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Resource-Based Utilization of Mineral Mining Operations in Panzhihua City, China: Basis for Strategic Plan

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Abstract. The comprehensive utilization of resources has become an urgent task to transform the mode of economic growth, develop a circular economy, build a resource-saving and environment-friendly society. The study conducted descriptive analysis to examine the resource-based utilization of mineral mining operations in Panzhihua City, China, through interviews with management and employees using questionnaires. It systematically described various aspects of mining operations, such as resource annual production, electric power consumption, manpower utilization, facilities and equipment, logistics, and production costs. Challenges highlighted included the gradual process of obtaining buy-in from managers and employees and convincing consumers to prioritize environmental protection. Based on these findings, a strategic plan was developed for mineral mining operators in Panzhihua City, focusing on addressing weaknesses and implementing strategies to improve resource utilization in areas like production, power consumption, manpower utilization, facilities, equipment, logistics, and production costs. These insights and strategies are crucial for mining operators in Panzhihua City to navigate challenges effectively and improve overall performance in resource utilization and allocation, ensuring long-term success and sustainability in the competitive mining industry landscape.

Keywords: Challenges; Mineral mining operations; Mining; Resource-based utilization; Strategic plan

1. Introduction

The need to transform the mode of economic growth, develop a circular economy, and build a resource-saving and environment-friendly society has made comprehensive resource utilization imperative. It was also crucial for ensuring the sustainable use of resources, reducing environmental pollution pressure, improving resource utilization efficiency, and enhancing economic development quality. As a typical resource-based

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city, Panzhihua's urban economic and social development was closely linked to the efficiency of comprehensive resource utilization. Failure to protect and develop limited resources scientifically would have led to resource exhaustion, resulting in economic weakness and lagging social development for many resource-based cities (Gao, 2018).

To address these challenges and promote sustainable economic and social development in Panzhihua, a comparative study was conducted on the comprehensive utilization of resources both domestically and internationally. This study included a survey and statistical analysis on the distribution and utilization of resources in Panzhihua City, focusing on iron, vanadium, and titanium resources. The aim of the study is to innovate and improve the comprehensive utilization mode of resources in Panzhihua, considering factors like technical bottlenecks, environmental capacity, industrial policy, and traffic constraints. The study also proposed countermeasures and suggestions to enhance resource utilization efficiency, promote environmental protection, and stimulate economic growth through innovative resource development strategies.

2. Methodology

This study employed a descriptive research method, focusing on describing the characteristics of the population or phenomenon without delving into the reasons behind them. The method collects quantifiable information for statistical analysis, aiming to provide a detailed description of the demographic segment being studied. Descriptive research is commonly used in market research to understand and describe the nature of a population sample (Voxco, 2021).

2.1. Sampling Procedure

The study utilized purposive and convenience sampling techniques, with employees as respondents. The selection criteria focused on well-known mineral mining enterprises in Panzhihua City, China, known for mining a common mineral.

2.2. Respondents

The study collected data from 150 respondents working in 5 mining enterprises specializing in one mineral mining. These respondents were chosen as they have various years of experience within their enterprises and were deemed suitable to provide the necessary data for the study.

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Table 1 Distribution of Respondents

No	Mining Enterprises	Number (N)	Percentage (%)
1	Pangang Group Mining Co., LTD.	50	33.33
2	Panzhihua Qinggangping Mining Co., LTD.	20	13.33
3	Panzhihua Group Panzhihua Xinbaima mining Co., LTD.	40	26.67
4	Sichuan Anning Iron & Titanium Co., LTD.	10	6.67
5	Longbai Sichuan Mining and Metallurgy Co., LTD.	30	20.00
	Total	**150**	**100**

Table 1 shows the distribution of the respondents.

2.2.1 Research Site

The study was conducted in Panzhihua City, Sichuan Province, China, known for its abundant mineral resources, especially vanadium and titanium. These resources are crucial for China's modernization efforts, given their strategic importance and significant reserves.

