities converge, remains a crucial area for deeper investigation. Developing practical tools—such as sector-based performance indicators, policy evaluation frameworks, and strategic alignment models—will also enhance the translational impact of research and ensure its relevance to policymakers, firms, and academic institutions alike.

Conclusion

This study provides a scoping review of competitive and comparative advantages within the midstream mineral industry, synthesizing a decade of peer-reviewed literature across strategic, operational, and policy-related dimensions. The review highlights the prominence of competitive advantage themes, particularly in areas such as strategic decision-making, sustainability, and resource-based capabilities. These findings underscore the importance of firm-level strategies in securing long-term market success. In contrast, research on comparative advantage focuses on broader macroeconomic factors such as trade dynamics, market access, and resource endowments. These studies offer valuable insights into how national and regional contexts influence competitiveness within the industry. Although these two domains have often been analyzed separately, their interaction is increasingly evident in midstream activities where firm capabilities and national policy instruments must align to generate sustainable value.

The findings also demonstrate the importance of sector-specific dynamics in shaping competitive strategies. Value creation in mineral processing, for example, depends not only on internal firm capabilities but also on the presence of effective institutions, infrastructure, and regulatory support. Industry actors and governments contribute jointly to shaping market trends through innovation policies, sustainability mandates, and strategic investments. This review confirms the interconnected nature of competitive and comparative advantages in driving organizational success, where strategic choices, innovation, and policy frameworks serve as key enablers. To further strengthen this understanding, future research would benefit from incorporating visual representations—such as causal loop diagrams—to better illustrate the feedback relationships among firm strategy, policy instruments, technological adaptation, and market performance in the mineral value chain.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s13563-025-00543-5.

Acknowledgements Our deepest appreciation goes to our colleagues at the School of Business and Management, Institut Teknologi Bandung (SBM ITB), for sharing their knowledge and related insights, as well as for their invaluable input, guidance, and support during the preparation of this study. Their contributions have greatly enriched the scoping review and enhanced its academic rigor.

Author Contribution All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Andri Budhiman Firmanto, Dermawan Wibisono, Manahan Parlindungan Saragih Siallagan, and Mohammad Zaki Mubarok. The first draft of the manuscript was written by Andri Budhiman Firmanto and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Declarations

Conflict of interest The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Alonso AD, Kok S, O'Shea M (2020) International diversification and economic development in a regional context: a dynamic capabilities approach. J Int Bus Entrepreneurship Dev 12(2–3):122–141. https://doi.org/10.1504/JIBED.2020.106182

Alriksson S, Filipsson M (2017) Risk perception and worry in environmental decision-making–a case study within the Swedish steel industry. J Risk Res 20(9):1173–1194. https://doi.org/10.1080/13669877.2016.1153498

Arksey H, O'Malley L (2005) Scoping studies: towards a methodological framework. Int J Soc Res Methodol 8(1):19–32. https://doi.org/10.1080/1364557032000119616

Ayinaddis SG (2023) The effect of innovation orientation on firm performance: evidence from micro and small manufacturing firms in selected towns of Awi zone, Ethiopia. J Innov Entrepren. https://doi.org/10.1186/s13731-023-00290-3

Bagaria N (2022) Analysing opportunities for India in global value chains in post COVID-19 era. Foreign Trade Rev 57(3):261–282. https://doi.org/10.1177/0015732520981470

Bas TG, Kunc MH (2009) National systems of innovations and natural resources clusters: evidence from copper mining industry patents. Eur Plan Stud 17(12):1861–1879. https://doi.org/10.1080/09654310903322363

Beyene HG (2014) Trade integration and revealed comparative advantages of sub-Saharan Africa and Latin America & Caribbean merchandise export. Int Trade J 28(5):411–441. https://doi.org/10.1080/08853908.2014.952851

Camargo Acuña G, Díaz Alonso RC, Pachecho V, Manotas N (2017) Dynamic innovation capacity in the metalworking exporting SMEs in Colombia[Capacidad dinámica de innovación en las PyME exportadoras metalmecánicas en Colombia]. Espacios 38(58)

