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Research on Cross-departmental Quality Collaborative Management Mechanism in Matrix Organizations

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ABSTRACT
As the mainstream structure for modern enterprises to cope with the complex market environment, the dual chain-of-command characteristics of the matrix organization have led to the systematic problem of cross-sectoral quality synergy while enhancing the ability of dynamic resource allocation. In this paper, by deconstructing the power configuration model of matrix organization and the connotation of quality synergy management, we reveal the three core dilemmas of fuzzy boundaries of authority and responsibility, broken process connection and misplaced behavioral motives, and therefore, put forward the integrated governance framework of reconstructing the organizational relationship network, realizing the full chain penetration of quality data based on the industrial Internet identification system, and reshaping the synergistic behavioral logic of the bundled appraisal mechanism.

KEYWORDS
Matrix organization; Cross-sector; Quality synergy

1 Introduction

In the context of globalized competition, the quality control of a product's entire life cycle has become a crucial component of an enterprise's core competitiveness. Matrix organizations are widely used in innovation-intensive fields such as high-end equipment manufacturing and information technology services due to their unique advantages of functional specialization and project flexibility. However, at the quality governance level, dual reporting mechanisms lead to overlapping decision-making authority and a responsibility vacuum, departmental goal differences result in the discrete implementation of quality standards, and cross-functional process faults lead to the attenuation of quality information transmission. The existing quality management system focuses on process control within a single functional domain and lacks a systematic response to the unique collaborative governance needs of matrix organizations. Academic studies are mostly limited to single-point breakthroughs, such as conflict management or process optimization, and fail to establish an integrated governance framework that encompasses organizational structure, business processes, and behavioral motivations. In this study, we design a collaborative quality management mechanism for matrix organizations, which realizes the reciprocal configuration of rights and responsibilities through structural reconstruction, guarantees the seamless flow of quality data through process reengineering, and promotes the cultivation of a knowledge-sharing culture through behavioral intervention, thus forming an ecosystem of quality governance with self-organization and self-adaptation characteristics.

2 Core concept definition

2.1 Structural characteristics of matrix organization

Matrix organization represents the structural innovation of modern enterprises in coping with diversified strategic objectives, and its essence lies in reconstructing the single command system of the traditional hierarchical system, while establishing dual command axes: the functional professional depth and the project dynamic control, operating in parallel [1]. In this framework, members of the organization assume two roles simultaneously: not only do they need to accept the professional and technical guidance and ability training from the functional departments, but also they must follow the task deployment and schedule constraints of the project team, thus forming a crisscrossing network of collaboration. As a result, the resource allocation mode is fundamentally changed, and the functional units of design, procurement, production, and others break through their static boundaries and are modularized according to project needs. This binary power structure is bound to give rise to inherent tension: the functional sequence is committed to the fine optimization of technical parameters and the depth of the construction of the knowledge system, the project sequence focuses on the delivery of the strict performance of the time limit and the agile response to user needs; resource allocation process of the continuity of the game is often triggered by the inter-departmental competition between the key testing equipment and quality experts; the dilemma lies in the structural absence of the main body of responsibility for the quality of the product when the product appears to be systematic When there is a systematic defect

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in the product, the functional line and the project line are easy to fall into the cycle of shirking responsibility. Mature matrix organizations achieve dynamic balance by establishing institutionalized consultation frameworks, such as cross-functional decision-making committees to define authority and responsibility for major quality issues, transparent rules for resource allocation, and regular debriefing mechanisms for dual-line supervisors, thereby transforming structural conflicts into innovation drivers.

1.2 Connotation of quality collaborative management

Quality collaborative management requires the establishment of a standard consensus system that covers the entire life cycle of products, ensuring that the technical definitions of design specifications, the operational requirements of process standards, and the judgment rules of inspection guidelines remain semantically unified in cross-departmental collaboration. The flow of quality information presents systematic dissipation characteristics, the information gap between departments leads to the continuous weakening of key quality parameters in the transmission process, the output of the design side of the precision tolerance requirements may be degraded to qualitative description in the manufacturing process, and the user side of the special working condition information is challenging to reverse transmission to the R & D department [2]. The theory of collaborative governance is reflected in the decision-making form of multi-participants: functional departments rely on professional reserves to formulate the standard framework, project teams are based on the implementation of process monitoring, user representatives convey market expectations through the demand channel, and the three parties form a quality consensus through iterative communication on the pre-set consultation platform. This model has fundamentally changed the logic of command and control in traditional quality management, constructed a networked ecosystem of shared governance centered on user value, and promoted the evolution of quality decision-making from one-way commands to multi-directional value co-creation.

