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Using Zijin Mining as a case study, the 3D-IDPT model in the study of HRM influencing factors

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Abstract

This study uses Zijin Mining as a case study to apply the 3D-IDPT model from Information Resource Management (IRM) to analyze the influencing factors of human resource management (HRM). Zijin Mining is a prominent multinational mining group involved in the exploration and development of various metal resources, including copper, gold, zinc, and lithium. The company also engages in engineering design, technical research, smelting and processing, and trade finance services. By integrating its history, development trajectory, competitive strategy, and human resource management (HRM) approaches, the company has positioned itself as a key player in the global mining sector. This paper innovatively uses the 3D-IDPT model to evaluate internal HRM factors, such as employee composition, corporate culture, and human resource policies. The study also employs the STEEPLED model for a comprehensive analysis of the external environmental factors affecting Zijin Mining's HRM and uses the SWOT model to predict the company's future development. The findings suggest that Zijin Mining has gradually established a competitive advantage in the global mining industry through the optimization of its HRM system and strategic execution, driving the company's green and low-carbon transformation.

1. Introduction of Zijin Mining Group

The research objectives include analyzing individual and collective factors influencing HRM, evaluating short-term versus long-term HR strategies, and identifying the roles of values and technological innovations.

Zijin Mining Group, a large multinational mining corporation, focuses on the exploration and development of copper, gold, zinc, lithium, and other metal mineral resources. It also engages in engineering design, technological application research, smelting and processing, as well as trade and financial services (Zijin Mining, 2023).

The company has established a relatively comprehensive industrial chain system and is listed on the Hong Kong Stock Exchange (Stock Code: HKEX: 2899) and the Shanghai Stock Exchange

(Stock Code: SSE: 601899). In the 2022 Forbes Global 2000 ranking, Zijin Mining secured the 325th position (Forbes, 2023), while also achieving 407th place in the Fortune Global 500 list for the same year (Fortune, 2023).

With a vision to "become a globally respected green metal producer," Zijin Mining is committed to evolving into a "green, high-tech, and leading global mining enterprise." Its mission is "Mining for a Better Society," upholding the values of "creating long-term value through shared development" and promoting the corporate spirit of "perseverance, entrepreneurship, and innovation" (Zijin Mining, 2023).

The company places high priority on employee development, adhering to the core value of "creating value and fostering shared growth," and embracing a talent management philosophy centered on "value creators as the cornerstone." Zijin Mining respects labor, workers, and the fruits of labor, striving to build a talent selection and appointment system based on value creation to ensure contributors share in the rewards. Furthermore, the company actively promotes a human resources management system aligned with global trends and international standards, aiming to attract diverse professionals worldwide. It spares no effort in safeguarding employee welfare and fulfilling their aspirations for a better life to retain talent.

Zijin Mining adheres strictly to international labor standards to safeguard employee rights.

As of now, Zijin Mining employs 48,836 staff members, with a localization rate of 96.29%. Female employees account for 14.92%, while the workforce spans three age groups at 25.38%, 59.91%, and 14.71%, respectively. Employees hail from China, Serbia, the Democratic Republic of Congo, Colombia, Russia, Australia, and other countries. Over 88% of staff have undergone training, averaging 33.3 hours per employee (Zijin Mining, 2023).

To ensure a coherent theoretical foundation, this study adopts the 3D-IDPT model from Information Resource Management (IRM) as the core analytical framework. The 3D-IDPT model offers a three-dimensional perspective—spatial, temporal, and constructive—that is especially suited for examining HRM in complex, resource-intensive multinational enterprises like Zijin Mining. Supporting tools such as the Balanced Scorecard (BSC), SWOT analysis, and the STEEPLED model are integrated as complementary instruments to enhance specific dimensions of the analysisAddress the following research questions:

(1) How do spatial, temporal, and construction dimensions interact to shape Zijin Mining's human resource management strategy?

(2) What role does the 3D-IDPT model play in integrating internal human resource dynamics with external environmental pressures?

(3) How can insights from the 3D-IDPT model be leveraged to guide sustainable strategic human resource management practices?

2. Zijin Mining's Development History & Current Status in China's Copper Industry

China's copper industry experienced rapid growth from the 1990s to the early 21st century. Driven by the booming real estate and power industries, copper demand surged to surpass supply, creating an attractive processing fee spread . Compared with other investment projects, the copper sector attracted numerous enterprises to establish and expand processing lines due to its low investment requirements, high output value, and low market entry barriers . This led to rapid expansion of domestic production capacity .

However, after the 2008 global financial crisis, the growth momentum of domestic copper demand slowed, and the market gradually shifted from a seller's market to a buyer's market . By 2018, amid an economic downturn, consumption growth rates plummeted sharply. The copper industry faced weak demand, severe overcapacity, increasing substitution effects from recycled copper, and intensifying market competition . Starting in 2020, under the dual pressures of complex domestic and international environments and the COVID-19 pandemic, continued capacity expansion and evolving business conditions forced continuous industrial restructuring, significantly increasing corporate survival pressures (Sun, 2020).

