

Research on the Upgrading Path of Business Management Mode for Small and Medium sized Manufacturing Enterprises under the Background of Digital Transformation

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ABSTRACT Digital transformation is reshaping the competitive rules of the manufacturing industry, and small and medium-sized manufacturing enterprises are facing practical pressures such as order fragmentation, cost rigidity, delivery cycle compression, and supply chain uncertainty, as well as transformation challenges such as insufficient data governance capabilities, extensive management processes, inefficient organizational collaboration, and unclear digital investment returns. Whether the business management model can be upgraded in a timely manner directly affects the response speed and resource allocation efficiency of enterprises in research and development, procurement, production, sales, finance, human resources, and supply chain collaboration. This article takes small and medium-sized manufacturing enterprises as the research object, and based on the relevant theories of digital economy, intelligent manufacturing, dynamic capability, and value chain management, analyzes the limitations of traditional business management models in strategic decision-making, process operation, organizational structure, data application, and performance evaluation. It constructs a six in one management model upgrade framework of "strategic traction, process reengineering, data-driven, organizational collaboration, ecological linkage, and risk governance". Research suggests that the digital transformation of small and medium-sized manufacturing enterprises should not be simply understood as purchasing software or building platforms, but should focus on business pain points and value creation scenarios to promote lightweight, phased, and assessable management upgrades. The article further proposes paths such as diagnostic evaluation, scenario entry, process standardization, data assetization, platform integration, talent mechanism, and performance closed-loop, in order to provide reference for small and medium-sized manufacturing enterprises to enhance their business resilience and competitiveness.

INDEX TERMS Digital transformation; Small and medium-sized manufacturing enterprises; Business management mode; Upgrade Path

I. INTRODUCTION

A. RESEARCH BACKGROUND

Manufacturing is an important foundation of the real economy, and small and medium-sized manufacturing enterprises are important carriers of industrial chain support, regional employment, technology diffusion, and market vitality. Compared with large enterprises, small and medium-sized manufacturing enterprises usually have advantages such as short decision-making chains, fast market response, and high degree of specialization. However, they also have shortcomings such as limited capital strength, imperfect management systems, scattered information systems, in-

sufficient talent reserves, and weak risk resistance. After entering the digital economy stage, customer demand gradually shifts from large quantities and standardization to small quantities, multiple varieties, fast delivery, and service-oriented extension. The competition of manufacturing enterprises no longer depends solely on equipment scale and low-cost labor, but also on the speed of order response, data utilization, supply chain collaboration, and business decision-making. The "14th Five Year Plan" for the development of the digital economy issued by the State Council emphasizes the need to promote the deep integration of digital technology and the real economy, and empower

traditional industries to transform and upgrade. This policy orientation makes the digital transformation of small and medium-sized manufacturing enterprises a practical issue to enhance industrial basic capabilities and supply chain resilience.

The digital transformation is first manifested in the change of technical tools, such as the application of enterprise resource planning system, manufacturing execution system, customer relationship management system, industrial Internet platform, data middle platform, intelligent devices and cloud services. But from the perspective of business management, the real difficulty lies not in the launch of a single system, but in the changes in management logic. Traditional small and medium-sized manufacturing enterprises often rely on experience scheduling, manual statistics, departmental division of labor, and post accounting to maintain operations. The slow transmission of management information between sales, procurement, production, warehousing, finance, and after-sales results in the inability to timely account for order profits, difficulty in dynamically matching inventory and production capacity, and inability to precipitate customer demand into product improvement information. The relevant documents on digital transformation of small and medium-sized enterprises issued by the Ministry of Industry and Information Technology and other departments also emphasize the need to promote business scenario traction and "small, fast, light and accurate" applications based on the actual needs of enterprises. Therefore, in the context of digital transformation, management upgrading should not be limited to the level of information construction, but should promote the synchronous adjustment of strategies, processes, organizations, and performance systems.

B. RESEARCH SIGNIFICANCE

From a theoretical perspective, this article analyzes the digital transformation of small and medium-sized manufacturing enterprises within the framework of upgrading business management models, which helps to address the issue of insufficient attention to management mechanisms in purely technological application research. Digital transformation is not a simple combination of equipment automation, software procurement, or platform integration, but rather a restructuring of resource allocation by enterprises around the value creation process. The dynamic capability theory suggests that enterprises need to adapt to external environmental changes by perceiving opportunities, integrating resources, and restructuring capabilities. To maintain competitiveness in the face of order fluctuations, cost pressures, and supply chain uncertainties, small and medium-sized manufacturing enterprises must transform digital technology into market awareness, operational collaboration, and organizational learning capabilities. This article combines digital transformation with strategic management, process management, organizational management, financial management, and supply chain management, which can provide a more complete

explanation of the inherent logic of upgrading management models.

