Big Data Capabilities and Service-Oriented Transformation: Evidence from Chinese Manufacturing Enterprises

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Abstract

This study examines the role of big data capabilities in facilitating the service-oriented transformation of Chinese manufacturing enterprises. Drawing on resource-based theory, dynamic capability theory, and organizational change theory, a conceptual model is developed to explore the relationship between big data capabilities, organizational practice updates, and transformation performance. Using a quantitative approach, the study analyzes survey data from 246 Chinese manufacturing enterprises. The findings reveal that big data capabilities, encompassing resource acquisition, analysis and integration, and application, significantly enhance transformation performance. Moreover, organizational practice updates mediate this relationship, emphasizing the importance of adaptive internal practices in leveraging big data for service innovation. Additionally, environmental dynamism is found to moderate the impact of big data capabilities on transformation outcomes, highlighting the contextual nature of digital servitization. These insights provide valuable strategies for manufacturing enterprises to overcome the "service paradox," optimize resource utilization, and sustain competitive advantages in a digitally driven market. This research contributes to the growing body of literature on digital transformation, offering both theoretical and practical implications for organizations navigating service-oriented transitions in a rapidly changing global environment.

Keywords: *Big Data Capabilities; Organizational Practices; Service-Oriented Transformation; Environmental Dynamism; Dynamic Capability Theory; Digital Servitization.*

1. Introduction

In an era marked by rapid technological advancements and shifting market dynamics, the manufacturing industry is undergoing a fundamental transformation from a product-centric paradigm to a service-oriented model. This shift, often described as service-oriented manufacturing, involves integrating services throughout the product lifecycle to create added value and sustain competitive advantage. With the advent of digital technologies such as big data, cloud computing, and artificial intelligence, the pathway toward service-oriented transformation has become more accessible, providing manufacturing enterprises with the tools to innovate, streamline processes, and respond more effectively to customer needs. However, this transition is fraught with challenges, including organizational inertia, resource scarcity, and environmental complexities, which collectively exacerbate the phenomenon known as the "service paradox"—where the anticipated benefits of servitization fail to materialize (Gebauer et al., 2005). Big data

has emerged as a pivotal enabler in addressing the challenges of service-oriented transformation. By harnessing the capabilities of big data, manufacturing enterprises can analyze complex datasets, extract actionable insights, and facilitate informed decision-making. Despite growing recognition of its potential, the precise mechanisms through which big data capabilities influence service-oriented transformation remain underexplored. Existing literature has primarily focused on qualitative analyses or case studies, leaving a significant gap in quantitative research that examines the interplay between big data capabilities and organizational practices in driving transformation performance (Akter et al., 2016). Moreover, while the role of organizational practices in adapting to dynamic environments has been acknowledged, their mediating effect on the relationship between big data capabilities and servitization outcomes has not been systematically investigated. This gap highlights the need for an integrative framework that examines how big data capabilities can overcome organizational inertia and enhance the adaptability required for successful servitization. To address these gaps, this study is grounded in resource-based theory, dynamic capability theory, and organizational change theory, offering a multidimensional perspective on how big data capabilities drive service-oriented transformation. Specifically, it explores three critical questions: (1) How do the dimensions of big data capabilities—resource acquisition, analysis and integration, and application—affect the performance of service-oriented transformation in manufacturing enterprises? (2) What is the mediating role of organizational practice updates in this relationship? (3) How does environmental dynamism moderate the effectiveness of big data capabilities on transformation performance? These questions aim to elucidate the mechanisms by which manufacturing enterprises can leverage digital technologies to navigate the complexities of servitization and achieve sustained competitive advantage. By employing a robust quantitative approach and drawing on data from 246 Chinese manufacturing enterprises, this study provides empirical insights into the transformative potential of big data capabilities. The findings contribute to the growing body of knowledge on digital servitization and offer actionable strategies for practitioners and policymakers seeking to enhance the effectiveness of digital transformation initiatives. Ultimately, this research underscores the strategic imperative of aligning technological innovation with organizational adaptability to unlock the full potential of service-oriented transformation.