In light of this, Zijin Mining has decisively adopted a cost leadership competitive strategy.

Currently, as copper prices gradually rise, downstream processing enterprises are encountering increasingly severe financial and market risks, along with escalating cost pressures. The status of China's copper rod industry is as follows:

The copper industry exhibits significant regional characteristics and faces intense internal competition (Xu, 2020).

The copper industry has experienced excessive capacity expansion, resulting in low capacity utilization rates. At present, the industry's supply-side growth significantly outpaces demand, and copper industrial products lack distinctiveness or differentiation, exacerbating product homogenization. Continuous emergence of new projects and expansion initiatives has led to ongoing capacity increases, creating severe market overcapacity. Although domestic copper producers possess robust production capabilities, new capacity expansions persist, perpetuating the issue of excess production capacity.

Rising environmental protection measures, labor costs, and capital expenditures have placed long-term pressure on copper processing fees, given that the copper industry is capital-intensive. Copper companies typically use cash for purchasing raw materials such as electrolytic copper, yet when selling copper products, credit terms range from a few days to several weeks, substantially increasing capital costs. Increasingly stringent environmental regulations have significantly elevated environmental compliance costs for copper rod enterprises. Consequently, processing fees for copper rods have declined annually, reducing profit margins for copper manufacturers or even causing losses.

Heightened copper price volatility complicates price-setting and hedging activities for copper enterprises. As copper prices enter a period of high volatility, enterprises face greater challenges in price determination and risk hedging. While enterprises can manage risks through hedging, discrepancies between raw material pricing mechanisms and copper rod sales pricing models undermine effective raw material procurement, exposing firms to relatively high market risks.

3. Human Resource Management and Effectiveness of Zijin Mining

3.1 How to Evaluate the Methods and Effects of Human Resource Management

HRM methods and effectiveness have gained growing attention from academia and industry alike. In the field of human resource management, the evaluation of its methods and effectiveness typically relies on a systematic framework that encompasses the following aspects:

I. Recruitment and Selection

As the initial stage of human resource management, recruitment and selection are not only the primary means for companies to acquire high-quality talent but also the foundation for building their talent competitiveness. When evaluating the methods and effectiveness of human resource management, the first area of focus is the company’s performance in recruitment and selection, which includes the diversification of recruitment channels, the scientific nature of the selection process, and the overall effectiveness of recruitment and selection activities.

II. Training and Development

Training and development enhance employee capabilities and support mutual growth. In a comprehensive evaluation of human resource management methods and effectiveness, it is essential to examine the company's investment in and returns from training and development, covering the relevance of training plans, the practicality of training content, and the implementation results of training and development programs.

III. Performance Management

Performance management drives employee potential and supports strategic goals. The evaluation of its effectiveness is of utmost importance. When assessing human resource management methods and effectiveness, special attention should be given to the company’s practices and outcomes in performance management, including the rationality of the performance evaluation system, the fairness of incentive and constraint mechanisms, and the overall effectiveness of performance management.

IV. Corporate Culture and Employee Relations

Corporate culture and employee relations are key factors in fostering employee belonging and enhancing organizational cohesion. In a holistic evaluation of human resource management methods and effectiveness, a comprehensive review of the company’s performance in shaping corporate culture and managing employee relations is necessary. It examines corporate culture, employee relations harmony, and staff loyalty.

3.2 Empirical Analysis of the Application of Balanced Scorecard in Zijin Mining

3.2.1 Design of the Company's Balanced Scorecard

I. Introduction

Zijin Mining's Balanced Scorecard (BSC) strategically breaks down its overall strategy into four core dimensions: Financial, Customer, Internal Processes, and Learning and Growth. These four dimensions are not only interdependent but also form a logically coherent chain of cause-and-effect relationships. The company's key performance indicators (KPIs), based on the BSC framework, are closely aligned with the company's strategic objectives and comprehensively consider the needs of five key stakeholders—shareholders, employees, customers, key suppliers, and society. The performance of both the company and individuals is evaluated across four dimensions: financial performance, customer satisfaction, internal process efficiency, and organizational learning and growth. Notably, this balanced scorecard strategic performance evaluation system demonstrates a forward-looking vision, seamlessly integrating both financial and non-financial aspects into the causal chain (Kaplan & Norton, 1998).

II. Design Considerations

Company Strategic Considerations. In designing the Balanced Scorecard, the company first examined its own strategic planning. Using the SWOT analysis framework, the company wisely adopted the SO growth strategy model, establishing a development-driven strategic orientation and clearly outlining its strategic development goals from 2006 to 2020. Therefore, the selection and quantification of KPIs based on the BSC accurately reflect the company's three strategic steps in advancing within the domestic gold industry, the mining sector, and the international mining arena, with annual incremental targets (Ma, 2007).

