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Development of New Quality Productive Forces Empowered by the Digital Management of Industrial Measurement from the Perspective of the Industrial Chain

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Abstract: The development of new quality productive forces largely depends on the data element collaboration within the industrial chain. Industrial measurement digitization serves as the underlying support for integrating quality control throughout the entire chain and releasing the value of data. This paper, from the perspective of the entire industrial chain, analyzes the internal mechanism of how measurement digitization empowers new quality productive forces from four aspects: data foundation, quality improvement and efficiency enhancement, inter-chain collaboration, and standard bottom line. It also identifies three practical bottlenecks: the digital gap among chain participants, inconsistent measurement standards, and the absence of a data conversion mechanism. The path of layer-by-layer implementation is proposed through chain leaders' guidance, unified standards, and data value addition, providing practical reference for the manufacturing industry's reliance on measurement digitalization to cultivate new quality productive forces.

Keywords: Industrial chain; Industrial measurement digitalization; Digital management; Industrial chain collaboration; New quality productivity

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1. Introduction

At present, the main task of the transformation and upgrading of the real economy is to cultivate new productive forces. As a new type of production factor, data needs to release its value through a measurement system that integrates the entire industrial chain. The current measurement of traditional industries has the drawbacks of fragmentation and offline operation. The data gaps in upstream and downstream measurement affect the collaborative improvement of the industry. Most existing research focuses on the digital transformation of measurement in individual enterprises, lacking systematic analysis from the perspective of the coordinated operation of the entire industrial chain. Therefore, this article starts from the industrial chain, clarifies the

logical relationship between the digitalization of industrial measurement and the new productive forces, identifies the pain points of industrial implementation, and provides corresponding optimization paths.

2. The mechanism of digitalized management of industrial measurement enabling new quality productivity from the perspective of the industrial chain

Industrial measurement digitalization promotes the development of new quality productivity through three channels: channel establishment, process control, and chain collaboration. By leveraging the Internet of Things and sensing devices to connect the measurement data transmission links of the industrial chain, a measurement database covering the entire process from raw material processing to after-sales service is created. This fills the gap of fragmented data in traditional industries and lays a solid foundation for the data elements of new quality productivity. Secondly, it replaces manual inspection with automated online measurement to monitor and warn about production parameters in real time, promptly correct process deviations, and transform quality control from post-check verification to dynamic control throughout the entire process. This effectively reduces the defective rate and material loss, achieving production improvement, cost reduction, and efficiency enhancement, which is in line with the low-carbon and high-quality development requirements of new quality productivity.

3. The realistic challenges of promoting new quality productivity through digital management of industrial measurement from the perspective of the industrial chain

3.1. The gap in the construction of chain entities is prominent, and data silos hinder the full circulation of factors throughout the chain

The resources of the industrial chain are stratified significantly. There is a large gap in terms of investment in digital measurement, equipment, and systems between the chain leader and small and medium-sized component enterprises. This has led to numerous data silos, preventing the full circulation of measurement data throughout the chain. Chain leader enterprises have strong R&D capabilities and can establish a dedicated digital measurement platform, covering all product categories in the entire workshop with digital measurement. However, small and medium-sized enterprises, which account for 70% of the chain, are still limited by factors such as funds, technology, and talent, and continue to use traditional testing equipment. The data is only saved in paper ledgers and local forms, and cannot be interconnected online. They cannot be connected to the chain leader system. The chain leader cannot obtain the original measurement data from upstream components in a timely manner and can only recheck upon delivery, prolonging the delivery time. Small and medium-sized enterprises cannot synchronize with the real-time process accuracy standards of the chain leader and can only produce according to lagging paper documents, resulting in data fragmentation between the upstream and downstream, reducing the flexible production capacity of the industrial chain, and limiting the empowerment of data elements to new quality productivity. The construction levels of 22 core enterprises in the Jianghuai construction machinery industrial chain are significantly stratified, as shown in Table 1 below.

