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Research on the Influence Mechanism of Cross-Departmental Collaboration in Technology Development on Enterprise Operation Efficiency

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Abstract: This study examines the influence of cross-departmental collaboration on enterprise operational efficiency in the context of digital transformation, using Shandong Longli Electronics Co., Ltd. as a case. Based on contingency theory and lean manufacturing theory, a descriptive-predictive quantitative design was adopted, with data collected from 60 managers and analyzed using descriptive statistics and regression analysis. The results show that collaboration effectiveness and efficiency are generally high, with leadership–member relationships and organizational coordination as key strengths. However, organizational structure and transactional processes remain major bottlenecks. The findings indicate that collaboration effectiveness and efficiency jointly enhance collaboration productivity, thereby improving operational efficiency. The study recommends structural optimization, process improvement, and system enhancement to strengthen cross-departmental collaboration.

Keywords: Cross-departmental collaboration; Operational efficiency; Collaboration effectiveness; Collaboration efficiency; Manufacturing enterprises.

1. Introduction

In the context of global digital transformation, enterprises are increasingly shifting from isolated competition toward system-level efficiency and collaborative advantage. Digital technologies such as big data, artificial intelligence, and the Internet of Things have reshaped traditional value chains into dynamic, networked systems requiring real-time coordination across departments [1-3]. However, despite rapid digital adoption, many manufacturing enterprises still struggle to translate technological innovation into operational efficiency due to weak cross-departmental collaboration mechanisms.

In high-end manufacturing industries such as power electronics, product development requires high precision, customization, and rapid iteration cycles. Traditional sequential workflows are no longer sufficient to meet market demands, making cross-departmental collaboration a determinant of enterprise performance [4-5]. However, common issues such as information silos, misaligned goals, and inefficient resource allocation persist, significantly reducing innovation conversion rates and operational efficiency [6-8].

Existing studies have explored collaboration between specific departments, but they fail to capture the complexity of multi-departmental collaboration networks in modern enterprises [9-10]. Moreover, prior research lacks a systematic framework integrating collaboration effectiveness, efficiency, and productivity, and rarely considers industry-specific contexts such as power electronics manufacturing.

To address these gaps, this study focuses on Shandong Longli Electronics Co., Ltd. and constructs a theoretical framework integrating contingency theory and lean manufacturing theory. It aims to examine how cross-departmental collaboration effectiveness and efficiency influence collaboration productivity, thereby affecting enterprise operational efficiency.

2. Methodology

This study adopts a descriptive-predictive quantitative research design to examine the influence mechanism of cross-departmental collaboration on enterprise operational efficiency. The design integrates both descriptive and predictive approaches, enabling the study to first assess the current levels of collaboration effectiveness, efficiency, and productivity within the organization, and subsequently analyze the relationships among these variables. This dual approach ensures that the research not only captures the existing conditions of collaboration practices but also rigorously tests the predictive effects of collaboration dimensions on productivity outcomes.

The research was conducted at Shandong Longli Electronics Co., Ltd., with the target population consisting of managers and supervisors across key functional departments, including research and development, production, marketing, sales, supply chain, quality, finance, and human resources. These respondents were selected because of their direct involvement in cross-departmental collaboration processes, particularly those interacting with the R&D department. A census sampling method was employed, covering all eligible participants ($n = 60$), to eliminate sampling bias and ensure full representation of the population. This approach also satisfies the minimum sample size requirement for multiple linear regression analysis, which recommends at least 10 observations per independent variable.

Data were collected using a structured questionnaire developed based on relevant literature and theoretical foundations. The instrument consists of four main sections, including respondents' demographic information, collaboration effectiveness, collaboration efficiency, and collaboration productivity. Each construct was measured using multiple indicators on a five-point Likert scale. To ensure content validity, the questionnaire items were adapted from established studies and evaluated by experts in organizational behavior and management. Preliminary

interviews with selected respondents were also conducted to refine item clarity and contextual relevance. Reliability testing was performed through a pilot study, and Cronbach's alpha coefficients for all constructs exceeded the acceptable threshold of 0.7, indicating strong internal consistency.

The data collection process followed standardized procedures and adhered to ethical research guidelines. Participation was voluntary, and respondents were assured of confidentiality and anonymity. The collected data were analyzed using statistical techniques, including descriptive statistics to summarize the levels of collaboration variables and multiple linear regression analysis to examine the predictive relationships between collaboration effectiveness, collaboration efficiency, and collaboration productivity. This analytical approach allows for a comprehensive evaluation of both the current collaboration status and the underlying mechanisms influencing enterprise operational efficiency.

