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Research on Digital Process Optimization of Enterprise Information Management Oriented toward Intelligent Manufacturing

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Abstract: Under the wave of intelligent manufacturing, digital processes of enterprise information management have become a core vehicle for integrating production factors and enhancing operational efficiency. This paper focuses on the optimization of enterprise information management digital processes oriented toward intelligent manufacturing. It systematically analyzes the core connotations of digital processes and, in light of the development requirements of intelligent manufacturing, examines the existing problems and underlying causes in current enterprise information management digital processes. On this basis, a comprehensive optimization model is constructed, encompassing optimization objectives and principles, framework design, technological support, and validation methods. Correspondingly, optimization strategies are proposed from four key dimensions: process architecture, system integration, data management, and organizational personnel. This study provides theoretical guidance and practical pathways for enterprises to empower intelligent manufacturing through digital transformation, and it is of significant importance for promoting the high-quality development of the manufacturing industry.

Keywords: Intelligent manufacturing; enterprise information management; digital process optimization

Introduction

The global manufacturing industry is accelerating its transition toward intelligent manufacturing. Technological innovations represented by Industry 4.0 and the Industrial Internet are driving profound transformations in enterprise production and management models. As a core component of enterprise operations, information management plays a decisive role in the advancement of intelligent manufacturing,

with the efficiency of its digital processes directly affecting implementation outcomes. Against this background, this paper investigates the optimization of enterprise information management digital processes from the perspective of intelligent manufacturing development. By constructing an optimization model and proposing targeted strategies, the study aims to address existing process bottlenecks, facilitate effective coordination between information management and

intelligent manufacturing, enhance enterprises' core competitiveness, and provide robust support for the digital transformation of the manufacturing sector.

1. Connotation of Enterprise Information Management Digital Processes

Enterprise information management digital processes refer to a dynamic system that, supported by digital technologies, transforms enterprise information collection, transmission, storage, processing, and application into standardized, automated, and visualized processes. Their core connotations are reflected in three dimensions. First, digitization of process carriers, whereby information systems, big data platforms, and related tools replace traditional paper-based and manual operations, enabling the online operation of management activities. Second, intelligent process logic, achieved by embedding algorithmic models, rule engines, and similar technologies to enable automatic information sorting, precise matching, and intelligent early warning, thereby improving the efficiency of management decision-making. Third, integrated process collaboration, which breaks down information silos between departments and establishes cross-departmental and cross-hierarchical collaborative processes to ensure smooth end-to-end information flow. Compared with traditional information management processes, digital processes are characterized by high efficiency, accuracy, and traceability. Their core objective is to optimize information flow efficiency and unlock data value, providing reliable support for enterprise production operations and strategic decision-making, and serving as a fundamental guarantee for enterprises to adapt to intelligent manufacturing [1].

2. Current Status Analysis of Enterprise Information Management Digital Processes Oriented toward Intelligent Manufacturing

2.1 New Requirements of Intelligent Manufacturing for Enterprise Information Management Digital Processes
Intelligent manufacturing takes data as its core driving factor and imposes four new requirements on enterprise information management digital processes. First, real-time capability: intelligent manufacturing emphasizes dynamic control of production processes,

requiring information management processes to achieve real-time data acquisition, transmission, and analysis, thereby ensuring synchronized updates of production instructions, equipment status, and material information. Second, flexibility: in response to diversified and small-batch production demands, information management processes must be capable of rapid adjustment, flexibly adapting process nodes and rules according to changes in production plans. Third, integration: it is necessary to connect information processes across the entire value chain—design, production, sales, and operation and maintenance—so as to achieve deep coordination with intelligent manufacturing production lines, equipment, and systems. Fourth, intelligence: by incorporating big data analytics and artificial intelligence technologies, information can be intelligently mined and predicted, providing decision support for production optimization and quality control, and driving the transformation of management models from "passive response" to "proactive prediction."