Table 1. Comparative table of the current situation of measurement and digitalization construction of equipment manufacturing industry chain enterprises in the Yangtze River Delta Region

Enterprise type	Number of enterprises	Coverage rate of intelligent online measuring equipment	Construction status of digital measurement system	Cross-enterprise data interoperability capacity
Leading Chain Core Enterprises	2	96%	Built a full-process integrated digital measurement platform	Capable of targeted data push to upstream and downstream partners
Medium-sized Supporting Enterprises	7	58%	Only partial workshop-level measurement data modules deployed	Only internal data viewing supported; cross-chain data interoperability restricted
Small & Micro Supporting Enterprises	13	27%	No professional digital measurement systems; records kept via paper ledgers	No cross-enterprise data transmission capability at all

3.2. The unified measurement standards across the entire chain have not been established, and cross-domain data is difficult to exchange, recognize, and share

There are no complete digital measurement standards for domestic segmented industrial chains. The data formats, precision standards, and verification processes of each enterprise's equipment are incompatible with each other. The data across different entities cannot be accepted and shared, resulting in an increase in the operational costs of the entire chain. The existing measurement standards only focus on internal management of enterprises and lack detailed regulations for upstream and downstream collaboration. The data encoding and error logic of detection equipment of different brands cannot be adapted. Taking the lithium battery industry chain as an example, the positive electrode, cell, and PACK enterprises have their own sets of measurement standards. The upstream measurement reports cannot be recognized by the downstream system and need to be manually rechecked. The fragmented standards have disconnected the data circulation across the entire chain, preventing the circulation and reuse of measurement data and failing to form the value of large-scale data, thereby affecting the cultivation of new quality productive forces [1].

3.3. The mechanism for converting measurement results is lacking, and the value of data cannot be transformed into growth momentum

Most industrial chain enterprises only apply digital measurement to the quality inspection of finished products at the factory exit. They lack the supporting mechanisms for data mining, sharing, and value transformation. A large amount of measurement data is left idle and cannot be converted into the driving force for technological iteration and industrial upgrading. Within enterprises, measurement data is separated from R&D and process systems. R&D personnel cannot access the previous large amounts of data to improve parameters. The measurement data is only used for post-inspection and does not play a predictive and optimizing role; in the industrial chain, there is no unified measurement data sharing pool, and the upstream and downstream cannot jointly rely on the full-chain data to improve processes; in the industrial service sector, there is a lack of a compliant data value-added service mechanism, which cannot provide professional services such as loss estimation, quality prediction, and new product development to the enterprises on the chain, and cannot be transformed into new quality production momentum that drives industrial upgrading, as shown in Table 2.

Table 2. The distribution of measurement digitalization data application scenarios in the key domestic manufacturing industry chains

Data application scenarios	Application proportion	Core functions	Level of data value exploitation
Finished Product Factory Quality Inspection	62%	Verification of product precision and safety performance	Basic shallow-layer application, no value-added mining
Workshop Production Process Monitoring	21%	Real-time monitoring of metering deviations in working procedures	Moderate application, for internal enterprise use only
Upstream and Downstream Process Collaborative Optimization	11%	Adjust production parameters based on chain metering data	In-depth application, piloted only by a small number of leading enterprises
Big Data Process Iteration and New Product R&D	6%	Model historical metering data to predict process defects	High-end value-added application, extremely low industry penetration

4. New paths for the development of industrial measurement digitalization-driven new quality productivity under the guidance of industrial chain synergy

4.1. Playing the leading role of the chain leader and building an integrated digital measurement sharing platform

In response to the significant differences in the construction of entities along the chain and the obvious data silos, relying on the resource and industrial appeal of the chain leader enterprises to coordinate the establishment of an integrated digital measurement sharing platform for the entire chain, and promote the digital transformation of upstream and downstream enterprises in a layered and categorized manner, to open up cross-entity data circulation channels [2].

First, create a platform operation model led by the chain leader and jointly built by multiple parties. The chain leader bears the main cost of development and operation, reducing the access threshold for small and medium-sized enterprises. The platform unifies data interfaces and collects and stores all chain measurement data uniformly, eliminating format barriers.