3. Results and Discussion

3.1. Profile of the Mineral Mining Operators in Panzhihua City

Table 2 Profile of Mineral Mining

Profile	Data
Location	Sub-urban area, Panzhihua City
Primary Mineral	Vanadium Titanium Magnetite Ore
Secondary Resources	Mine tailings (materials leftover)
Environmental Capacity	Very strong
Process, Production	extraction
Demand for the products	Less than 100 million tons
Technology	Remote-controlled mining trucks, excavators, and mining equipment, humans can sometimes be removed from dangerous tasks, thus avoiding accidents

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Mining operations in Panzhihua City are strategically located in suburban areas, optimizing logistical efficiency and accessibility to mineral resources. The primary focus remains on extracting vanadium-titanium magnetite ore, a valuable native mineral resource that offers significant market opportunities. Managing secondary resources like tailings is crucial for maximizing resource utilization while prioritizing environmental protection. Panzhihua's mining operators exhibit a robust environmental capacity, employing advanced technologies to minimize environmental impact. They prioritize sustainable practices, employ innovative production techniques like smelting, and maintain market demand below a sustainable threshold, showcasing a commitment to resource conservation and market stability. Advanced mining technologies further enhance operational efficiency and safety, reflecting a comprehensive approach that integrates environmental sustainability with efficient resource utilization in the mining sector.

3.2 Resource Utilization Versus Allocation of the Mineral Mining Operators

3.2.1 Resource Annual Production in Tons

Table 3 Resource annual production in tons

Resource Annual Production (Utilization)	f	%	Resource Annual Production (Allocation)	f	%
Less than 1000 tons	3	60.00	500 tons	3	60.00
1001 - 5000 tons	2	40.00	501-1000 tons	2	40.00
Total	**5**	**100.00**	**Total**	**5**	**100.00**

The data from resource allocation and annual production indicates that 60% of allocations fall within the 500 tons range, with the remaining 40% in the 501-1000 tons range, sourced from (insert source). Annual production also reflects a concentration in lower tonnage ranges, with 60% less than 1000 tons and 40% between 1001-5000 tons, without any production exceeding 5000 tons. This alignment between allocation and production indicates a deliberate operational strategy focused on smaller-scale production, potentially influenced by operational constraints or market demand considerations.

3.2.2 Electric Power Consumption

Table 8 shows the data on electric power consumption.

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Table 4 Electric power consumption

Electric power consumption (Utilization)	f	%	Electric power consumption (Allocation)	f	%
Less than 10000 kWh	–	–	Less than 5000 kWh	4	80
10001 – 50000 kWh	5	100	5001 – 10000 kWh	1	20
Total	**5**	**100**	**Total**	**5**	**100.00**

According to data from electric power allocation and consumption, 80% allocate power below 5000 kWh, while 20% allocate in the 5001–10000 kWh range. However, 100% of actual power consumption falls within 10001–50000 kWh. This discrepancy highlights a potential overallocation or underestimation issue, necessitating further investigation to align allocation with actual consumption and ensure accurate recording of power usage to prevent errors.

3.2.3 Manpower Utilization

Table 5 Manpower

Manpower (Utilization)	f	%	Manpower (Allocation)	f	%
Less than 50 people	5	100	Less than 50 people	5	100
Total	**5**	**100**	**Total**	**5**	**100**

The data on human resources allocation and utilization shows that all units concentrate their allocation and utilization in the "Less than 50 people" range. This consistency between allocation and utilization suggests that units have relatively small-scale human resource needs, requiring fewer than 50 people. While this alignment may reflect current business needs and efficiency considerations, a reassessment may be necessary if units plan to expand, ensuring future demands are met and adjustments are made accordingly based on changes in scale and requirements.

3.2.4 Facilities and Equipment Utilization

The data on equipment and facility allocation and utilization reveals complete uniformity across categories, with 100% frequency and percentage in each category. This alignment indicates that all units allocate and utilize equipment and facilities comprehensively, including loaders, drilling machines, trucks, excavators, and conveyor belts.

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Table 6 Facilities and equipment

Facilities and equipment (Utilization)	f	%	Facilities and equipment (Allocation)	f	%
Loader	5	100	Loader	5	100
Drilling machine	5	100	Drilling machine	5	100
Truck	5	100	Truck	5	100
Excavator	5	100	Excavator	5	100
Conveyor belt	5	100	Conveyor belt	5	100
Total	**5**	**100**	**Total**	**5**	**100.00**

The consistency reflects intentional alignment and meets operational requirements, ongoing monitoring may ensure continued efficiency in resource allocation without the need for specific corrective actions.

3.2.5 Logistics

Table 7 Logistics

Logistics (Utilization)	f	%	Logistics (Allocation)	f	%
Road transport	5	100	Road transport	5	100
Railway transport	5	100	Railway transport	5	100
Total	**5**	**100.00**	**Total**	**5**	**100**

The data on logistics allocation and utilization indicates that all units exclusively utilize road transport and railway transport, with 100% frequency and percentage in each category. This complete alignment in logistics allocation and utilization underscores the reliance on these modes for logistical needs. However, the absence of data for water transport, air transport, and other categories signals potential areas for future research and strategy development to ensure comprehensive logistical planning and meet evolving transportation needs effectively.