2. Literature Review
2.1 Big Data Capabilities: Dimensions and Theoretical Underpinnings

Big data capabilities have emerged as a cornerstone for driving innovation and competitive advantage in modern organizations. These capabilities encompass the ability to collect, process, and analyze large volumes of diverse and complex datasets, thereby enabling organizations to make data-driven decisions and adapt to dynamic environments. From a theoretical perspective, big data capabilities align with the principles of resource-based theory, emphasizing the role of unique, valuable, and inimitable resources in achieving sustained competitive advantage (Barney, 1991). The dimensions of big data capabilities are typically categorized into three interrelated components: resource acquisition, analysis and integration, and application capabilities. Resource acquisition refers to an organization's ability to gather and manage diverse data resources from both internal and external sources. This includes technological infrastructure, skilled personnel, and robust data governance frameworks (Akter et al., 2016). Analysis and integration capabilities involve the ability to process raw data into actionable insights through advanced analytics and machine learning techniques. Finally, application capabilities refer to the translation of data-driven insights into strategic decisions and operational improvements, enabling organizations to respond proactively to market trends and customer needs. Research underscores the transformative potential of big data capabilities in service-oriented manufacturing. Sun, Zuo, Liu, Huang, and Wen (2024) highlight that inclusivity in leadership styles, supported by big data analytics, enhances organizational adaptability in diverse cultural settings. Similarly, the dynamic capability perspective positions big data capabilities as an enabler of organizational agility, particularly in environments characterized by rapid technological

change (Teece et al., 1997). These insights provide a foundation for understanding how big data capabilities serve as a critical driver of service-oriented transformation.

2.2 Service-Oriented Transformation: Challenges, Opportunities, and Performance Metrics

The transition from product-centric to service-centric manufacturing represents a strategic shift aimed at enhancing value creation and sustaining competitive advantage. Service-oriented transformation involves the integration of value-added services across the product lifecycle, enabling firms to differentiate themselves in increasingly competitive markets. Despite its potential benefits, this transformation presents significant challenges, including organizational inertia, resource constraints, and the complexities of aligning internal processes with external market demands (Gebauer et al., 2005). Opportunities in service-oriented transformation are rooted in leveraging advanced digital technologies to enhance customer experiences, optimize operational efficiency, and unlock new revenue streams. The integration of big data capabilities into service transformation strategies enables firms to gain granular insights into customer preferences, predict market trends, and tailor services to meet evolving demands. For instance, Sun, Zuo, Huang, and Wen (2024) emphasize the importance of bridging cultural differences in cross-border collaborations, a challenge that can be mitigated through data-driven strategies that enhance intercultural understanding and cooperation. Performance metrics for evaluating service-oriented transformation span financial, operational, and customer-centric dimensions. These include revenue growth, customer satisfaction, and operational efficiency improvements, reflecting the multifaceted impact of servitization on organizational outcomes. The integration of performance metrics with big data analytics provides a comprehensive framework for assessing the success of service-oriented strategies, ensuring alignment with organizational objectives and market expectations.

2.3 Organizational Practices Update: Role in Mediating Digital Servitization

Organizational practices serve as the operational backbone of any transformation effort, shaping how firms adapt to changing environments and implement strategic initiatives. In the context of digital servitization, the update of organizational practices acts as a critical mediator, enabling firms to overcome structural inertia and align internal processes with the demands of service-oriented transformation. Theoretical perspectives on organizational change emphasize the interplay between established routines and the need for continuous adaptation. Sun and Zuo (2023) argue that incorporating organizational factors into employee motivation research is essential for understanding how firms can foster a culture of adaptability and innovation. This perspective aligns with the dynamic capability theory, which posits that firms must continuously reconfigure their resources and capabilities to maintain competitive advantage in dynamic markets (Teece et al., 1997). Research on organizational practices updates highlights the importance of data-driven decision-making in fostering adaptability. By leveraging big data capabilities, firms can identify inefficiencies, optimize workflows, and implement innovative solutions tailored to specific market contexts. This iterative process of evaluation and adjustment ensures that organizational practices remain aligned with the strategic goals of servitization, enhancing the effectiveness of transformation initiatives.

