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Implement circular economy in coal industry: Applied at Mong Duong mine, Quang Ninh province

Dao Trung Thanh*, Nguyen Thi Hong
Hanoi University of Mining and Geology

ABSTRACT

Implementing a circular economy in the coal industry, specifically at the Mong Duong mine in Quang Ninh, requires a comprehensive approach involving various stakeholders. Although the coal industry presents unique challenges, several strategies and measures can be applied to foster a more circular and sustainable approach: Resource Efficiency; Recycling and Reuse; Renewable Energy Transition; Research and Development; Stakeholder Engagement; Regulatory Framework; Economic Diversification; and Education and Awareness. Implementing a circular economy in the coal industry is a complex and long-term process that requires collaboration, investment, and commitment from all stakeholders involved. It is essential to balance economic development with environmental and social considerations to achieve a sustainable and resilient future for the Mong Duong mine and the broader Quang Ninh region.

Keywords: Circular economy; Sustainable development; Coal industry; Mong Duong mine.

1. Introduction

The term "circular economy" was first introduced in a publication by the European Union in 2015 as part of its efforts to promote a more sustainable and efficient use of resources [1]. This concept focuses on creating an integrated model of production, distribution, and consumption that aims to keep products, components, and materials in use for as long as possible while minimizing raw material inputs and waste outputs [2]. Over the years, various definitions and models have emerged, emphasizing principles such as reducing, reusing, recycling, and recovering resources to achieve a closed-loop system and maximize resource efficiency [3]. The circular economy concept has gained significant attention in academic research, with a growing number of publications exploring its potential to drive sustainability and environmental benefits across different sectors [4].

As outlined in the provided research papers, the coal industry can benefit significantly from embracing circular economy principles. Transitioning to circular business models in coal mining operations can optimize material flows, reduce production costs, expand product ranges, and enhance sustainable development indicators [5]. Circular economy approaches, such as narrowing supply chain loops, slowing loops through product repair, and closing loops via recycling, can help reduce energy consumption and greenhouse gas emissions on a global scale [6]. In Quang Ninh, where coal plays a vital role, implementing circular economy models in coal mines is seen as a strategic move towards sustainable development, addressing economic challenges, energy shortages, and environmental issues. By integrating circular economy practices, the coal industry can improve its environmental impact and drive economic growth and resilience.

Studies emphasize the benefits of circular business models in mining operations, highlighting cost reduction, product range expansion, and improved sustainability indicators [7]. Additionally, the implementation of product-service systems (PSSs) in the mining industry can facilitate the transition to circularity through supplier involvement, a concept that remains underexplored but holds significant potential for achieving sustainability in mining operations [8]. Furthermore, practicing a circular economy in the mining industry involves various strategies such as increasing the recycling of mine wastewater, reusing mine waste rock, controlling air pollution, and managing other wastes effectively. By valorizing wastewater, communal production, and agricultural wastes and utilizing mining waste as alternative materials in construction, the industry can reduce resource consumption, minimize waste generation, and promote sustainable practices [9]. Additionally, adopting a circular economy approach to address acid mine

* Tác giả liên hệ
Email: daotrongthanh@humg.edu.vn

drainage issues through recycling mining wastes as buffering agents for sulfide-bearing tailings can significantly mitigate environmental pollution [10]. By integrating these insights and strategies, the Mong Duong mine can serve as a pioneering example, inspiring broader industry adoption of circular economy principles. The paper explores barriers and drivers for implementing circular economy practices in the mining industry, which can be applied to promote circular economy at Mong Duong mine and the broader coal industry.

2. Materials and methods

2.1. Description of Study Area

Mong Duong mine is currently in the implementation phase of the underground mining project at level -250m to -550m (Fig 1), with total reserves of 33.7 million tons, mine life is 18 years, and ending in 2044. Contiguous location of the mine: the North borders on Mong Duong River; the South borders with 790 factories; the West borders Khe Cham Coal Company; the East borders with Bai Tu Long Bay. The location of the Mong Duong mine is shown in Fig. 2.