2.2 Problems in Existing Enterprise Information Management Digital Processes
At present, enterprise information management digital processes struggle to meet the requirements of intelligent manufacturing, with core problems concentrated in four main aspects. First, fragmented process architecture: different departments independently establish information systems and processes. For example, information flows between production and sales departments are often disconnected, resulting in mismatches between production planning and market demand and making it difficult to achieve full value-chain coordination. Second, low system integration: most existing information systems are heterogeneous, with non-unified interface standards, making cross-system data circulation difficult and giving rise to "data silos," which severely constrain the realization of data value. Third, insufficient data management capability: the lack of unified data standards and quality control mechanisms leads to prominent issues such as data redundancy and errors. Moreover, data analysis remains largely at the level of descriptive analysis, failing to support the precise decision-making required by intelligent manufacturing. Fourth, lagging process responsiveness: processes are characterized by complex

nodes and excessive approval procedures, and there is a lack of dynamic adjustment mechanisms. As a result, enterprises are unable to respond rapidly to unexpected situations such as changes in production plans or equipment failures, thereby affecting the flexible production efficiency of intelligent manufacturing [2].

2.3 Analysis of the Causes of These Problems

The root causes of the problems in existing information management digital processes lie in insufficient coordination across technology, management, and conceptual dimensions. From a conceptual perspective, some enterprises still perceive digital processes merely as the "online migration of offline processes," lacking a systematic mindset oriented toward intelligent manufacturing and failing to deeply integrate process optimization with production activities. From a management perspective, organizational structures are typically pyramidal, with clearly defined departmental responsibilities but inadequate coordination mechanisms. Process design and optimization lack cross-departmental integration, leading to fragmented processes. From a technological perspective, early-stage informatization initiatives were often implemented without unified planning, resulting in inconsistent system selection and development standards, as well as insufficient support from advanced data management and integration technologies, which hinders seamless interoperability among heterogeneous systems. From a human resource perspective, there is a shortage of interdisciplinary talents who possess both information management expertise and a solid understanding of intelligent manufacturing. In addition, frontline employees often lack digital operation skills and show limited participation in process optimization, which constrains the effective implementation of digital process optimization initiatives.

3. Construction of an Enterprise Information Management Digital Process Optimization Model Oriented toward Intelligent Manufacturing

3.1 Optimization Objectives and Principles

The core objective of optimizing enterprise information management digital processes oriented toward intelligent manufacturing is to build a digital process system characterized by "real-time collaboration, intelligent efficiency, and flexible adaptability."

This system aims to ensure smooth end-to-end information flow, enhance data-driven decision-making capabilities, strengthen coordinated alignment with all stages of intelligent manufacturing, and ultimately improve enterprise operational efficiency and core competitiveness. The optimization should adhere to four fundamental principles. First, the strategic alignment principle: process optimization must closely align with the enterprise's intelligent manufacturing development strategy, ensuring precise matching between process nodes and strategic objectives. Second, the customer-oriented principle: with market demand and internal business needs as the core focus, redundant links should be streamlined to enhance process responsiveness. Third, the data-driven principle: with data integration as the central element, unified data standards and circulation mechanisms should be established to fully exploit data value. Fourth, the progressive implementation principle: optimization should be advanced in stages and modules based on the enterprise's existing foundation, balancing optimization effectiveness with operational stability.

3.2 Framework Design of the Optimization Model

A "three-layer, four-dimension" optimization model framework is constructed. The three layers include the strategic layer, the technological layer, and the execution layer, while the four dimensions comprise process architecture, system integration, data management, and organizational support. The strategic layer serves as the top-level guidance, defining the overall direction, objectives, and priorities of process optimization and formulating optimization plans in alignment with intelligent manufacturing strategies. The technological layer provides core support, encompassing information systems, integration technologies, and data analytics tools, thereby ensuring technical support for process optimization. The execution layer functions as the implementation carrier, responsible for process design, execution, monitoring, and iterative improvement. The four-dimensional collaborative modules run through all three layers: the process architecture module focuses on sorting and optimizing full value-chain processes and node design; the system integration module enables interoperability among heterogeneous systems and data sharing; the data management module addresses

data standard formulation, quality control, and value mining; and the organizational support module ensures effective implementation through personnel training, responsibility allocation, and the establishment of coordination mechanisms.