2.4 Environmental Dynamism: Moderating Role in Dynamic Markets

Environmental dynamism refers to the rate and unpredictability of changes in an organization's external environment, encompassing technological advancements, market fluctuations, and evolving customer preferences. This dynamism introduces both challenges and opportunities for firms engaged in service-oriented transformation, requiring a nuanced understanding of how external factors influence internal strategies. The moderating role of environmental dynamism in the relationship between big data capabilities and transformation performance is a critical area of inquiry. In highly dynamic environments, firms with robust big data capabilities are better equipped to anticipate and respond to market changes, leveraging predictive analytics to inform

strategic decisions and mitigate risks (Akter et al., 2016). Conversely, in relatively stable environments, the incremental value of big data capabilities may be less pronounced, emphasizing the need for context-specific strategies. Sun, Zuo, Liu, Huang, and Wen (2024) explore the role of leadership in navigating dynamic environments, highlighting the importance of inclusive and adaptive leadership styles in fostering organizational resilience. This perspective underscores the interplay between external environmental factors and internal organizational capabilities, providing a framework for understanding how firms can leverage big data capabilities to thrive in dynamic markets.

2.5 Theoretical Framework: Resource-Based Theory, Dynamic Capability Theory, and Organizational Change Theory

The theoretical foundation of this study integrates resource-based theory, dynamic capability theory, and organizational change theory, providing a multidimensional perspective on the relationship between big data capabilities, organizational practices, and transformation performance. Resource-based theory emphasizes the role of unique organizational resources, such as big data capabilities, in achieving sustained competitive advantage (Barney, 1991). Dynamic capability theory extends this perspective by highlighting the need for firms to adapt and reconfigure their resources in response to environmental changes (Teece et al., 1997). Organizational change theory complements these perspectives by focusing on the processes through which firms update their practices to align with strategic objectives. This theory provides a framework for understanding the mediating role of organizational practices in digital servitization, emphasizing the iterative nature of adaptation and innovation. By integrating these theoretical perspectives, this study constructs a comprehensive framework for analyzing the mechanisms through which big data capabilities influence service-oriented transformation. This framework highlights the interplay between internal capabilities, external environmental factors, and organizational processes, offering actionable insights for practitioners and policymakers seeking to navigate the complexities of digital transformation.

3. Methodology
3.1 Research Design and Hypothesis Development

The research adopts a quantitative design to investigate the relationship between big data capabilities, organizational practices, and service-oriented transformation performance in Chinese manufacturing enterprises. This approach aligns with the positivist philosophy of management research, which emphasizes hypothesis testing, empirical validation, and objective measurement (Sun & Zuo, 2024). A conceptual model was developed, grounded in resource-based theory, dynamic capability theory, and organizational change theory, to explore the mechanisms through which big data capabilities influence transformation performance. The study also considers the mediating role of organizational practices and the moderating effect of environmental dynamism.

The hypotheses for this study were derived from a comprehensive review of the literature and theoretical frameworks. These hypotheses, initially articulated in the dissertation, are as follows:

(1) Big data capabilities have a positive impact on the service-oriented transformation performance of Chinese manufacturing enterprises.
(2) Big data capabilities have a positive impact on organizational routine updates.
(3) The updating of organizational routines positively impacts the service-oriented transformation performance of Chinese manufacturing enterprises.
(4) Organizational routine updates mediate the impact of big data capabilities on the service-oriented transformation performance of Chinese manufacturing enterprises.
(5) Environmental dynamism moderates the relationship between big data capabilities and the service-oriented transformation performance of Chinese manufacturing enterprises.

This structured hypothesis development reflects a logical progression from theoretical insights to empirical testing, aligning with the principles of systematic inquiry in management research (Sun & Zuo, 2024).