Industry Characteristics and Company Traits. Given that the mining sector in which the company operates is influenced by multiple domestic and international factors, it has distinct industry characteristics. As such, when designing the Balanced Scorecard, the company thoroughly analyzed both the industry characteristics and its unique traits. This analysis was particularly evident in the selection of KPIs, demonstrating high relevance and specificity (Liu, 2007). For example, when selecting financial KPIs, the return on total assets was included as a key metric, considering the company's special status as a dual-listed A+H share company. In the "Internal Processes" KPIs, diverse indicators such as resource utilization (gold, copper, zinc), mineral gold, copper, and zinc production, resource utilization rates, comprehensive cost per ton of ore, energy consumption per ten thousand yuan output (tons of standard coal/ten thousand yuan), and major safety and environmental incidents were included. These metrics reflect the company's industry-specific features and core attributes (Zhao, 2009).

III. Specific Model Construction

The company carefully considered the diverse needs of five key stakeholders, including shareholders, employees, customers, key suppliers, and society, and skillfully applied the Balanced Scorecard model to construct a strategic goals (KPI) system covering over 30 key indicators. This system encompasses overall control indicators, annual performance metrics, core economic and technical indicators, and inter-company comparative indicators, with a five-year planning cycle. The system meticulously records target values from 2006 to 2010 and provides a clear and specific definition of the main strategic objectives for 2020.

3.2.2 Implementation of the Company's Balanced Scorecard

I. Introduction to the BSC+MAP+SFO Strategic Management Model

With the company’s rapid growth and its ongoing pursuit of excellence in management performance, Zijin Mining Group officially launched and implemented its Medium- and Long-Term Strategic Development Plan at the end of 2005. To effectively facilitate the execution of this strategy, the company introduced the BSC+MAP+SFO strategic management model in early 2005. Concurrently, it adopted a uniquely tailored "H-type regional control model" that reflects the distinctive organizational and operational characteristics of Zijin Mining.

This model integrates the group headquarters, various branches, and functional departments through strategic collaboration, ensuring close coordination and teamwork between departments. It focuses the collective efforts of all employees on strategic objectives, thus building an organization centered around strategy.

The company uses the Balanced Scorecard (BSC) as the core strategic management measurement system, ensuring effective control of key processes and optimal allocation of resources. For example:

Articulate and implement the development vision and strategy; Communicate and link strategic objectives with measurement methods; Formulate plans, set goals, and ensure alignment of strategic initiatives; Strengthen strategic feedback and learning mechanisms, etc.

II. Enhancing Strategic Execution and Control through the Balanced Scorecard

The implementation of this model not only overcame the limitations and subjectivity inherent in the company's traditional evaluation system, but also achieved an effective integration between strategic assessment and control mechanisms. Under the direct leadership of the Board of Directors, the Board Office took the lead in translating the Group's overall strategic planning goals into annual objectives using the Balanced Scorecard (BSC) framework.

A comprehensive accountability system was established, assigning clear responsibilities to department heads, regional branches, and subsidiaries. Strategic goals and tasks were further broken down and quantified, ensuring clarity in both responsibility assignment and performance accountability. This system emphasized a principle of full operational accountability: every task has a designated person responsible, every objective has a dedicated manager, and every initiative is ensured of execution. This structure significantly strengthened the company's strategic alignment, execution discipline, and overall management control.

III. Establishing a Performance Management System Based on BSC

The company implements an annual fixed budget with mid-year adjustments. Through monthly financial analysis, work reports, and key business operation analyses, the company conducts benchmarking analysis of budget execution, monitors the completion of key technical and economic indicators, and adjusts the budget as needed on a quarterly or semi-annual basis.

The Finance Department, Marketing and Operations Department, Construction Department, Geological Survey and Research Institute, and other functional units are responsible for tracking and supervising the implementation of strategic initiatives, ensuring the achievement of the annual budgetary and performance targets. The Office of the President of the Group is tasked with organizing and coordinating the breakdown of key annual objectives and tasks to each unit and department, and conducts biannual follow-up assessments to monitor progress.

In addition, the company holds regular economic operation analysis meetings to conduct comprehensive reviews and monitoring of the performance of key technical, economic, and financial indicators, thereby reinforcing data-driven decision-making and ensuring strategic objectives are aligned with actual operational outcomes.

4. Analyze the microenvironment of the Zijin Mining using the 3D-IDPT model

The 3D-IDPT model in information resource management emphasizes information's core attribute—shareability. The shareability of information determines its inherent trend of continuous flow and transmission. Information, as a material, is subject to restrictions and distinctions in its movement, transmission, and sharing by the vertical axis of time (synchronic and instant) and the horizontal axis of space (individual and collective), as well as being driven by the construction axis (z-axis) of value, demand, and technology. This model can be used to analyze the composition and impact of all information elements within an environment (Li, 2021).