3.3 Selection of Key Technologies and Tools

In alignment with the optimization model framework and the requirements of intelligent manufacturing, four categories of key technologies and tools are selected. First, system integration technologies: application programming interfaces (APIs), enterprise service buses (ESB), and Internet of Things (IoT) gateways are adopted to achieve seamless integration among heterogeneous systems such as ERP, MES, and SCM, thereby opening up channels for information flow. Second, data management technologies: master data management (MDM) is employed to establish unified data standards, while data cleansing and desensitization techniques are used to improve data quality. Meanwhile, big data platforms are leveraged to realize centralized data storage and management. Third, intelligent analytics technologies: machine learning and deep learning algorithms are introduced and combined with business intelligence (BI) tools to enable predictive data analysis and visualized presentation, providing intelligent support for decision-making. Fourth, process management tools: BPMN-based process modeling tools are used for visual process design, and robotic process automation (RPA) is applied to automatically handle repetitive process nodes, thereby improving overall process efficiency. The coordinated application of these technologies and tools provides comprehensive technical support for digital process optimization.

3.4 Model Validation Methods

A combined approach of "case validation + indicator comparison" is adopted to verify the effectiveness of the optimization model. A manufacturing enterprise is selected as the case study, as it has initiated an intelligent manufacturing transformation and exhibits typical issues such as fragmented information management digital processes and low system integration [3]. First, the current process status of the case enterprise is analyzed, and a targeted optimization plan is developed and implemented based on the proposed model. Second, a multidimensional

evaluation indicator system is established, covering process efficiency indicators (e.g., process cycle time and approval duration), data quality indicators (e.g., data accuracy and completeness), and collaborative adaptability indicators (e.g., system integration rate and coordination between production and sales). Finally, changes in these indicators before and after optimization are compared. If the process cycle is reduced by more than 30%, data accuracy is increased to over 95%, system integration reaches above 90%, and the processes can effectively adapt to intelligent manufacturing production requirements, the model can be considered effective and feasible. In addition, expert review methods are applied to collect feedback from industry experts, further refining and improving the details of the model.

4. Optimization Strategies for Enterprise Information Management Digital Processes Oriented toward Intelligent Manufacturing

4.1 Process Architecture Optimization Strategies

The process architecture is optimized by adopting the approach of "full value-chain mapping + node streamlining + flexible design." First, with the full value chain of intelligent manufacturing as the core, information processes across design, production, sales, and operation and maintenance are systematically mapped, and a comprehensive process map is constructed to identify redundant or disconnected process nodes, such as eliminating unnecessary approval steps and merging repetitive data collection nodes. Second, an "end-to-end" process model is established to break down departmental barriers. Cross-departmental process task forces are set up to coordinate full-chain process optimization—for example, by building an integrated process of "sales demand–production planning–material procurement" to ensure synchronized information flow. Third, flexible design concepts are introduced by embedding dynamic rule engines into processes, enabling flexible adjustment of process nodes and circulation rules in response to changes in production plans or market demand, thereby enhancing process adaptability.