3. Result and Discussion

Table 1. Summary of Collaboration Effectiveness

Sub-Dimension	Mean	Description	Interpretation
Leadership–Member Relationship	3.35	Strongly Agree	Very high level of cross-departmental collaboration
Organizational Structure	2.87	Agree	High level of cross-departmental collaboration
System	3.14	Agree	High level of cross-departmental collaboration
Overall Mean	3.12	High	High level of cross-departmental collaboration

Table 1 presents the overall assessment of collaboration effectiveness across three dimensions. The results indicate that the overall level of collaboration effectiveness is high (Mean = 3.12), suggesting that the organization demonstrates a generally strong capacity for cross-departmental collaboration.

Among the dimensions, leadership–member relationship obtained the highest mean (3.35) and was interpreted as very high. This implies that leaders are effective in fostering trust, clarifying goals, and maintaining fairness across departments. This finding supports the perspective of Contingency Theory, which emphasizes that leadership must adapt to complex organizational environments to enhance coordination and reduce interdepartmental conflict.

In contrast, organizational structure recorded the lowest mean (2.87), although still within the high category. This suggests that while collaboration exists, structural limitations may restrict flexibility and slow down decision-making processes. This aligns with prior research indicating that traditional structures hinder cross-functional integration.

The system dimension (Mean = 3.14) also reflects a high level of effectiveness, indicating that the organization has established relatively functional systems. However, the moderate score suggests room for improvement, particularly in aligning performance evaluation systems with collaboration goals.

Overall, the findings indicate that while interpersonal and system-level factors support collaboration, structural constraints remain a key bottleneck affecting overall effectiveness.

Table 2. Summary of Collaboration Efficiency

Sub-Dimension	Mean	Description	Interpretation
Transactional Processes	2.98	Agree	High level of cross-departmental collaboration efficiency
Organizational Coordination	3.17	Agree	High level of cross-departmental collaboration efficiency
Spatial Arrangement	2.99	Agree	High level of cross-departmental collaboration efficiency
Overall Mean	3.05	Agree	High level of cross-departmental collaboration efficiency

Table 2 summarizes the evaluation of collaboration efficiency across three dimensions. The overall mean score of 3.05 indicates that the organization maintains a high level of collaboration efficiency, although certain inefficiencies persist.

Among the dimensions, organizational coordination achieved the highest mean (3.17), highlighting the effectiveness of coordination mechanisms such as task division, meetings, and communication processes. This suggests that the organization has relatively well-established coordination practices, which facilitate smoother collaboration across departments.

However, transactional processes (Mean = 2.98) and spatial arrangement (Mean = 2.99) scored comparatively lower. These findings indicate inefficiencies in process execution and physical or digital collaboration environments. Specifically, delays in approval processes and fragmented office layouts or outdated collaboration tools may contribute to reduced efficiency. These issues are consistent with lean manufacturing theory, which identifies process waste such as waiting time and inefficient workflows as critical barriers to performance improvement.

The relatively lower scores of these two dimensions suggest that while coordination mechanisms are strong, process optimization and infrastructure support require significant improvement.

Combining the results of collaboration effectiveness and efficiency, several important insights emerge. First, the organization demonstrates a balanced but uneven collaboration system, where interpersonal relationships and coordination mechanisms are strong, but structural and procedural factors lag. Second, the findings confirm that collaboration effectiveness and efficiency are interdependent, as strong leadership and coordination cannot fully compensate for structural rigidity and process inefficiencies.

Furthermore, the results provide empirical support for the study's theoretical framework. From a contingency theory perspective, the mismatch between organizational structure and environmental demands limits collaboration effectiveness. From a lean perspective, inefficiencies in transactional processes and spatial arrangements reflect the presence of operational waste, which reduces overall productivity.

Therefore, improving enterprise operational efficiency

requires not only strengthening leadership and coordination but also systematically optimizing structure, processes, and collaboration infrastructure.

4. Conclusion and Recommendation

This study concludes that cross-departmental collaboration plays a critical role in enhancing enterprise operational efficiency, with Shandong Longli Electronics Co., Ltd. demonstrating generally high levels of collaboration effectiveness and efficiency; however, structural rigidity, inefficient transactional processes, and limitations in spatial and technological support remainconstraints that hinder optimal collaboration outcomes. While strong leadership–member relationships and organizational coordination provide a solid foundation for collaboration, these strengths are insufficient to fully offset inefficiencies embedded in organizational structure and workflow design. Therefore, it is recommended that the company adopt a matrix organizational structure to improve flexibility, streamline approval processes using lean principles to reduce delays, enhance digital collaboration systems for real-time information sharing, and strengthen performance evaluation mechanisms to better incentivize cross-departmental collaboration.

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