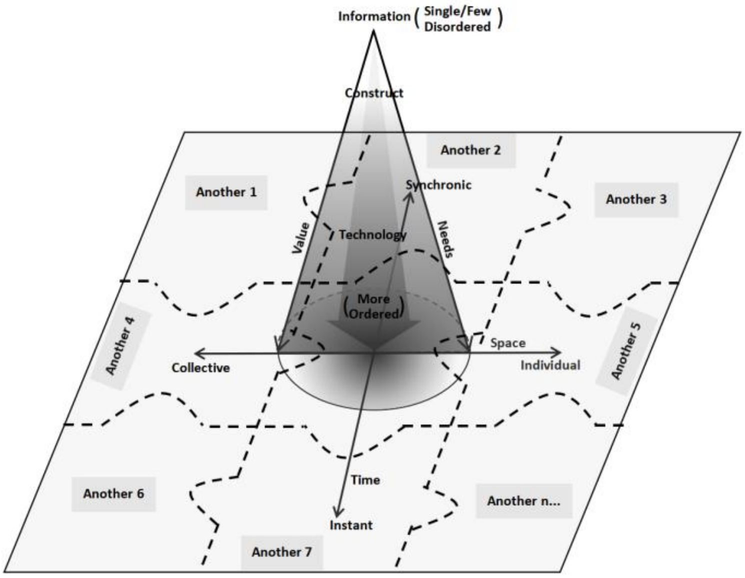

Figure 1: 3D-IDPT (Integrate Discipline Puzzle Theory) model

4.1 Construction of the Analysis Model Based on 3D-IDPT

Through the spatial dimension (individual and collective), the temporal dimension (synchronic and instant), and the construction dimension (value, needs, technology), a three-dimensional analytical framework for the influencing factors of Human Resource Management (HRM) is formed.

The specific construction method is as follows:

Table 1: Analysis table based on 3D-IDPT model

Dimension	Axis	Meaning	Corresponding Elements in HRM
Space	Individual	Factors, needs, and behaviors of individual employees	Employee abilities, motivation, satisfaction, expectations, individual performance
	Collective	Group factors of the organization and external stakeholders	Corporate culture, team atmosphere, organizational structure, social relationships
Time	Instant	Short-term, urgent management needs	Recruitment, training, immediate response measures in performance evaluation
	Synchronic	Long-term strategic factors, historical evolution, and future trends	Long-term business strategy, organizational development trends, human resource planning
Construction	Value & Needs	The interaction and alignment between corporate values and employee needs	Compensation and benefits system, career development planning, corporate social responsibility
	Technology	Application and innovation of HR technology	Digital HRM tools, Human Resource Information System (HRIS)

Analyzing HRM influencing factors through the 3D-IDPT model clearly reflects that:

The spatial axis balances individual and group needs, guiding HR strategies that address both.

The time dimension highlights that HRM strategies should possess the ability for quick and flexible short-term responses, while also maintaining stable long-term planning capabilities.

The construct axis shows HRM as a process of dynamic optimization. It requires continuous attention to technological innovation and changes in employee values and needs, thereby constantly improving and enhancing the HR system.

This method offers a structured, dynamic analysis of HRM factors, helping organizations understand key drivers and take action.

4.2 Detailed Analysis Framework of HRM Influencing Factors Based on the 3D-IDPT Model

4.2.1 Horizontal Axis: Spatial Dimension (Space)

Individual Factors (Individual):

The abilities, motivations, career interests, and psychological needs of individual employees.

Employees' needs for training and development, their responses to career advancement and salary incentives.

The manifestation of individual differences among employees in terms of job performance, satisfaction, and loyalty.

Collective Factors (Collective):

Corporate organizational culture and team atmosphere, such as innovative culture, team cohesion, etc.

The impact of managerial decisions and organizational structure on employee teams, such as empowerment mechanisms, communication channels, etc.

The influence of external stakeholders' (customers, shareholders, suppliers) expectations and feedback on HRM.

4.2.2 Vertical Axis: Time Dimension (Time)

Instant Factors (Instant):

The short-term recruitment needs and emergency measures of enterprises when facing sudden events.

The immediate effects and reactions of employee performance evaluation and incentive measures in the short term.

The short-term implementation of training and development activities, such as short-term project training and immediate needs for skill enhancement.

Synchronic Factors (Synchronic):

The impact of past human resource decisions on the present and future of the enterprise, such as the long-term effects of past recruitment and training strategies.

Long-term strategic goals of HR, such as leadership development, talent pipeline construction, and succession planning.

The long-term evolution of the employee career life cycle, such as long-term development plans for talent and the continuous innovation needs of the organization.

4.2.3 Z-Axis: Construct Dimension (Construct)

This axis emphasizes how companies continuously optimize the construction process of human resource management systems through technological means, value orientation, and employee needs-driven approaches.

Value & Needs:

How the company's core values influence HR strategy (such as fairness, justice,inclusiveness, sustainable development).