4.2 Information System Integration Strategies

A system integration strategy is formulated with "unified standards, layered integration, and security assurance" as its core. First, establishing a unified

technical standards system is essential. Standards for system interfaces, data formats, and communication protocols are clearly defined, effectively creating a common "language" for different systems and ensuring seamless interoperability between newly introduced systems and existing ones. Second, a layered integration model is adopted. Priority is given to integrating core business systems, such as ERP and MES, so that key production and operational processes are connected first to achieve efficient collaboration. On this basis, integration is gradually extended to auxiliary systems, such as office automation systems and customer relationship management systems, thereby reducing integration complexity and risk. Third, an enterprise-level integration platform is constructed. By leveraging ESB and API gateways, centralized scheduling and circulation of data across systems are realized, ensuring real-time synchronization of core data related to production, sales, and inventory, and providing accurate support for enterprise decision-making. Finally, integration security assurance is strengthened through technologies such as data encryption, identity authentication, and access control, forming a robust security framework to mitigate risks during data transmission and system integration and to effectively safeguard enterprise information security [4].

4.3 Data Management and Analytics Strategies

Building a full-process data management system characterized by "standards first, quality control, and value mining" is critical for enterprises to achieve intelligent manufacturing. Establishing a unified data standards system is the foundation. Clear definitions of data elements, coding rules, and classification standards should be formulated, with particular emphasis on standardizing core data such as production equipment data, material data, and customer data. This ensures consistency at the source of data generation and avoids confusion and errors caused by inconsistent standards. Establishing a robust data quality control mechanism is indispensable. Dedicated data management roles should be set up, and automated tools should be used for data cleansing and validation. Regular data quality audits should be conducted to promptly identify and rectify issues such as data redundancy and inaccuracies, thereby ensuring data accuracy and integrity. Deepening data value mining is the core objective. Based on big

data platforms, multidimensional analytical models should be developed to support scenarios such as production optimization, quality control, and demand forecasting. Through BI tools, analytical results can be visualized to allow data to "speak," providing strong support for precise decision-making in intelligent manufacturing and promoting the transformation of data from a "resource" into a true "asset."

4.4 Organizational and Personnel Transformation Strategies

Promoting organizational and personnel transformation from the perspectives of organizational structure, talent development, and cultural construction is an inevitable choice for enterprises adapting to intelligent manufacturing. In terms of organizational structure, traditional pyramidal structures should be reformed by establishing flattened process management departments. These departments should take overall responsibility for the planning, implementation, and monitoring of process optimization, clearly defining the responsibilities and authorities of each department within processes and establishing cross-departmental coordination mechanisms to break down silos and improve efficiency and responsiveness. In terms of talent development, a system combining "cultivation of interdisciplinary talents and enterprise-wide digital empowerment" should be established. Through university–enterprise cooperation and internal training programs, professionals who possess both information management expertise and an understanding of intelligent manufacturing should be developed to provide intellectual support for enterprise growth. At the same time, enterprise-wide digital skills training should be conducted to enhance frontline employees' system operation and process execution capabilities, ensuring the effective implementation of digital transformation strategies. In terms of cultural construction, efforts should be made to strengthen the communication and dissemination of digital transformation and process optimization concepts so that employees fully understand their significance. Employees should be encouraged to participate in process optimization by proposing suggestions, supported by incentive mechanisms that reward outstanding ideas and successful implementations. This helps foster a positive atmosphere of "participation by

all" and stimulates employees' initiative and creativity.

Conclusion

In the context of intelligent manufacturing, optimizing enterprise information management digital processes is a core component of manufacturing digital transformation and directly determines an enterprise's ability to adapt to intelligent manufacturing. By analyzing the connotations of digital processes, identifying existing problems and their causes, constructing a "three-layer, four-dimension" optimization model, and proposing comprehensive optimization strategies encompassing processes, systems, data, and organization, this paper provides an integrated solution for enterprise digital process optimization. With the continuous development of technologies such as the Industrial Internet and artificial intelligence, enterprises must continuously iterate and optimize their digital processes, strengthen deep integration with intelligent manufacturing technologies, and closely monitor industry trends and technological innovations. By adjusting optimization directions in line with their own development needs, enterprises can gradually build adaptive and intelligent information management digital process systems, injecting sustained momentum into the high-quality development of the manufacturing industry.

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