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DIGITAL TRANSFORMATION OF METALLURGICAL ENTERPRISE MANAGEMENT

As the basic pillar industry of the national economy, the metallurgical industry is facing the double impact of a new round of technological revolution and industrial transformation. Driven by the wave of global Industry 4.0, the cutting-edge technologies represented by the industrial Internet, digital twin and artificial intelligence are accelerating their penetration into the traditional manufacturing industry. According to the statistics of International Data Corporation (IDC), the expenditure scale of the digital transformation of China's manufacturing industry exceeded 380 billion yuan in 2023, of which the metallurgical industry accounted for 18.6%, an increase of nearly three times compared with 2020. This change stems from the practical challenges faced by metallurgical enterprises: raw material price fluctuations increase, environmental regulatory standards continue to upgrade, and customer demand presents a trend of small batch and customized. The traditional management mode that relies on manual experience has been difficult to cope with the complex market environment, and it is urgent to reconstruct the management paradigm [1,3-8] through digital means.

The digital transformation of metallurgical enterprise management refers to the reconstruction of enterprise operation mode and management system through the new generation of information technology. Its core goal is to realize the data-driven intelligent decision-making and the collaborative optimization of the whole value

chain. According to the White Paper on the Digital Transformation of the Steel Industry in 2023 published by the China Iron and Steel Association, the transformation includes three realization paths: the intelligent transformation of the underlying equipment, the construction of the data governance system in the middle platform, and the reorganization of the top-level management structure. Among them, the bottom level transformation focuses on the deployment of industrial Internet of Things equipment and 5G private network construction, the middle platform construction emphasizes data standardization and AI model training, and the top level reorganization involves organizational process reengineering and digital culture cultivation [2, 522-527].

The essence of the digital transformation of metallurgical enterprises is to build a new production function with data as the core element. According to the calculation of McKinsey Global Research Institute, the comprehensive digital transformation can reduce the operating costs of metallurgical enterprises by 12-18%, improve the comprehensive efficiency of equipment by 15-25%, and shorten the development cycle of new products by 30-40%. This transformation not only changes the traditional human-machine collaboration mode, but also gives birth to emerging positions such as data engineers and algorithm model trainers, and promotes the evolution of the talent structure in the metallurgical industry to the digital direction of [4, 684-690].

In the wave of digital transformation of metallurgical enterprise management, the application of big data technology has significantly enhanced the scientificity and accuracy of decision-making. Baowu Iron and Steel, using Hadoop and Spark as the core data processing framework, and combined with Tableau visualization tools, has built an enterprise-level data center platform, realizing the real-time analysis of the global steel market, production equipment operation and supply chain information. The system can handle more than 50TB of industrial data per hour, which not only reduces the frequency of annual production plan adjustment from quarterly to weekly, improves the decision-making efficiency by 20%, but also reduces the inventory

turnover days from 35 days to 29.8 days by accurately forecasting market demand, reducing the inventory cost by 15%. This data-driven decision-making model effectively solves the problem of supply and demand imbalance caused by the empirical judgment in the traditional metallurgical industry.

The core value of the digital transformation of metallurgical enterprises lies in promoting the efficiency improvement and mode innovation of the whole chain through technological reconstruction. The research confirmed that big data technology increases the response speed of production decision by more than 40%, and Baosteel Group shortened the raw material procurement cycle to 72 hours and increased the inventory turnover rate by 28%; the application of artificial intelligence algorithm in Angang hot rolling workshop increased the optimization efficiency of process parameters by 60% and the product defect rate to 0.15% (Fig.1).
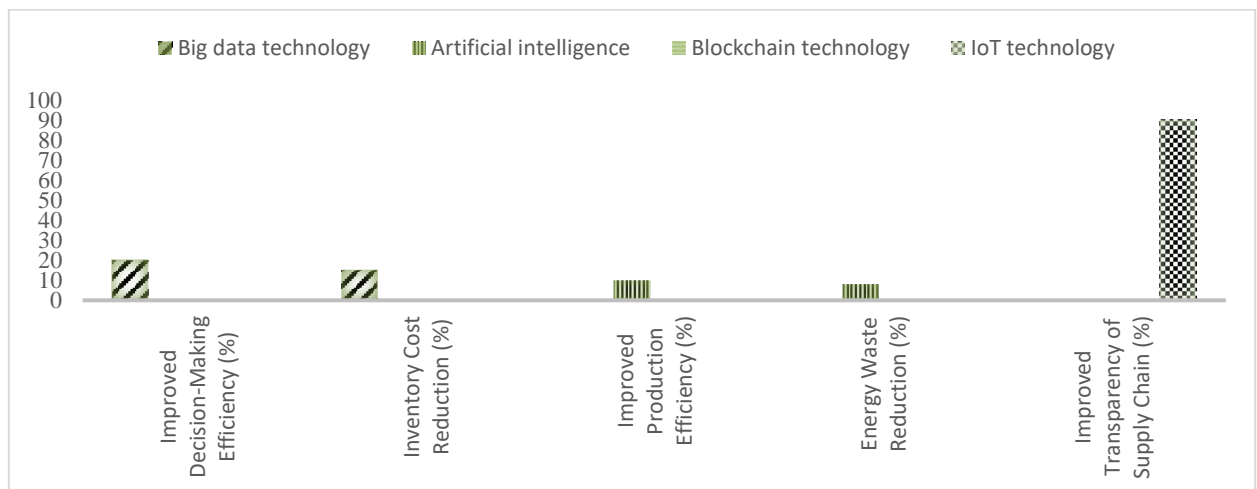

Fig. 1. Application effect of digital transformation technology in metallurgical enterprise management [4]

The application of digital transformation technologies, such as big data and artificial intelligence, in metallurgical enterprises, particularly in the case of Baowu Iron and Steel, significantly improves production management efficiency. The use of such platforms for real-time market analysis and production data enables a 15% reduction in costs, a decrease in inventory turnover days, and an improvement in demand forecasting accuracy. This confirms the importance of digital technologies in enhancing competitiveness and enabling enterprises to

adapt to new market conditions.

The digital transformation of the metallurgical industry is a key factor in improving production efficiency and management, ensuring the integration of industrial Internet, digital twin, and artificial intelligence technologies. In 2023, spending on these technologies in China reached 380 billion yuan, highlighting the importance of their implementation in the sector. Digital transformation helps improve the efficiency of enterprises by reducing costs, increasing decision-making speed, and optimizing production processes. The adoption of big data and artificial intelligence technologies enables companies like Baowu Iron and Steel to significantly reduce costs and improve inventory management efficiency.

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