Cappellari G, Welter CVN, Hermes LCR, Sausen JO (2019) Absorptive capacity: components and organizational mechanisms for its development. RAM Rev Adm Mackenzie. https://doi.org/10.1590/1678-6971/eramd190028

Castillo G, Alarcón LF, González VA (2015) Implementing lean production in copper mining development projects: case study. J Constr Eng Manag. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000917

Chen X, Tan Z, Li S (2022) Study on the characteristics of international coal trade on complex network. J Bus Econ Manage 23(4):797–817. https://doi.org/10.3846/jbem.2022.15670

da Tondolo RP, Severo R, Tondolo EA, Camargo ME (2013) Management of operating costs on a small firm: A case study in southern Brazil[Gestão dos Custos Operacionais na Empresa de Pequeno-Porte: Um estudo de caso no sul do Brasil]. Espacios 34(5)

Diana C, Sorin M, Mirela I, Laura M, Sabina I (2015) Creating competitive advantage in coal mining industry in Romania: a new challenge. Procedia Econ Finance 23:428–433. https://doi.org/10.1016/S2212-5671(15)00396-2

Doorasamy M (2015) Benchmarking: business strategy to improve environmental performance. Invest Manag Financ Innov 12(2):214–229

EPA (2023) *Mining Sector Information | US EPA*. https://www.epa.gov/smartsectors/mining-sector-information

Fernandes DS, Joseph G (2020) Organisational strategies for competitive advantage in the construction industry: Chinese dominance in Southern Africa. J Constr Develop Ctries 25(2):1–38. https://doi.org/10.21315/jcdc2020.25.2.1

Firmanto AR, Wibisono Y (2025) A strategic evaluation of Indonesia's policy on mineral downstreaming: a case study of the nickel industry. Resour Policy. https://doi.org/10.1016/j.resourpol.2024.104281

Fliess B, Idsardi E, Rossouw R (2017) Export controls and competitiveness in African mining and minerals processing industries | OECD Trade Policy Papers |. OECD iLibrary. https://www.oecd-ilibrary.org/trade/export-controls-and-competitiveness-in-african-mining-and-minerals-processing-industries_1fddd828-en

Gupta SD (2015) Comparative advantage and competitive advantage: an economics perspective and a synthesis. Athens J Bus Econ 1:1–9. https://doi.org/10.30958/ajbe.1-1-1

Hanafi M, Wibisono D, Mangkusubroto K, Siallagan M, Badriyah MJK (2019) Designing smelter industry investment competitiveness policy in Indonesia through system dynamics model. J Sci Technol Policy Manage 10(3):617–641. https://doi.org/10.1108/JSTPM-06-2018-0064

Hannan S, Suharjo B, Nurmalina R (2016) The influence of perceived quality, perceived value, and customer expectation on customer satisfaction: an empirical study on independent surveyor industry in Indonesia. Int J Appl Bus Econ Res 14(2):603–613

Hariastuti NLP, Santoso PB, Tama IP (2021) Analyzing the drivers of sustainable value creation, partnership strategies, and their impact on business competitive advantages of small & medium enterprises: a PLS-model. East-Eur J Enterp Technol 2(13–110):55–66. https://doi.org/10.15587/1729-4061.2021.228864

Hilman H, Mohamed ZA (2013) Specific match between specific types of strategic flexibility and sourcing strategy: another strategic approach to build competitive advantage. J Glob Bus Adv 6(2):167–178. https://doi.org/10.1504/JGBA.2013.053569

Ilinova A, Dmitrieva D (2017) Competitive advantages of mining and chemical companies in high environmental turbulence. Proceedings of International Conference on Management – Economics – Ethics – Technology (MEET 2017)

Jia L, Zhang Y, Tao L, Jing H, Bao S (2014) A methodology for assessing cleaner production in the vanadium extraction industry. J Clean Prod 84(1):598–605. https://doi.org/10.1016/j.jclepro.2013.05.016