C. RESEARCH APPROACH

This article follows the research approach of "problem identification theoretical analysis framework construction path design guarantee mechanism". Firstly, define the core concepts of digital transformation and upgrading of business management models, and explain the relationship between the two; Secondly, analyze the typical problems of small and medium-sized manufacturing enterprises in strategic decision-making, process operation, data governance, organizational collaboration, and performance evaluation; Once again, establish an overall framework for upgrading the business management model; Finally, propose an implementation path from the aspects of strategy, process, organization, data, supply chain, and performance loop. For the convenience of later development, this article summarizes the key dimensions involved in management upgrade as follows, as shown in Table 1.

TABLE 1. Core Dimensions of Management Mode Upgrade

Type	Dimension	Symbol
Strategic	Digital strategy alignment	DSA
Process	End-to-end process redesign	EPR
Data	Data governance and analytics	DGA
Organization	Cross-functional collaboration	CFC
Finance	Cost and performance visibility	CPV
Supply Chain	Supplier and customer integration	SCI
Capability	Digital talent and learning	DTL
Risk	Security and compliance control	SCC
Outcome	Operational resilience	OR

II. THEORETICAL BASIS AND MODEL ASSUMPTIONS

A. THE CONNOTATION OF DIGITAL TRANSFORMATION

Digital transformation is the process by which enterprises utilize data, algorithms, network connections, and digital platforms to reconstruct the ways in which value is created, transmitted, and acquired. Bharadwaj et al. proposed that digital business strategy is no longer a subsidiary of traditional information technology strategy, but an important component of overall enterprise strategy. Vial's research further suggests that digital transformation is the process by which digital technology triggers organizational responses and changes the path of value creation. For small and medium-sized manufacturing enterprises, digital transformation cannot be simply equated with "machine to human" or "cloud to platform", but should be understood as connecting customers, orders, materials, equipment, personnel, and finance through data, enabling enterprises to quickly identify market changes, allocate resources more accurately, and control risks more transparently.

B. THE MEANING OF UPGRADING THE BUSINESS MANAGEMENT MODE

The business management model is a system arrangement for enterprises to plan, organize, coordinate, control, and

evaluate their production and operation activities around strategic goals. Its content includes strategic management, marketing, production and operation, procurement and supply, financial control, human resources, quality management, and risk management. In the context of digital transformation, upgrading the business management model is not about moving offline processes to online, but about redesigning business processes, organizational responsibilities, data rules, and performance mechanisms, shifting management activities from post statistics to real-time perception, from department segmentation to process collaboration, from experience judgment to data support, and from single cost control to value creation.

The value chain theory emphasizes that a company's competitive advantage comes from the systematic synergy between activities such as research and development, procurement, production, marketing, and service. Digital technology has made the data connections of various links in the value chain more closely connected, and has also extended the management boundaries from within the enterprise to suppliers, customers, platforms, and industrial ecosystems. Porter and Heppelmann's research on intelligent interconnected products points out that after product networking, the competitive mode, organizational structure, and value chain activities of enterprises will all change. Although small and medium-sized manufacturing enterprises may not directly develop complex intelligent products, their orders, equipment, inventory, quality, and customer service are also reorganized in digital connectivity. Therefore, the core of upgrading the business management model is to adapt the management system to data-driven value chain collaboration.

C. SPECIAL CHARACTERISTICS OF SMALL AND MEDIUM SIZED MANUFACTURING ENTERPRISES

The upgrading of management models for small and medium-sized manufacturing enterprises should adhere to business traction, lightweight deployment, step-by-step integration, and continuous iteration. Matt et al. proposed that digital transformation strategies need to simultaneously address changes in technology usage, value creation, structural adjustments, and financial factors. For small and medium-sized manufacturing enterprises, any digital project should answer four questions: which business pain point to solve, which process to change, which type of data to generate, and which performance indicator to improve. If these questions cannot be answered, the project is prone to becoming a showcase project. The management priorities for different stages of transformation are shown in Table 2.

TABLE 2. Digital Transformation Stages of SMEs

Main Feature	Management Focus	Typical Tool	Key Risk	Expected Output
Manual records dominate	Standardize data	Spreadsheet and barcode	Data discontinuity	Visible order and inventory
Single system applied	Improve department efficiency	ERP or MES module	System island	Process-level data
Cross-system connection	Coordinate plan and execution	ERP-MES-WMS link	Integration cost	End-to-end process
Analytics support decisions	Optimize cost and delivery	BI and dashboard	Indicator distortion	Real-time decision support
External partners connected	Supply chain synergy	Industrial internet platform	Data security	Networked value creation