1.3 The value logic of cross-sectoral collaboration

The effectiveness of systematic quality risk prevention and control relies on the coupled protective network built by multi-functional units. When the design, procurement, manufacturing, testing, and other aspects of the formation of the depth of articulation of the dynamic chain of cooperation are considered, the potential quality defects of the conduction path will be intercepted layer by layer. The risk exposure in the dimensional space presents a structural compression. The actual effectiveness of the response mechanism is contingent upon the process coupling status of departmental interfaces, and the smoothness of its information transmission constitutes a stringent constraint on the overall response capability. The process of user value creation shows multi-dimensional superposition effect: the front-end accurately captures the demand characteristics to ensure that the product attributes and market expectations of the dynamic fit, the middle-end efficiently block the abnormal conduction to reduce the probability of user loss, and the terminal to maintain the consistency of the full-cycle service experience to shape the core foundation of user loyalty. This composite value generation mechanism promotes the fundamental transformation of quality collaborative management, from passive problem repair to active strategic ability cultivation, and eventually evolves into the essential source for enterprises to build asymmetric competitive advantages.

2 The dilemma of cross-sector collaboration

2.1 Structural conflicts

The inherent dual power structure of matrix organizations triggers a deep-rooted contradiction in the allocation of power and responsibility. Functional managers focus on professional and technical aspects, while project managers prioritize timely delivery, and the two form a tension zone in the implementation of quality standards. When a new product has design defects, the R&D department prioritizes technical optimization. In contrast, the manufacturing department demands stability of the production line, and the quality decision-making is left in limbo due to the uncertainty of the responsible parties. Departmental barriers lead to the attenuation of information quality in the supply chain. Design department output inspection standards are not effectively implemented throughout the process, and production links after the transfer of key indicators of integrity are significantly weakened, especially in terms of tolerance requirements and special process parameters. More prominent conflict is the compromise of quality standards caused by resource competition: under the pressure of the project cycle, testing equipment and quality engineers have become the object of departmental competition, the project team to catch up with the progress of the first piece of inspection process is often simplified, and the functional departments to reduce the process of sampling frequency to release the resources [3]. The root cause of this structural conflict is that the matrix organization has not established a system design that ensures equal rights, responsibilities, and benefits, resulting in reduced quality control and a sacrifice of efficiency.

2.2 Process deficiencies

The failure of cross-sectoral process connections forms a timing blind spot in quality control, which ultimately results in

a structural conflict between the asynchronous decision-making mechanism and the rigid process structure within the organization. When the design department finally freezes the technical parameters of the product, the purchasing department completes the front-end information isolation, often completing the initial standard raw material orders. This results in new material characteristics and process requirements that are misaligned. This timing disconnect is the most significant and destructive feature in the change management process. The systematic time lag between the updating process documentation and issuing production orders not only disrupts the continuity necessary for quality traceability but also triggers a chaotic state of implementation, where old and new technical standards coexist. The user feedback response mechanism exposes the systemic dilemma of multi-level agency: when the complaint information passively flows among customer service, technology, operation and maintenance and other departments, the process of identifying the responsible body itself consumes a lot of disposal resources, which is the organization's failure to establish an authoritative arbitration mechanism across the nodes of the process. The existing process system divides the quality responsibility into departmental segments but does not establish an end-to-end responsibility transfer path. The departmental interface, due to the lack of a mandatory information-sharing system and joint decision-making authorization, will inevitably be alienated into an area of information and action blocking, leading to quality control issues in the process of disconnection and continuous dysfunction.

2.3 Behavioral barriers

The departmental localism, under the performance appraisal orientation, gives rise to a defensive decision-making logic. The R&D department tends to choose high-cost materials to fulfill the technological innovation index, and this technology-first strategy directly suppresses the manufacturing department's reasonable demand for production stability; the quality department mechanically raises the inspection threshold to control the index of defective rate, and its risk-avoidant behavior leads to the forced prolongation of the delivery cycle. Organizational knowledge management shows structural breaks, and key experiences are fragmented and deposited in different functional units. For example, solutions to specific technical problems are kept in separate areas, such as process parameter adjustments, equipment and tooling modifications, and on-site operation specifications, which cannot be integrated into migratory systematic knowledge assets. The cultural basis for cross-departmental collaboration is fundamentally lacking, and quality coordination meetings are often reduced to debates over departmental positions. At the same time, professional and technical disputes are frequently escalated into irrational interpersonal confrontations. In some organizations, quality analysis meetings are ritualized, with participants either absent or present symbolically, often with preconceived conclusions. Such behavioral patterns reflect the inherent contradiction in the organizational incentive system. There is an irreconcilable institutional tension between the rigid assessment of departmental performance and the synergistic logic of cross-departmental value creation [4].