How employee needs (such as personal growth, career stability, work-life balance) drive the formulation and optimization of HR policies.

How companies continuously align individual employee needs with organizational development goals to form effective incentive and retention mechanisms.

Technology:

The digital construction of corporate HR (such as Human Resource Information Systems HRIS, artificial intelligence recruitment tools).

The application of talent big data and analytics in HR decision-making, such as employee profiling, turnover prediction analysis, etc.

The development and application of emerging technologies in the HR field, such as Virtual Reality training (VR), mobile learning platforms, etc.

4.3 Analysis of HRM Influence Factors at Zijin Mining under the 3D-IDPT Model

Table 2: Analysis of Influencing Factors on Human Resource Management at Zijin Mining Based on the 3D-IDPT Model

Quadrant	**HRM Factors & Examples**
Individual & Instant	Candidates' responses to hypothetical emergencies during selection; urgent recruitment strategies for sudden vacancies (Song, 2021)
Individual & Synchronic	Alignment between personal career plans and long-term training development, e.g., Excellent Engineer Training Program (Liu, 2012)
Collective & Instant	Real-time team performance evaluations; adjustment measures and incentives for short-term departmental goals (Bai, 2023)
Collective & Synchronic	Long-term corporate culture building; continuous global talent strategies; employee engagement enhancement policies (Zijin Mining, 2023)
Value & Needs Axis (Z-Axis/Construct)	Long-term optimization of compensation and benefits systems; career promotion path design; corporate social responsibility (CSR) project design (Zhang, 2010) (Lei, 2009)
Technology Axis (Z-Axis/Construct)	Integrated information systems development; optimization of employee data analytics platforms; application of mobile HR management tools (Jiang, 2006)

5. Analyze the macro environment of the group company with the STEEPLED model

5.1 Social and Cultural Factors (S)

With the strategic advancement of the new energy vehicle (NEV) industry, the demand for key components such as automotive wiring harnesses, battery electrodes, electronic connectors, and terminals has witnessed a substantial surge. This has directly led to a significant increase in the consumption of copper-based materials, including copper foil, copper wire, and copper strip. In the broader electronics sector, the increasing requirements for materials with high strength and superior electrical conductivity have further driven demand for copper and copper alloys, exerting strong upward pressure on the copper processing industry.

By contrast, industries such as electric power infrastructure and real estate, which have already experienced rapid expansion in recent years, are projected to exhibit a gradual slowdown in their demand for basic copper materials. This evolving demand landscape, particularly in the context of large-scale production capacities, is expected to accelerate structural optimization within the copper processing sector, encouraging a shift towards more value-added, technologically advanced applications.

Strategies like 'New Infrastructure' and 'Carbon Neutrality' are driving growth in energy, transport, and digital sectors. The expansion of these sub-industries is likely to stimulate demand for wire and cable products and drive adjustments in the product structure, with a growing emphasis on efficiency, sustainability, and technological advancement.

The rise of high-end manufacturing is also expected to create a premium market for the transformation, innovation, and upgrading of the wire and cable industry. However, due to the cost structure of the industry—where raw materials account for over 80% of total production costs—the copper wire and cable sector remains a low-margin industry characterized as "material-intensive but labor-light."

Furthermore, the sharp rise in the prices of key raw materials, such as electrolytic copper, has created significant operational pressures for cable manufacturers. As a result, some companies have reduced or declined new orders to minimize potential losses, while downstream users have responded by canceling or deferring orders due to the high costs. Substitute materials and technologies challenge traditional copper products. These factors collectively exert downward pressure on the copper industry's growth prospects, underscoring the need for strategic adaptation, cost control, and innovation across the supply chain.

5.2 Technical Factors (T)

Over the past decade, the Group has witnessed steady advancements in its production technology, with annual improvements in process sophistication and operational efficiency. Currently, the main production processes employed include the Upward Continuous Casting (UCC) method and the Continuous Casting and Rolling (CCR) method. Copper rods produced via the UCC method are classified as oxygen-free copper rods, while those produced using the CCR method are categorized as low-oxygen copper rods.

UCC yields conductive, bright copper rods with low investment and simple operation. However, coarse grains make UCC rods brittle and unsuitable for fine wire drawing. This results in a higher risk of wire breakage and lower production efficiency. Nevertheless, if high-purity electrolytic copper is used as raw material in the UCC process, it is possible to produce ultra-fine copper wires with diameters smaller than 0.1 mm. To reduce costs, scrap copper can be partially substituted as raw material, but this typically leads to inconsistent product quality, making it suitable only for general-purpose copper core cables (Yan, 2015).

By contrast, the CCR method is better suited for producing low-oxygen copper rods, and is widely recognized for its capacity to ensure high product consistency and mechanical performance. During the production process, the rods are cooled and cleaned using an alcohol-based solution, resulting in smooth, burr-free surfaces. These rods are characterized by excellent tensile strength, stable quality, and compatibility with multi-wire high-speed drawing machines. The process also supports large-scale production, with high thermal efficiency and low unit energy consumption once full capacity is achieved. However, it does require significantly higher capital investment compared to UCC systems.