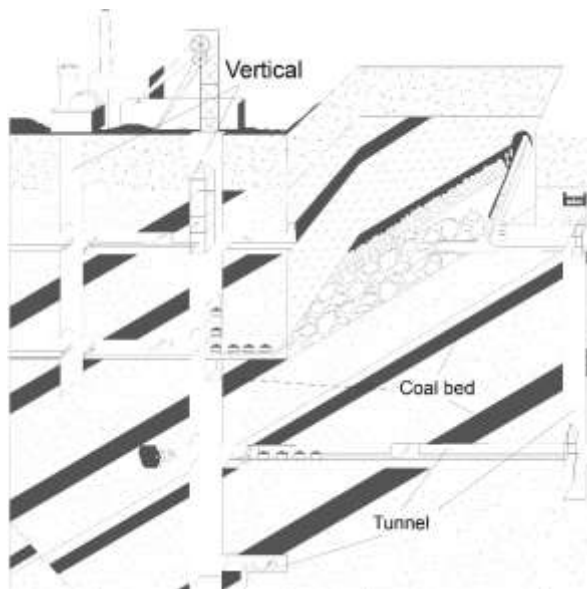


Fig 1. Cross section of underground coal mine



Fig 2. The locality of the Mong Duong mine

2.2. SWOT Analysis

The SWOT method, which stands for strengths, weaknesses, opportunities, and threats analysis, was initially introduced as an analytical tool in management in the 1960s and has since been widely referenced in conventional management literature [11]. It is mainly used in the fields of corporate competitiveness and strategy research. In this study, it is used to assess the possibility of applying circular economy at Mong Duong mine (Fig 3).

2.3. Survey method

Explore the mine's readiness and needs in the circular economy progression. From the information collected, the survey was designed to facilitate the mine to achieve sustainable development through circular economy approaches. The questions revolved around the relationship between the components of the circular economy (production, supply chain, distribution, consumption, and responsibility) and sustainable performance (economic, environmental, and social). The statistical results of the responses will provide an overview of the production situation and the collective desire for sustainable and circular business. In addition, the survey results can be used to design a circular economy model for the mine or adjust the current business model (Fig 4).

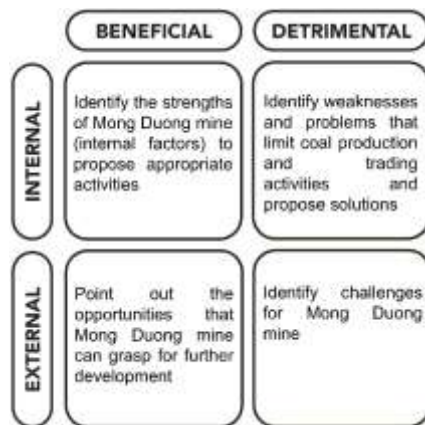


Fig 3. SWOT analysis for Mong Duong mine

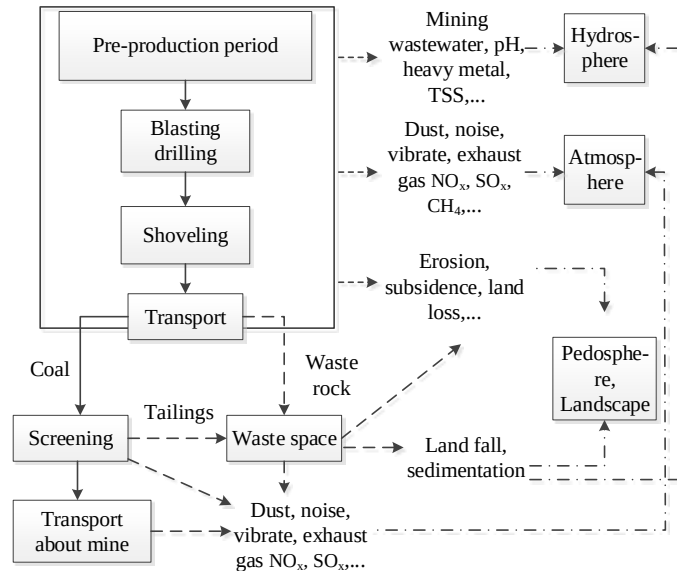


Fig 4. Schematic product and waste streams at Mong Duong mine

2.4. Interview method

- The objective is to add information sources and reliability to the collected data.
- Interview subjects: Experts in the coal industry; mine management; employees, engineers, and workers directly involved.
- Type of interview: Semi-structured interview (SSI) uses a pre-prepared set of questions, but the interviewer has the right to ask additional questions based on the interviewee's responses.
- Implementation steps: i) Preparation: Identify objective, list interviewees, design questions and schedule; ii) Conduct the interview: The interviewer and interviewee exchange information, sometimes using audio or video recording equipment to record the entire conversation; iii) Information processing: After interviewing, information needs to be processed, synthesized and classified.

3. Results and discussion

3.1. Analyze results and evaluate survey data

Fig 5 shows that the results for priority, experience, ambition, and current business model are all at an average level. However, the priority factor has the highest score (29/40), indicating that the mine is always ready to transform its business model towards a circular economy. However, there is still little understanding of the circular economy model and needs support to move towards a more sustainable business model.