Kharad S (2023) (19) Industrial Minerals Market Latest Forecast Report by 2030 | LinkedIn. https://www.linkedin.com/pulse/industrial-minerals-market-shreejeet-kharad/

Khubana T, Rootman C, Smith EE (2022) Outcomes of shared value: perceptions within the South African mining industry. Int J Interdiscip Organ Stud 17(2):111–133. https://doi.org/10.18848/2324-7649/CGP/v17i02/111-133

Knop K (2020) Importance of visual management in metal and automotive branch and its influence in Building a competitive advantage[Znaczenie zarządzania wizualnego w branży metalowej i motoryzacyjnej i jego wpływ na budownictwo, przewaga konkurencyjna]. Pol J Manage Stud 22(1):263–278. https://doi.org/10.17512/pjms.2020.22.1.17

Kyzy BT, uulu TA, Ryskulov U (2023) Matkasym: an entrepreneurial journey from bazaar to factory. South Asian J Bus Manag Cases 12(2):194–206. https://doi.org/10.1177/22779779231189546

Levac D, Colquhoun H, O'Brien KK (2010) Scoping studies: advancing the methodology. Implement Sci 5(1):69. https://doi.org/10.1186/1748-5908-5-69

Löwer J, Bringezu S (2019) Assessing economic aspects of material production: a new method and dataset for global mining production and its link to gross domestic product. Miner Econ 32:205–219. https://doi.org/10.1007/s13563-019-00191-6

Macheda F (2022) Politiche industriali e imprese pubbliche: le fondamenta della via cinese alla decarbonizzazione. L'industria 43(4):581–619

Maley J, Kowalkowski C, Brege S, Biggemann S (2015) Outsourcing maintenance in complex process industries: managing firm capabilities in lock-in effect. Asia Pac J Mark Logist 27(5):801–825. https://doi.org/10.1108/APJML-02-2015-0018

Mamina M, Maganga FP (2020) An analysis of zimbabwe's comparative advantage in the mining sector: A case for beneficiation. Resour Policy 68:101794. https://doi.org/10.1016/j.resourpol.2020.101794

Maqbool MS, Rehman MAU, Ditta A (2020) Comparative advantage and the product mapping of exporting sector of minerals in Pakistan. Acad J Social Sci (AJSS) 4(3):700–710. https://doi.org/10.54692/AJSS.2020.04031210

Moncarz PE, Barone SV (2020) Rising commodity prices and welfare in Brazil: A simulation of medium-term effects using a SAM price model. Int J Emerg Mar 15(5):1029–1060

Munn Z, Peters MDJ, Stern C, Tufanaru C, McArthur A, Aromataris E (2018) Systematic review or scoping review? Guidance for