Low-oxygen copper rods produced via the CCR method also exhibit superior flexibility, resilience (rebound angle), and winding performance, particularly in enamel wire manufacturing, making them more suitable for high-end applications. Globally, state-of-the-art continuous copper rod production systems include the Southwire Continuous Rod (SCR) line from the United States and the Contirod line from Germany. While these systems are largely similar in operational principles, the primary differences lie in the design and configuration of their casting and rolling units.

At present, the Group’s large and medium-sized copper material manufacturing subsidiaries predominantly utilize imported CCR production lines, which are known for their high production efficiency, stable product quality, and strong operational reliability. In contrast, smaller and mid-sized enterprises equipped with domestically manufactured production lines face challenges such as lower productivity, weaker cost control, and limited resilience to market volatility, resulting in lower operational rates. Within the Group, the proportion of newly imported CCR lines continues to grow, while outdated production equipment is being progressively phased out to enhance overall technical competitiveness and operational efficiency.

5.3 Economic Factors (E)

The transformation of China's economic development model from high-speed growth to high-quality development has been affected by factors such as the rising comprehensive costs of domestic production enterprises (including production costs, labor costs, environmental protection costs, etc.), the re-industrialization of developed countries, and the economic weakness of many developing countries in the post-epidemic era. In 2020, China's GDP reached 101.6 trillion yuan, a 2.3% increase compared to 2019, making it the only major economy to achieve positive economic growth. The current economic growth structure has a unique character. Service industry output and residential consumption, the primary drivers of economic growth in the past three years, suffered severe losses and a slow recovery during the epidemic. In the post-epidemic era, industrial output has been the first to recover. The slow global economic recovery has increased China's dependence on exports, and its growth rate is moving toward a normal level. The country is vigorously promoting a new economic development model, focused on domestic circulation with domestic and international circulations combined, which will provide a solid foundation and space for the transformation and upgrading of the copper industry. Increased investment in the national power grid has spurred rapid development in the copper wire and cable industry, with steady growth in market demand. However, China remains in the middle stage of industrialization and urbanization, providing substantial investment opportunities for infrastructure construction and upgrades. New urbanization projects will offer a stable market for the supply structure and capacity upgrades of the wire and cable industry, while increasing demand for copper wire and cable products will inevitably benefit the copper industry.

5.4 Environmental Factors (E)

Since the implementation of China's 13th Five-Year Plan, green development has emerged as a central theme in the transformation and upgrading of the industrial sector. Product competitiveness is increasingly expected to reflect the new global trends and requirements of green industrial transformation. In the context of copper rod manufacturing, the potential environmental impacts span multiple dimensions, including wastewater discharge, air emissions, solid waste generation, and significant resource and energy consumption.

Wastewater is produced throughout various stages of the copper rod production process, primarily from cooling systems, equipment cleaning, and desulfurization units. This effluent often contains heavy metals and chemical residues that require rigorous treatment before discharge.

Air pollutants are emitted from several production sources, including reverberatory furnaces, alternating current (AC) furnaces, and pre-treatment roasting of water tanks. The resulting exhaust gases contain sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and particulate matter (PM2.5–PM10), all of which are recognized contributors to air pollution, acid rain, and public health risks.

Industrial solid waste generated during the production process includes a range of byproducts such as furnace slag, offcuts, collected dust, desulfurization residue, sedimentary sludge, spent refractory materials, and used bag filters. These materials pose challenges in terms of hazardous waste disposal, resource recovery, and land pollution control.

In terms of resource and energy consumption, the primary raw material used is cathode copper, while auxiliary materials include emulsifiers, release agents, charcoal, and lime. The main energy sources consist of electricity, natural gas, and heavy oil. The consumption of energy—both on-site and during external logistics—results in the emission of greenhouse gases (GHGs) and volatile organic compounds (VOCs), contributing not only to global warming, but also to broader environmental issues such as air pollution, ozone layer depletion, acid deposition, deforestation, and even the release of radioactive substances (General Administration of Quality Supervision, 2009).

From the perspectives of energy use and carbon emissions, China's current energy structure remains heavily reliant on fossil fuels. The copper smelting and processing industry is projected to reach peak production around 2030, aligning with the broader national goals of carbon peaking and neutrality. Against this backdrop, the Group faces a dual landscape of opportunities and challenges.

On the one hand, the shift toward a low-carbon economy—characterized by energy efficiency, emissions reduction, technological innovation, and industrial restructuring—offers a path for sustainable growth and long-term competitiveness. On the other hand, the company must navigate substantial challenges, such as overcoming technical bottlenecks in low-carbon production, establishing robust green and low-carbon operational mechanisms, and adapting to evolving regulatory and market expectations.