III. THE REALISTIC DILEMMA OF BUSINESS MANAGEMENT MODE FOR SMALL AND MEDIUM-SIZED MANUFACTURING ENTERPRISES

A. DEVIATION IN STRATEGIC COGNITION AND TRANSFORMATION POSITIONING

Many small and medium-sized manufacturing enterprises still understand digital transformation at the level of equipment updates, software procurement, and automated management reports, lacking a transformation positioning that matches the company's development strategy. Some companies launch systems to meet customer factory audits, government applications, or financing displays, but do not embed the system into daily business decisions; Some companies understand digitalization as a cost reduction tool and overlook its value in customer response, quality traceability, flexible production, and service extension; Some companies have high expectations for transformation benefits and hope to solve all management problems through a single system in the short term. Kane et al. found that the key to driving digital maturity is not the technology itself, but rather the strategic, cultural, and talent mechanisms. This viewpoint is particularly important for small and medium-sized manufacturing enterprises, as the smaller the scale of the enterprise, the more directly the manager's cognition affects the direction of resource investment.

B. EXTENSIVE PROCESSES AND DATA SILOS

Small and medium-sized manufacturing enterprises generally suffer from a structural weakness of insufficient reserves of digital composite talents. Traditional production, finance, and sales employees within the enterprise only possess a single business skill, do not understand the logic of digital system operation, and do not have data-driven management thinking; External high-end digital operation, data governance, and industrial system operation and maintenance talents tend to choose large manufacturing enterprises due to factors such as salary, platform, and development space. Small and medium-sized manufacturing enterprises have long faced the dilemma of "difficult to recruit and even more difficult to retain personnel". The relationship between typical pain points and management response is shown in Table 3.

TABLE 3. Pain Points and Management Responses

Pain Point	Business Symptom	Root Cause	Management Response
Unstable delivery	Frequent delay	Sales-plan-production disconnect	Order promise review
Inventory mismatch	Overstock and shortage coexist	Weak material coding	Inventory standardization
Cost opacity	Order profit unclear	Late cost collection	Cost object redesign
Quality fluctuation	Repeated defects	Traceability gap	Quality process control
Slow response	Customer feedback delayed	Fragmented service records	Customer data integration

IV. THE OVERALL FRAMEWORK FOR UPGRADING THE BUSINESS MANAGEMENT MODEL

A. STRATEGIC TRACTION: FROM INFORMATION TECHNOLOGY PROJECTS TO BUSINESS CAPABILITY BUILDING

The digital management upgrade of small and medium-sized manufacturing enterprises must first return to business objectives. Enterprises should clarify the priority direction of digital transformation based on their position in the industry chain, product type, customer structure, and competitive pressure. For order oriented enterprises, the focus may be on quotation, production scheduling, delivery, and cost accounting; For component supporting enterprises, the focus may be on quality traceability, supply chain collaboration, and customer data interfaces; For private label enterprises, the focus may be on customer relations, channel management, and product serviceization. Westerman et al.'s research on digital leadership suggests that digital maturity requires both technological capabilities and leadership to drive organizational change. Small and medium-sized manufacturing enterprises need managers to incorporate digital transformation into their strategic agenda, rather than viewing it as auxiliary work for their finance or information departments.

B. PROCESS REENGINEERING: FROM DEPARTMENTAL EFFICIENCY TO END-TO-END COLLABORATION

Process reengineering needs to follow the order of "standards first, systems later; main lines first, details later; closed loops first, optimization later". Standardization refers to establishing basic data rules such as material codes, customer codes, process routes, quality defect classifications, and cost accounts. Post system refers to configuring software functions after clear rules are established. First line refers to prioritizing the integration of main processes such as sales orders, production planning, procurement requirements, warehousing and material issuance, production reporting, quality inspection, and financial accounting. Post details refer to the further processing of personalized reports, mobile approvals, and intelligent analysis. Closed loop first refers to ensuring that data can be returned from business occurrence to management evaluation. Post optimization refers to the reuse of data for prediction and decision support.

C. DATA DRIVEN: FROM EXPERIENCE JUDGMENT TO REAL-TIME DECISION-MAKING

Data driven does not mean that all decisions are automatically made by algorithms, but rather that enterprises can use timely, accurate, and interpretable data to support management judgments. Small and medium-sized manufacturing enterprises must first address the issue of data trustworthiness. If the basic data is incorrect, the input is not timely, and the caliber is not consistent, the more beautiful the management dashboard, the more serious the misleading. Data governance should clarify data owners, entry responsibilities, verification rules, and change permissions. For example, material master data is jointly maintained by technology and procurement, inventory data is regularly verified by warehousing and finance, work hour data is jointly confirmed by production teams and equipment systems, and quality data is classified and recorded by the inspection department.