Through the results of Fig 6, the most chosen strategies in 9R by businesses are Rethink and Reduce. In addition, Repair and Recycle are also the choices of the interviewee.



Fig 5. Investigation results at Mong Duong mine in circular economy practice strategy



Fig 6. Results of the strategic orientation survey of Mong Duong mine

3.2. Factors influencing circular economy practice strategies at Mong Duong mine

From the results of the investigation and data analysis, the article presents four main factors affecting the circular economy practice strategy of the Mong Duong mine in Quang Ninh province. Details are presented in Figure 7.

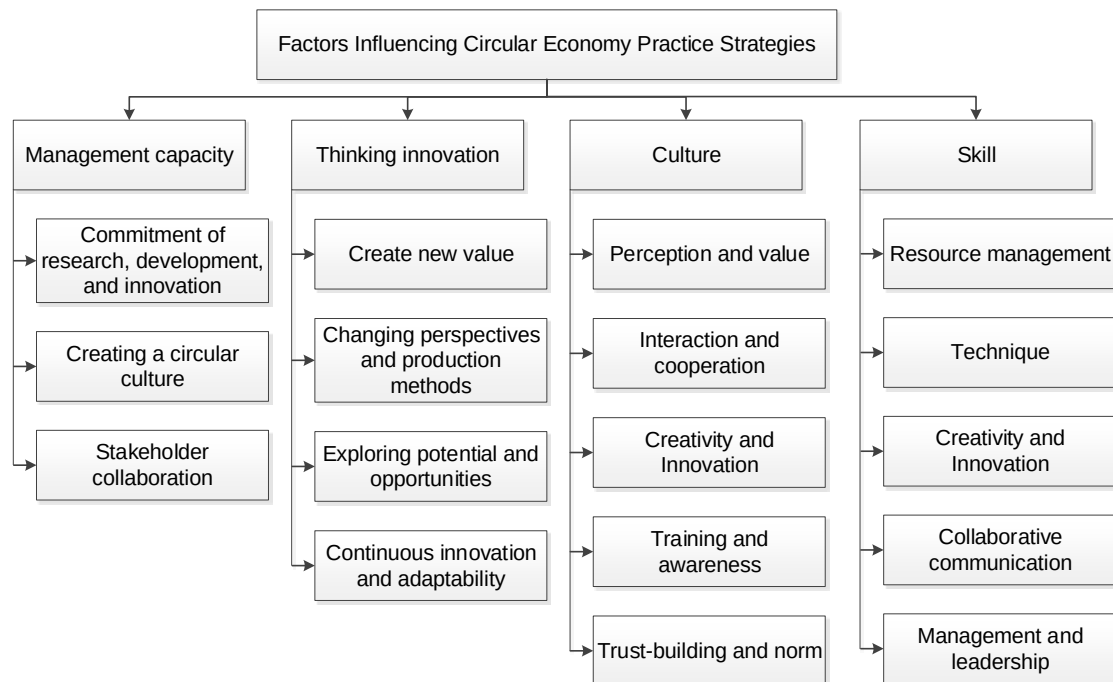


Fig 7. Factors influencing circular economy practice strategies at Mong Duong mine

Factors influencing circular economy practice strategies at Mong Duong mine including:

a. Management capacity

Leadership is an important element in the circular economy strategy for the coal industry in Vietnam. Leadership has a decisive role in setting business goals and commitments towards a circular economy. Leadership needs to demonstrate awareness of the importance of the circular economy and devise a long-term strategy to ensure that the business's production, consumption, and recycling activities all comply with circular principles.

- Commitment of research, development, and innovation (R&D&I): Leaders commits to promoting research, development, and technological innovation to create new products and production processes that are highly circular. This means increased reuse and recycling in the mine's production process.

- Creating a circular culture: Creating a circular culture means understanding mine's current impact on the environment and society. Leaders are responsible for building a circular culture within the company, encouraging employee participation, and promoting activities that comply with circular economy principles. This includes providing training, awareness, and support to workers on circular economy aspects, from product grading, and production processes, to recycling and resource disposal.

- Stakeholder collaboration: Leaders need to create collaborative relationships with stakeholders such as governments, Non-governmental organizations, researchers, and other businesses to promote a circular economy. This cooperation can include sharing information, techniques, and best solutions to achieve common circular economy goals.

b. Thinking innovation

In the context of the coal industry, innovation in thinking is crucial for the successful implementation of circular economy practices.