3.2.6 Production Cost

Table 8 Production cost

Production cost (Utilization)	f	%	Production cost (Allocation)	f	%
Less than 500 yuan	5	100	Above 500 yuan	5	100
Total	**5**	**100.00**	**Total**	**5**	**100**

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The data on production allocation and production costs reveals a complete alignment, with all units uniformly allocating production and incurring costs across different categories, particularly within the "Less than 500 yuan" and "above 500 yuan" range. This indicates a coherent operational strategy where planned allocations closely match actual production costs. However, the discrepancy between allocated costs and actual production costs above 500 yuan warrants further investigation to ensure accurate resource planning and cost management strategies are in place.

3.3 The challenges in the resource utilization of the mineral mining operators

3.3.1 Resource Annual Production

The assessment of various indicators related to annual resource production highlights significant challenges faced by the company. These challenges include insufficient or aging technical equipment, a shortage of human resources, environmental regulatory compliance issues, transportation and logistics concerns, and supply chain disruptions. Among these, addressing technical equipment challenges should be a priority, as it has the most significant impact on resource production efficiency. The company needs to take proactive measures such as equipment optimization or updates, human resources management improvements, and stronger focus on environmental compliance and supply chain management to ensure stable and efficient resource production (Yang, 2017) .

3.3.2 Electric Power Consumption

The assessment of electricity consumption data reveals several recurring challenges for the company. These challenges include high electricity costs impacting production profits, power supply instability leading to production interruptions, increasing energy pressure, low equipment efficiency, and changes in electricity demand due to mineral quality variations. Among these, addressing power supply instability and improving energy efficiency should be top priorities to ensure production continuity and reduce electricity-related costs. The company needs to focus on effective energy management, equipment upgrades, and flexible electricity planning to mitigate these challenges and maintain a stable mining process (Tang, 2019).

3.3.3 Manpower Utilization

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The analysis of manpower utilization data highlights several recurring challenges for the company. These challenges include difficulty recruiting suitable miners and technicians, unbalanced manpower utilization, rising labor costs affecting production efficiency, difficulty matching training with required skills, and a high employee turnover rate. Addressing these challenges require the company to improve recruitment strategies, optimize job assignments, control labor costs, enhance training programs, and implement measures to improve employee retention. By addressing these aspects, the company can improve production efficiency and stabilize its workforce, contributing to overall operational effectiveness.

3.3.4 Facilities and Equipment Utilization

The analysis of facilities and equipment utilization reveals several recurring challenges faced by the company, such as high equipment maintenance costs, occasional equipment idleness, long equipment update cycles, suboptimal facility layouts, and insufficient coordination between facilities. These challenges often lead to increased production costs and reduced production efficiency.

3.3.5 Logistics

The analysis of logistics data reveals several recurring challenges faced by the company, including frequent rises in transportation costs, unstable logistics chains resulting in delivery interruptions, inefficiencies in the transportation process leading to extended delivery times, regional traffic issues affecting logistics flow, and occasional insufficiency of transportation resources. These challenges often impact business operations and require strategic and operational improvements (Jia, 2019).

3.3.6 Product Cost

The analysis of production cost data highlights several frequent challenges faced by the company, including the impact of fluctuating raw material prices, rising energy and resource costs, labor cost fluctuations, high equipment *maintenance expenses, and occasional issues with production efficiency.*

3.4 Proposed Strategic Plan for Mineral Mining Operators

The strategic action plan above focused on the areas of concerns namely resource annual production, electric power consumption, manpower utilization, facilities and equipment utilization, logistics and production cost.

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4. Conclusions

Most mineral mining operations are located in urban areas and focus primarily on extracting primary and secondary minerals, highlighting the importance of technology in their processing and production processes. However, gaps have been identified in various variables such as resource annual production, electric power consumption, manpower utilization, facilities and equipment utilization, logistics, and production costs, indicating discrepancies between allocation and actual utilization/consumption. These challenges in resource utilization, including frequent issues denoted by the "often" interpretation, need to be addressed to enhance operational efficiency. As a result of this study, a proposed strategic plan has been formulated to tackle these challenges comprehensively and improve the overall performance of mineral mining operators.

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