On the basis of reliable data, enterprises can gradually establish a business analysis system. The sales end focuses on customer structure, order gross profit, payment cycle, and demand forecasting; The production end focuses on capacity load, equipment efficiency, reporting accuracy, and abnormal downtime; The procurement side pays attention to supplier delivery, price fluctuations, and procurement cycles; The finance department focuses on cost collection, cash flow, and budget execution; The management focuses on profit, delivery, inventory, quality, and risk. The goal of data-driven approach is not to increase the number of reports, but to align key indicators with management actions. The main paths for upgrading the management mode framework are shown in Table 4 below.

TABLE 4. Management Upgrade Path Matrix

Path	Core Task	Expected Capability
Strategic alignment	Link digital projects with business goals	Clear transformation roadmap
Process redesign	Connect order, production and finance	End-to-end visibility
Data governance	Unify coding, rules and responsibility	Trusted operational data
Platform integration	Connect ERP, MES, WMS and CRM	Cross-system collaboration
Organization change	Build cross-functional teams	Faster decision-making
Performance loop	Use indicators to guide improvement	Continuous management optimization
Risk control	Protect data and stabilize operation	Secure and resilient transformation

V. IMPLEMENT SAFEGUARDS AND RISK CONTROL

A. CAPITAL INVESTMENT AND TECHNOLOGY SELECTION

The selection of technology should adhere to the principle of adaptation. Firstly, the system functionality should cover the current core scenario and have the ability to expand in the future. Secondly, the data interface should be open to avoid the formation of new islands. Thirdly, service providers should understand the manufacturing business and be able to support process configuration and on-site training. Fourthly, the complexity of the system should match the management capabilities of the enterprise. Frank et al.'s research on the application mode of Industry 4.0 technology shows that there are different paths for manufacturing enterprises to

adopt digital technology, from front-end connection to intelligent manufacturing and then to service-oriented extension [15]. Small and medium-sized enterprises should choose a path that matches their own stage, rather than blindly pursuing high-end concepts.

B. DATA SECURITY AND RISK GOVERNANCE

Digital transformation has expanded the scope of enterprise data flow, but also brought risks to data security, system stability, and trade secret protection. When small and medium-sized manufacturing enterprises access cloud platforms, industrial Internet platforms or customer collaboration systems, they need to define data boundaries and authority rules. What data can be shared with customers, which data is only used internally within the enterprise, which data needs to be desensitized, and which operations need to be traceable, should all be institutionalized. Network security and data security should not be taught until the system scale expands, but should be incorporated into the design at the foundational stage. The main risks and governance measures are shown in Table 6 below.

TABLE 6. Risks and Governance Measures

Risk	Manifestation	Governance Measure
Strategic drift	Projects detached from business goals	Roadmap review and value assessment
Data island	Systems cannot exchange data	Unified coding and interface planning
Low adoption	Employees avoid using the system	Training, incentives and workflow redesign
Cost overrun	Investment exceeds expected return	Stage-gate budgeting and pilot validation
Security leakage	Customer and process data exposed	Permission control and data classification
System interruption	Production affected by platform failure	Backup plan and manual fallback
Performance distortion	Indicators encourage local optimization	Balanced KPI and cross-process review

C. POLICY SYNERGY AND ECOLOGICAL SUPPORT

In addition, small and medium-sized manufacturing enterprises can form industrial digital collaborative alliances together, share lightweight digital tools with small and medium-sized enterprises in the same region and industry chain, unify material coding standardization, and jointly connect with high-quality industrial software service providers to share digital diagnosis, system implementation, and later operation and maintenance costs. The alliance can share supplier and customer collaboration data interface standards internally, establish a unified industry wide quality traceability process, and solve the problems of limited funds, weak bargaining power, and insufficient digital transformation experience for individual small and medium-sized enterprises. At the same time, actively connect with the digital public service platform of local industrial parks, and utilize the platform's free digital diagnosis, lean management coaching, data security testing and other public services to supplement the internal management shortcomings of enterprises with external ecological resources, achieving low-cost and sustainable industrial and commercial management mode iteration and upgrading.

VII. CONCLUSION

In the context of digital transformation, the core of upgrading the business management mode of small and medium-sized manufacturing enterprises is not simply the introduction of software systems or intelligent devices, but the reconstruction of strategic decision-making, process operation, organizational collaboration, data governance, and performance evaluation around the value creation process. This study suggests that the traditional management model of small and medium-sized manufacturing enterprises has significant shortcomings in experiential decision-making, departmental segmentation, extensive processes, data silos, and post accounting, making it difficult to adapt to the development requirements of fragmented orders, rapid delivery, traceable quality, and supply chain synergy. Digital transformation provides tools for management upgrading, but only when combined with enterprise strategy, business processes, and organizational capabilities can it be transformed into business performance.

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