Green features will become key to product competitiveness and market acceptance. The transition toward environmentally sustainable operations is no longer optional but a strategic imperative in the global copper industry (Yang & Deng, 2015).

5.5 Political Factors (P)

Three years ago, amid the simultaneous challenges posed by the global spread of COVID-19, escalating U.S.–China trade tensions, and ongoing industrial transformation, the Chinese government introduced a series of economic stimulus policies aimed at stabilizing growth and promoting industrial resilience. These policies encompassed substantial investment in key infrastructure and strategic sectors, including power grids, rail transportation, 5G networks, real estate, urban rail transit, and new energy vehicles (NEVs).

These investments have sustained robust growth on a large scale, with particularly notable expansion in high-speed railway infrastructure, power grid upgrades, and rural electrification projects. Such developments have served as a powerful engine for the accelerated growth of the wire and cable industry, thereby driving significant downstream demand for copper rods, a critical raw material in electrical transmission and distribution.

In the post-pandemic era, China's electric power sector is undergoing substantial restructuring and adjustment, characterized by a shift toward smarter, greener, and more resilient infrastructure. During the 14th Five-Year Plan period (2021–2025), the value chain within China's electricity investment sector is expected to undergo deep structural adjustments. These shifts are set to further stimulate copper rod consumption, not only through continued infrastructure investment, but also via the expansion of renewable energy deployment, grid intelligence upgrades, and distributed energy systems.

Overall, the intersection of national policy direction, infrastructure-led recovery strategies, and industrial modernization trends presents both opportunities and momentum for growth in the copper rod industry, positioning it as a key beneficiary of China's ongoing transformation in the energy and infrastructure sectors.

5.6 Legal Factors (L)

Copper serves as a critical raw material in the wire and cable industry, primarily due to its essential role in electrical energy transmission, where safety and reliability are of paramount importance. However, due to variations in manufacturing technologies and production processes across Chinese copper rod producers, the quality of copper rods in the market remains inconsistent. In particular, some manufacturers utilize recycled or scrap copper as input material, which often leads to significant quality fluctuations and creates potential safety hazards in downstream applications, especially in high-performance or high-voltage environments.

To address these concerns and promote energy efficiency across the sector, the Chinese government introduced a national industrial standard titled "Energy Consumption Limits for Copper Rods Used in Electrical Engineering" (GB32046-2015). This standard was jointly approved by the General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) and the Standardization Administration of China (SAC), and came into official effect on October 1, 2015.

The GB32046-2015 standard establishes mandatory energy consumption limits for copper rod production, promoting energy conservation and improved resource utilization efficiency. In addition, the standard plays a vital role in enhancing energy management practices within copper manufacturing enterprises and has significantly accelerated the phasing-out of outdated and inefficient production capacities. By enforcing stricter technical and environmental benchmarks, the regulation contributes not only to higher product quality and production consistency, but also to greater operational safety and industry sustainability.

5.7 Ethical Factors (E)

In today's society, environmental protection and sustainable development have become deeply ingrained in people's values. As a listed multinational corporation with significant global influence, Zijin Mining faces ethical constraints such as those outlined by the United Nations Sustainable Development Goals. As a resource-intensive industry, the copper industry is under considerable environmental pressure. Companies must accept supervision from society, fulfill their social responsibilities, and publish periodic reports on their social responsibility efforts. They must also adopt sustainable production methods to minimize environmental impacts.

In addition, companies must focus on business ethics, operate with integrity, and avoid fraudulent practices. They must also protect employee rights by providing safe and healthy work environments.

5.8 Demographic Factors (D)

The impact of demographic factors on the mining industry is multifaceted. Population size and growth directly affect the exploitation of mineral resources. As the global population grows, especially in developing countries undergoing industrialization and urbanization, demand for mineral resources will rise, prompting the copper industry to expand and improve mining efficiency. Though some developed countries, including China, have stable or decreasing populations, demand for mineral resources remains high in densely populated regions due to post-industrialization. The quality of the population and technological advancements also impact the copper industry. Improved population quality and technological progress increase copper product efficiency and resource utilization. However, this also brings challenges, such as heightened environmental awareness, leading to stricter production and utilization standards. As people's expectations for enterprises rise, mining industries must constantly improve their technology and management methods to meet these expectations.

6. Summary and Prospects

Political, economic, environmental, and legal forces drive development and structural shifts in the copper rod industry. At present, the copper sector benefits from a relatively favorable social and regulatory environment, which supports industrial growth and infrastructure expansion. However, the industry still faces notable technological shortcomings, particularly in areas such as advanced processing capabilities, automation, and environmentally sustainable operations. As a result, copper production enterprises are under increasing pressure to undergo strategic transformation and upgrading.

With the continued implementation of environmental protection policies and overcapacity reduction initiatives, outdated and inefficient production facilities within the copper industry are being gradually phased out. This regulatory trend is expected to bring about major shifts in the distribution of production capacity across the sector, consolidating resources around more competitive and technologically advanced firms.