Second, implement a layered lightweight digital transformation plan. The leading enterprises achieve full coverage of online measurement in workshops, medium-sized enterprises transform core measurement nodes, and small enterprises use portable terminals and cloud modules, without the need to build local systems.

Third, create a hierarchical data access permission management system. Differentiate between enterprise private and industry-wide shared measurement data, set different access permissions, protect the core processes of enterprises, break data silos, and achieve full-chain circulation of measurement data.

4.2. Coordinating the construction of the entire chain's measurement standards and opening channels for data intercommunication and sharing

To solve the problem of inconsistent digital measurement standards across the entire chain and the inability to recognize and use cross-domain data, collaborate with industry associations, measurement technology institutions, and chain leader enterprises to create a digital measurement standard system for the entire chain, enabling automatic identification and online recognition of upstream and downstream measurement data.

On one hand, formulate exclusive digital measurement unified norms for the chain. Based on the production characteristics of each segmented industry, unify the data output format of intelligent measurement equipment, quality error judgment standards, and online measurement report templates, formulate data

transmission and verification processes across enterprises, enabling the standardized upgrade of measurement detection equipment of upstream and downstream enterprises, and preventing problems of incompatible data from occurring at the source.

On the other hand, implement the online mutual recognition mechanism for measurement reports in the chain. Based on the integrated digital measurement platform, establish a standard verification module, and after standardized verification and acceptance, the digital measurement reports of upstream and downstream enterprises can enter the production process without going through offline detection procedures.

4.3. Improving the measurement data transformation mechanism and deeply exploring the value potential of digital elements

In response to the lack of a measurement data transformation mechanism and the idle value of data, a complete data value transformation system is established from three aspects: internal enterprise application, industry chain collaborative sharing, and market-oriented value-added services. This fully leverages the driving role of measurement data in new quality productivity.

Firstly, connect the interfaces of measurement data within the enterprise with those of the R&D and process systems. Promote the interconnection of the measurement digital platform with the enterprise's R&D design and production control systems. The process R&D team can access the historical measurement data throughout the entire cycle, transforming measurement data from post-event quality inspection tools into pre-event R&D optimization support, thereby shortening the new product iteration cycle.

Secondly, establish a measurement data sharing pool for the industry chain. Under the premise of ensuring the core confidentiality of the enterprise, collect all-chain general measurement data and provide support for upstream and downstream enterprises in process adaptation and quality collaborative improvement. Relying on the massive measurement data throughout the chain, promote the overall process improvement of the entire industry chain and enhance the production collaboration efficiency throughout the chain.

Finally, implement market-oriented value-added services for measurement data within the compliance scope [3]. Utilize the shared platform to integrate standardized measurement data resources and provide professional data services such as loss analysis, quality risk prediction, and new product accuracy simulation for the chain enterprises. Transform the static measurement data accumulated into reusable and value-added new production elements, providing all-round support for the long-term cultivation of new quality productivity in the industry chain.

5. Conclusion

Integrated development of the industrial chain is the main carrier for cultivating new quality productive forces. Industrial measurement digitalization is the foundation for quality and data control throughout the entire chain. Whether the enabling value of industrial measurement digitalization can be fully exerted depends on whether the three systems of coordinated industrial chain entities, unified standards, and data value transformation are complete. The industrial chain should rely on the leading enterprises to create shared digital platforms, establish dynamically updated full-chain measurement standards, and create multi-level data value-added transformation mechanisms. With the full-chain measurement data elements, it will continuously empower the long-term development of the new quality productive forces of the real economy.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Yang Y, 2026, New Quality Productivity Empowering Digital Transformation of Traditional Industries in Guizhou: Realistic Logic, Problem Analysis and Practical Paths. Science and Industry, 26(7): 17–23.

[2] Zhou Z, Miao Y, Liu M, et al., 2024, Establishing a Foundation with Measurement to Promote Sustainable Development. Chinese Metrology, (5): 6–36.

[3] Wei B, 2024, Research on Digital Empowerment of Traditional Industries from the Perspective of New Quality Productivity. Economist, (10): 291–292.