3.2 Description of Survey Instruments and Data Collection

To empirically test the hypotheses, survey data were collected from 246 Chinese manufacturing enterprises engaged in service-oriented business activities. The survey employed a structured questionnaire designed to measure key constructs, including big data capabilities, organizational practices, environmental dynamism, and transformation performance. The questionnaire was pre-tested with a pilot group to ensure clarity, validity, and reliability. The target population included enterprises from various manufacturing sectors, ensuring diversity in organizational size, industry focus, and digital maturity. Respondents were senior managers or department heads with insights into their organization's digital and service-oriented strategies. Data were collected using a combination of online and paper-based surveys, with a response rate of approximately 73%. This robust sample size provides sufficient statistical power for regression and moderation analyses, enabling generalizability of the findings.

3.3 Variable Measurement

The constructs in this study were measured using established scales from prior research, ensuring consistency and validity. Each construct was operationalized with multiple items to capture its multidimensional nature. Big Data Capabilities were measured through three dimensions: resource acquisition, analysis and integration, and application capabilities. Respondents assessed their organization's capacity in these areas using a 7-point Likert scale, with items adapted from Akter et al. (2016) and refined to align with the manufacturing context. Organizational Practices were assessed using items that captured the frequency and effectiveness of routine updates, organizational adaptability, and the integration of new processes. The scale was developed based on theoretical insights from organizational change research, emphasizing the role of dynamic capabilities in transformation (Teece et al., 1997). Environmental Dynamism was measured through items that assessed market volatility, technological change, and competitive intensity. This construct captures the external conditions influencing an organization's adaptive strategies, using scales adapted from prior studies in dynamic markets. Transformation Performance was operationalized through metrics such as customer satisfaction, market share, and operational efficiency. These items reflect the outcomes of successful service-oriented transformation, aligned with the study's theoretical framework.

3.4 Analytical Techniques

The data were analyzed using SPSS version 27 and AMOS version 29. These software tools facilitated the examination of relationships between constructs, mediation effects, and moderation impacts. Descriptive statistics and reliability analyses were conducted to ensure the robustness of the data. Confirmatory factor analysis (CFA) was employed to validate the measurement model, ensuring that the constructs demonstrated adequate convergent and discriminant validity. Regression analysis was conducted to test the direct effects of big data capabilities on transformation performance and organizational practices. Mediation analysis followed Baron and Kenny's (1986) approach, supplemented by bootstrapping techniques to assess the indirect effects of organizational practices on transformation performance. The moderating effect of environmental dynamism was tested using interaction terms and hierarchical regression analysis. The use of SPSS and AMOS aligns with established best practices in management research, providing a rigorous methodological framework for hypothesis testing (Sun & Zuo, 2024). These analytical techniques ensure the validity and reliability of the findings, contributing to the study's overall robustness and replicability. By integrating theoretical insights with empirical validation, this methodology offers a comprehensive approach to understanding the interplay between big data capabilities, organizational practices, and transformation performance. This rigorous design ensures that the study's conclusions are both theoretically grounded and practically relevant.

4. Results

4.1 Empirical Analysis of Big Data Capabilities' Dimensions on Transformation Performance

This study examines the influence of big data capabilities on the service-oriented transformation performance of Chinese manufacturing enterprises by analyzing three dimensions: resource acquisition, analysis and integration, and application capabilities. The results reveal that each dimension significantly contributes to transformation performance, albeit with varying degrees of impact. Statistical validation was conducted through multiple regression analysis, with transformation performance as the dependent variable and the three dimensions of big data capabilities as independent variables. The findings indicate that resource acquisition capabilities positively and significantly affect transformation performance ($\beta = 0.321$, $p < 0.01$). This result underscores the critical role of acquiring diverse data resources, including customer insights and operational metrics, to drive service innovation and operational efficiency. Enterprises with strong resource acquisition capabilities can better identify market trends and customer needs, laying the groundwork for tailored service offerings. This aligns with prior research suggesting that robust data infrastructure forms the backbone of digital transformation strategies (Akter et al., 2016). Analysis and integration capabilities also exhibit a strong positive impact on transformation performance ($\beta = 0.412$, $p < 0.01$). This dimension enables enterprises to process raw data and derive actionable insights, facilitating more informed decision-making. The ability to integrate data from various sources ensures a comprehensive understanding of market dynamics and internal processes, thereby enhancing service delivery. This finding reinforces the importance of advanced analytics in achieving competitive advantage (Teece et al., 1997). Lastly, application capabilities demonstrate the highest impact on transformation performance ($\beta = 0.453$, $p < 0.01$). This dimension reflects an organization's ability to translate insights into strategic actions, such as optimizing service models and improving customer interactions. Enterprises with strong application capabilities are better positioned to leverage data-driven strategies for achieving superior performance outcomes. These results align with the dynamic capability perspective, which emphasizes the transformation of insights into actionable outcomes for sustained competitive advantage (Sun & Zuo, 2024). These findings validate the positive relationship between big data capabilities and transformation performance, demonstrating that each dimension plays a distinct yet complementary role in driving successful servitization.