Small-scale enterprises with inferior product quality and limited production capacity are likely to be gradually merged, acquired, or eliminated by market forces, as the industry moves toward greater consolidation and specialization. Our company is not exempt from these structural pressures, and must proactively address the challenges of technological upgrading, environmental compliance, and market competitiveness in order to sustain long-term growth and remain resilient in a rapidly evolving industrial landscape.

6.1 Analyzing the Current Situation with SWOT Analysis

Strengths - S

China ranks sixth in the world in copper reserves, and the company has a complete industrial chain from upstream to downstream, with a solid industrial foundation. The company also benefits from advanced primary copper smelting and separation technology, with large-scale applications. Additionally, the vast domestic market for the electronics industry provides significant space for downstream application development.

Weaknesses - W

China's copper demand is immense, requiring 50% of the world's copper resources, which weakens the company's bargaining power in the global market. Furthermore, copper ore resources have low purity, and the efficiency of research and development conversion is not high. The company also struggles with weak talent attraction, intense homogeneous competition in downstream material companies, and has not fully realized the advantages of cluster development. The company's R&D capabilities and process levels are also significantly behind developed countries.

Opportunities - O

In the future, as carbon neutrality goals continue to advance, copper demand will grow. The rapid development of new energy vehicles will further increase the demand for copper conductors. Furthermore, the national focus on technological innovation and the ongoing use of intelligent mining and processing technology in copper products present new opportunities for the company.

Threats - T

The company's global trade is hindered by global economic cycles and geopolitical factors. The copper product market is becoming increasingly competitive as more large-scale mining companies enter the market, leading to a more diversified industry. Developed countries control high-end patents and market dominance, while rising labor, raw material, and other operating costs squeeze the company's profit margins.

6.2 Future Outlook Based on SWOT Analysis

Strengths - Opportunities (SO) Strategy Combination:

Leverage Strengths and Seize Opportunities

The company should fully utilize its global resource advantages and expand copper material applications in downstream fields. As more countries and regions propose and promote carbon neutrality, the strategic value of copper resources will become more prominent. The company should leverage the "dual carbon" strategy to develop and grow.

Strengths - Threats (ST) Strategy Combination:

Leverage Strengths and Avoid Threats

The company needs to further integrate and optimize existing mining, smelting, and separation capacities, plan the industrial layout as a whole, and improve industry concentration and operational efficiency. By developing a global high-end industrial chain network, the company can become a broader core node enterprise, strengthening control over the entire industry and core technologies, while mitigating the risks of weakening its market position.

Weaknesses - Opportunities (WO) Strategy Combination:

Leverage Opportunities and Overcome Weaknesses

The company needs to integrate R&D resources and establish an employee innovation platform. It should focus on R&D of key technologies and equipment in the industrial chain, especially addressing bottlenecks and chokepoints, to obtain independent intellectual property rights. The company should promote the construction of intelligent production lines to improve product quality stability and consistency.

Weaknesses - Threats (WT) Strategy Combination:

Reduce Weaknesses and Avoid Threats

The company should ensure a full-cycle, multi-path supply system and expand its global copper industry layout, forming a symbiotic relationship within the industrial chain. By attracting technology through resources, strengthening cooperation with advanced enterprises, introducing advanced technology, and improving product value-added, the company can address its weaknesses and reduce threats.

The company sees rising demand for high-tech talent and scientific HRM to support long-term growth. To this end, the company plans to further leverage intelligent systems and digital training platforms to cultivate an in-house team of highly skilled professionals. Simultaneously, it will work to establish a comprehensive employee welfare system, ensuring that the needs of talent development are aligned with sustainable employee satisfaction and organizational resilience.

The company will continue to strengthen its global talent recruitment system, with the aim of optimizing its human capital structure. Special emphasis will be placed on the development of local talent and the localization of project management, particularly in overseas operations, to promote regional integration and knowledge transfer. In parallel, the company will foster a diverse and inclusive corporate culture to create a positive, collaborative, and equitable work environment.

A robust compensation system will support employee motivation and retention. Career advancement and promotion assessments will incorporate ethical performance, with moral conduct serving as a critical veto factor in the evaluation process. In addition, the scope of the company's employee stock ownership plan (ESOP) will be expanded, thereby strengthening employees' sense of ownership, commitment, and long-term engagement with the organization. These initiatives are expected to significantly improve employee retention rates and support the creation of a strategic, high-performance workforce (Zijin Mining, 2023).

The issue of copper overcapacity in China will be effectively addressed, stabilizing the copper consumption market. Copper products are shifting to high-end applications amid industry consolidation. Copper production enterprises should continuously improve production management, reduce energy and resource consumption, minimize environmental risks and operational costs, and create competitive advantages. This will enhance brand value and strengthen industry competitiveness. Strengthening exchanges between enterprises and cooperation with upstream and downstream industries will promote win-win cooperation and contribute to the healthy development of the copper industry.

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