- Create new value: Innovative thinking is a driving force behind the creation of new value in the Mong Duong mine's transition towards a circular economy model. Innovations that focus on maximizing resource efficiency and reducing waste generation can lead to significant cost savings for mine.

- Changing perspectives and production methods: Thinking innovation promotes a change in traditional perspectives and working methods of the Mong Duong mine. It encourages flexibility, creativity, and adaptability to changes and challenges in applying the circular economy.

- Exploring potential and opportunities: Thinking innovation helps recognize and explore the potential and opportunities in applying the circular economy of the Mong Duong mine. It encourages the exploration and adoption of new technologies, processes, and methods to maximize resource value and minimize loss.

- Continuous innovation and adaptability: Innovative thinking is also crucial for fostering a culture and environment of adaptation and continuous innovation in mine operations. It promotes continuous learning, experimentation, and revision to improve the productivity and efficiency of circular economy strategies.

c. Skill

Skills are paramount in the successful implementation of circular economy practices within the coal industry. A skilled workforce equipped with the necessary expertise in resource management, technique, creativity, innovation, collaborative communication, management and leadership is essential for driving sustainable change in coal mining operations.

- Resource management: Resource management skills are an important factor in optimizing resource use and reducing losses in the production process. Workers need to be able to identify and sort reusable and recyclable resources and allocate them efficiently in the production process.

- Technique: Technical skills are important to develop and apply mine reuse technologies and processes. Workers need to have the necessary knowledge and skills for repair, maintenance, waste recycling, and wastewater recirculation.

- Creativity and innovation: Promote a work environment that encourages creativity, where employees are empowered to think outside the box and explore new ideas for implementing circular economy practices in coal operations. Encourage experimentation and risk-taking to test innovative solutions that can lead to more sustainable resource management and waste reduction strategies.

- Collaborative and communication: These skills are important in creating a positive and collaborative working environment within a circular economy strategy. Workers need to be able to work in teams, communicate effectively and interact with other stakeholders to promote reuse and recycling. Collaborative communication only works if everyone feels confident sharing their opinions.

- Management and leadership: Management and leadership skills are important in defining and promoting circular economy practice strategies. Leadership needs to be able to define goals and allocate resources, as well as create an environment that encourages innovation and creativity.

d. Culture

Cultural factors deeply rooted in the coal industry, such as a historical reliance on linear production models and resource extraction, can pose challenges to the adoption of circular economy practices. Overcoming ingrained traditional practices requires a cultural shift towards embracing concepts of sustainability, resource efficiency, and waste reduction.

- Perception and value: By aligning perceptions and values with the principles of circular economy, the coal industry can drive positive change, improve its productivity, and contribute to a more sustainable future for both the mine and the broader ecosystem.

- Interaction and cooperation: The culture in the Mong Duong mine needs to promote interaction and cooperation between stakeholders in the supply chain. Encourage open communication, collaboration, and idea-sharing among employees at all levels to drive a culture of innovation from the top down. Collaboration between businesses, suppliers, customers, and waste management organizations contributes to the creation of a multi-sector circular economy environment.

- Creativity and innovation: Innovation and creativity in a coal mine's culture of circular economy practices are essential for driving sustainable change and fostering a mindset of continuous improvement. Cultivating a culture that values innovation and creativity not only drives operational efficiency but also opens up opportunities for collaboration, experimentation, and the adoption of cutting-edge technologies that align with the principles of the circular economy.

- Training and awareness: The culture needs to place special emphasis on training and raising awareness about the circular economy for the entire company. Training programs and awareness activities help build a workforce with the knowledge and skills needed to implement recycling and reuse activities in the manufacturing process.

- Trust-building and norm: Establishing trust among stakeholders, including mining companies, local communities, regulatory bodies, and environmental organizations, is crucial for fostering collaboration and achieving shared sustainability goals. Transparency in operations, clear communication channels, and a commitment to responsible mining practices are key elements in building trust within the industry. Moreover, establishing norms and standards that prioritize environmental stewardship, resource efficiency, and social responsibility can help create a framework for sustainable practices to thrive. By adhering to these norms and fostering a culture of accountability, the coal industry can work towards integrating circular economy principles into its operations, driving positive change and setting a foundation for long-term sustainability in the sector.

4. Conclusion

The circular economy in the coal industry plays an important role in optimizing resource use and

minimizing environmental impact.

Leadership, innovation, culture, and skills contribute to the application of Mong Duong Mine's circular economy strategy.

However, the Mong Duong mine also faces challenges and limitations such as a lack of recycled resource supply, a complex recycling process, a lack of cooperation and intellectual property rights, cultural awareness, and awareness inconsistency, as well as changing regulations and policies.