authors when choosing between a systematic or scoping review approach. BMC Med Res Methodol 18:143. https://doi.org/10.1186/s12874-018-0611-x
Naatu F (2016) Brand building for competitive advantage in the Ghanaian jewelry industry. Int Rev Manag Mark 6(3):551–558. https://www.scopus.com/inward/record.uri?eid=2-s2.0-84978984878&partnerID=40&md5=c41e1e63ca4683c26dc55026062a22cf
Nurwulandari A, Adnyana IM (2019) Did inter-regional trade agreements bring mutual benefits? An empirical scheme of Indonesian commodity exports in Asean-China free trade area. Int J Financial Res 10(6):241–249. https://doi.org/10.5430/ijfr.v10n6p241
Piyathanavong V, Huynh V-N, Karnjana J, Olapiriyakul S (2022) Role of project management on sustainable supply chain development through industry 4.0 technologies and circular economy during the COVID-19 pandemic: a multiple case study of Thai metals industry. Oper Manage Res. https://doi.org/10.1007/s12063-022-00283-7
Porter ME (1985) Competitive advantage: Creating and sustaining superior performance. Free
Porter ME (1990) The competitive advantage of nations. Free, New York
Prasad SS (2020) Interpreting competitive advantage: evidence from existing literature. Indian J Mark 50(8):88–95. https://doi.org/10.17010/ijom/2020/v50/i8-9/154694
Prinsloo H, Hofmeyr KB (2022) Organisational culture, frontline supervisory engagement and accountability, as drivers of safety behaviour in a platinum mining organisation. SA J Hum Resource Manage 20. https://doi.org/10.4102/sajhrm.v20i0.1705
Quaye D, Mensah I (2019) Marketing innovation and sustainable competitive advantage of manufacturing SMEs in Ghana. Manag Decis 57(7):1535–1553. https://doi.org/10.1108/MD-08-2017-0784
Rahchamandi E, Fallahi K (2014) An investigation on logistics outsourcing on exports of minerals goods. Uncertain Supply Chain Manage 2(3):163–166. https://doi.org/10.5267/j.uscm.2014.5.001
Rohn D, Bican PM, Brem A, Kraus S, Clauss T (2021) Digital platform-based business models – an exploration of critical success factors. J Eng Technol Manage. https://doi.org/10.1016/j.jengtecman.2021.101625
Salavou HE (2015) Competitive strategies and their shift to the future. Eur Bus Rev 27(1):80–99. https://doi.org/10.1108/EBR-04-2013-0073
Sellitto MA, Almeida FA (2020) Strategies for value recovery from industrial waste: case studies of six industries from Brazil. Benchmarking 27(2):867–885. https://doi.org/10.1108/BIJ-03-2019-0138
Severo EA, De Guimarães JCF (2015) Corporate environmentalism: an empirical study in Brazil. Int J Bus Glob 15(1):81–95. https://doi.org/10.1504/IJBG.2015.070225
Shatunov V (2023) Revealed comparative advantages in terms of added value of mineral production in Russia. Russ J Ind Econ 16(1):24–35. https://doi.org/10.17073/2072-1633-2023-1-24-35
Shuai J, Zhao Y, Xiong X, Shuai C, Wang J (2023) The co-opetition relationships of critical mineral resources for the solar PV industry between China and the world major powers. J Clean Prod. https://doi.org/10.1016/j.jclepro.2023.139171
Thibeault A, Ryder M, Tomomewo O, Mann M (2023) A review of competitive advantage theory applied to the global rare Earth industry transition. Resour Policy 85:103795. https://doi.org/10.1016/j.resourpol.2023.103795
Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, Moher D, Peters MDJ, Horsley T, Weeks L, Hempel S, Akhondi-Asl A, Realist A, Kenny M, Warren R, Wilson MG, Tetzlaff J, Straus SE (2018) PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. Ann Intern Med 169(7):467–473. https://doi.org/10.7326/M18-0850
Vasilev Y (2016) Assessment features of coal mining enterprise competitiveness
Verico K, Riefky T (2022) Bilateral trade and investment relations analysis: Indonesia and South Korea. Int J Bus Soc 23(2):714–750. https://doi.org/10.33736/IJBS.4835.2022
Wang C, Lu F-H, Sun Q, Zuo L-S, Geng H-J (2019) How do policies take effect in the development of the urban mining industry? A local capability perspective: evidence from miluo, China (2000–2017). J Clean Prod. https://doi.org/10.1016/j.jclepro.2019.118216
World Bank (2013) Results Profile: Mining. Retrieved from https://www.worldbank.org/en/results/2013/04/14/mining-results-profile
Xie S (2019) Why comparative advantage is a problematic guide to practical policy. Econ Aff 39(2):243–250. https://doi.org/10.1111/ecaf.12347
Yang J, Li C, Wang Y (2024) Global value chains, digital trade, and comparative advantage: evidence from the mineral processing industry. Minerals 14(2):187. https://doi.org/10.3390/min14020187
Zahra SA, George G (2002) Absorptive capacity: a review, reconceptualization, and extension. Acad Manage Rev 27(2):185–203. https://doi.org/10.5465/amr.2002.6587995