3 The optimization path of collaborative management mechanism

3.1 Structural reconstruction plan

To resolve the inherent dilemma of ambiguous authority and responsibility in matrix organizations, it is necessary to establish a three-dimensional quality responsibility matrix structure. The structure systematically defines the proportion of authority and accountability in the functional dimension (quality department leads the standard development and compliance review), the project dimension (project manager is responsible for process execution and supervision) and the product dimension (product manager coordinates the whole life-cycle quality objectives), and quantifies the weight distribution of key decision-making scenarios through the responsibility matrix [5]. To deal with cross-departmental disputes, a quality arbitration committee is set up under the direct control of the vice president of operations, which is given the right to stop production under abnormal working conditions and the priority of resource allocation, and a three-level conflict resolution channel is established: "departmental independent consultation - committee hearing and ruling - final review by the senior management". Simultaneously implement the pooling management of core resources, such as testing equipment, experts, and talent, by dynamically scheduling high-value resources according to project priorities. This approach eliminates the phenomenon of idle testing capacity and standard compromise caused by departmental resource fragmentation. An aerospace manufacturing company has organized 142 cross-functional powers and responsibilities of the design department, project department, and quality department in the development of the system through a three-dimensional matrix, resulting in a threefold increase in the time efficiency of design change approval.

3.2 Process reengineering strategy

The core of process optimization is to open up the transformation channel from user requirements to quality standards. The quality function development (QFD) methodology is used to build a four-stage transformation mechanism: the original user demand is transformed into technical parameters, the technical parameters are decomposed into process control points, and the process points are ultimately mapped into inspection standards,

forming a non-destructive demand conduction chain between the market side and the manufacturing side. To address the faults in quality data circulation, build a data coherence program based on the Industrial Internet Identification and Resolution System: key change commands automatically trigger the update of the digital twin, and version change records are synchronized and written into the safety audit database to ensure that the quality records of the whole process are traceable and tamper-proof. At the user response level, a cross-departmental closed-loop mechanism is established, which sets the positioning of the responsible department within two hours after the acceptance of the complaint, convenes a joint meeting for root cause analysis within 24 hours, and submits an improvement plan to the user within 72 hours, to crack the stubborn problem of departmental shirking through the process of mandatory time constraints. The home appliance industry practice shows that the mechanism shortens the repeated complaints processing cycle by sixty percent.

3.3 Behavioral intervention system

Behavioral change requires reconstructing departmental value recognition and knowledge-sharing mechanisms. Implement departmental bundled assessment of quality performance, incorporate core indicators such as the first inspection pass rate of new products and the market return rate into the KPI system of R&D, manufacturing and quality departments at the same time, and set up a special incentive fund for cross-departmental quality research, to make the departmental interests form a symbiotic relationship with the overall quality goals. Develop an enterprise-level knowledge mapping system that analyzes unstructured data, such as historical failure reports and maintenance cases, using natural language processing technology. This system automatically builds an association network of failure modes and solutions, enabling the explicit and structured storage of implicit experience. Simultaneously carry out immersive quality sandbox training, simulate abnormal production line shutdowns, user batch claims, and other stressful scenarios, requiring cross-departmental teams to collaborate to formulate disposal plans under limited information conditions, and mandatory role rotation in training to eliminate departmental proprietary thinking. Following the implementation of the system in semiconductor companies, the rate of cross-departmental knowledge sharing about quality has increased significantly.

4 Conclusion

The study of cross-departmental quality co-management mechanisms of matrix organizations reveals the inherent contradiction of quality governance under the dual command system. The blurring of authority and responsibility boundaries, process disconnection, and misalignment of behavioral motives constitute the triple systemic obstacles to quality effectiveness, which is essentially the failure of organizational design to adapt to the dynamic needs of systemic risk prevention and control. The integrated governance framework proposed in this study enables the structured configuration of rights and responsibilities through a three-dimensional responsibility matrix, addresses process timing blind spots by leveraging the industrial Internet identification system and digital twin technology, and reconstructs the logic of collaborative behaviors with the aid of bundled assessment and knowledge mapping. These three dimensions of intervention form a mutually reinforcing governance closed loop: the definition of responsibility provides a systematic basis for process reengineering, data transparency creates technical conditions for behavioral change, and incentive mechanism injects sustained power for structural optimization. This systematic governance path not only resolves quality compromises caused by conflicting departmental goals but also propels the enterprise from passive defect repair to proactive value creation, ultimately realizing strategic returns through the cultivation of user loyalty and the construction of asymmetric competitive advantages. Future research should further explore how this framework can be adapted for use in a globalized and distributed organization.

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