To overcome these challenges, the mine needs to increase investment in research and development of recycling technology, cooperation between businesses, raising awareness and consciousness about the circular economy, and creating a sustainable environment with favorable conditions from the government through regulations and supportive policies.

The effectiveness of applying a mine's circular economy strategy will help minimize environmental impacts, enhance mine competitiveness and sustainability, and create great economic and social value.

References

European Commission, 2015. Closing the loop - An EU action plan for the Circular Economy. *COM*, 614.

Ignasi Puig Ventosa and Verónica Martínez Sánchez, 2023. Circular economy. *Edward Elgar, Ecological Economics Chapter 9*, 48-55.

Eli Vicente Raudales-Garcia, José Valdo Acosta-Tzin, Pablo Alcides Aguilar-Hernández, 2024. Circular economy: a systematic and bibliometric review. *Región Científica*, 3(1), 2024192.

Ana Galina, Gabriel Lucas Bandeira, Ubiratã Tortato, 2023. Evolution of the Circular Economy: Exploratory Network Analysis and State of The Art. *The 41st IBIMA International Conference*, 26-27.

Oksana Marinina, Natalia Kirsanova, Marina Nevskaya, 2022. Circular Economy Models in Industry: Developing a Conceptual Framework. *Energies*, 15(24), 9376-9376.

Andreas Feldmann, 2023. Circular economy for energy-intensive industries. *Edward Elgar, Climate Change and Technology Chapter 13*, 228-236.

Oksana Marinina, Natalia Kirsanova, Marina Nevskaya, 2022. Circular Economy Models in Industry: Developing a Conceptual Framework. *Energies*, 15(24), 9376.

Vargas Juan Pablo, Angélica Patricia Muñoz Lagos, José Guillermo Feriz Torres, Ian Scott Kinney, Sebastián Pérez Cortés, and Juan Pablo Hurtado, 2022. Achieving Circularity through Novel Product-Service Systems in the Mining Industry: An Opportunity for Circularity. *Sustainability*, 14(6), 3614.

El Machi Aiman, Yahya El Berdai, Safaa Mabroum, Amine el Mahdi Safhi, Yassine Taha, Mostafa Benzaazoua, and Rachid Hakkou, 2024. Recycling of Mine Wastes in the Concrete Industry: A Review. *Buildings*, 14(6), 1508.

Giovanni Grieco, Giuseppe Cocomazzi, Stefano Naitza, Micol Bussolesi, Matteo Luca Deidda, Elena Ferrari, and Enrico Destefanis, 2024. Recycling Feldspar Mining Waste as Buffering Agent for Acid Mine Drainage Mitigation. *Minerals*, 14(6), 552.

Alka Jain, 2015. SWOT Analysis in Thirukkural: Comparative Analysis with Humphrey SWOT Matrix. *IOSR Journal of Business and Management*, 17(1), 31-34.

TÓM TẮT

Thực hành kinh tế tuần hoàn trong ngành than: Áp dụng tại mỏ than Mông Dương, tỉnh Quảng Ninh

Đào Trung Thành, Nguyễn Thị Hồng
Trường Đại học Mỏ - Địa chất

Việc thực hiện kinh tế tuần hoàn trong ngành than, như lấy ví dụ tại mỏ than Mông Dương ở Quảng Ninh, đòi hỏi một cách tiếp cận toàn diện với sự tham gia của các bên liên quan. Bài báo cũng đã chỉ ra những thách thức chung và đặc thù cho mỏ than Mông Dương, từ đó xây dựng chiến lược và đề xuất một số biện pháp để thúc đẩy sản xuất tuần hoàn bền vững hơn, bao gồm: Hiệu quả sử dụng tài nguyên; Tái chế và Tái sử dụng; Chuyển đổi năng lượng tái tạo; Nghiên cứu và phát triển; Sự tham gia của các bên liên quan; Khung pháp lý; Liên kết chuỗi kinh tế; Giáo dục và nhận thức. Việc triển khai nền kinh tế tuần hoàn trong ngành than là một quá trình, đòi hỏi sự hợp tác, đầu tư và cam kết từ tất cả các bên liên quan. Do đó, những người ra quyết định cần phải cân bằng giữa phát triển kinh tế với lợi ích môi trường và xã hội để hướng tới phát triển xanh bền vững và phục hồi môi trường cho mỏ Mông Dương nói riêng và vùng mỏ Quảng Ninh nói chung.

Từ khóa: Kinh tế tuần hoàn; Phát triển bền vững; Ngành than; Mỏ than Mông Dương.