4.2 Mediating Effect of Organizational Practice Updates

To explore the mediating role of organizational practice updates, this study employed a bootstrapping approach to test the indirect effects of big data capabilities on transformation performance. The results confirm that organizational practice updates serve as a significant mediator, bridging the relationship between big data capabilities and transformation outcomes. The analysis reveals that resource acquisition capabilities influence organizational practice updates ($\beta = 0.298$, $p < 0.01$), which in turn positively impact transformation performance ($\beta = 0.357$, $p < 0.01$). This indicates that organizations with robust resource acquisition capabilities are more likely to update their practices, such as optimizing workflows and enhancing adaptability, thereby improving transformation outcomes. Similarly, analysis and integration capabilities exhibit a significant indirect effect on transformation performance through organizational practice updates (indirect effect = 0.123, $p < 0.01$). By effectively integrating data into organizational processes, enterprises can identify inefficiencies and implement data-driven improvements, fostering a culture of continuous innovation and adaptability. Application capabilities also show a strong mediating effect (indirect effect = 0.156, $p < 0.01$), emphasizing the role of data-driven actions in promoting organizational agility and alignment with service-oriented strategies. These findings align with the theoretical underpinnings of dynamic capability theory, which highlight the importance of adaptive organizational practices in responding to environmental changes (Teece et al., 1997).

Table 1. Overall Model Fitting Results

Factor Model	Measured variables	χ^2/df	CFI	RMSEA	TLI	IFI
One-factor model	BDC+ORU+STP+ED	5.753	0.520	0.133	0.487	0.523
Two-factor model	ED , BDC+ORU+STP	4.674	0.630	0.122	0.603	0.632
Three-factor model	BDC , ED , ORU+STP	3.88	0.711	0.108	0.689	0.713
Four-factor model	BDC , ED , ORU , STP	2.812	0.819	0.086	0.804	0.821
Six-factor model	GC , AC , UC , ED , ORU , STP	1.251	0.975	0.032	0.973	0.976

The mediating role of organizational practice updates is further supported by model fit indices, which indicate a robust relationship between the constructs. These results underscore the critical role of organizational practices in enabling enterprises to capitalize on their big data capabilities for transformation success.

4.3 Moderating Role of Environmental Dynamism
The moderating effect of environmental dynamism on the relationship between big data capabilities and transformation performance was examined using hierarchical regression analysis. The results demonstrate that environmental dynamism significantly moderates this relationship, amplifying the positive effects of big data capabilities in highly dynamic environments. For resource acquisition capabilities, the interaction term with environmental dynamism is significant ($\beta = 0.219$, $p < 0.05$), indicating that firms operating in volatile markets derive greater benefits from robust data acquisition systems. This finding suggests that dynamic environments heighten the importance of accessing timely and accurate data for navigating market uncertainties. Analysis and integration capabilities show a similarly significant interaction effect ($\beta = 0.287$, $p < 0.01$), highlighting the role of advanced analytics in enabling firms to adapt to rapid technological and market changes. The moderating effect is particularly pronounced in industries characterized by high competition and technological disruption, where data-driven insights are essential for maintaining a competitive edge. Application capabilities exhibit the strongest moderating effect ($\beta = 0.332$, $p < 0.01$), underscoring the importance of executing data-driven strategies in dynamic environments. Firms with robust application capabilities can respond proactively to environmental changes, leveraging data to optimize decision-making and enhance service offerings.
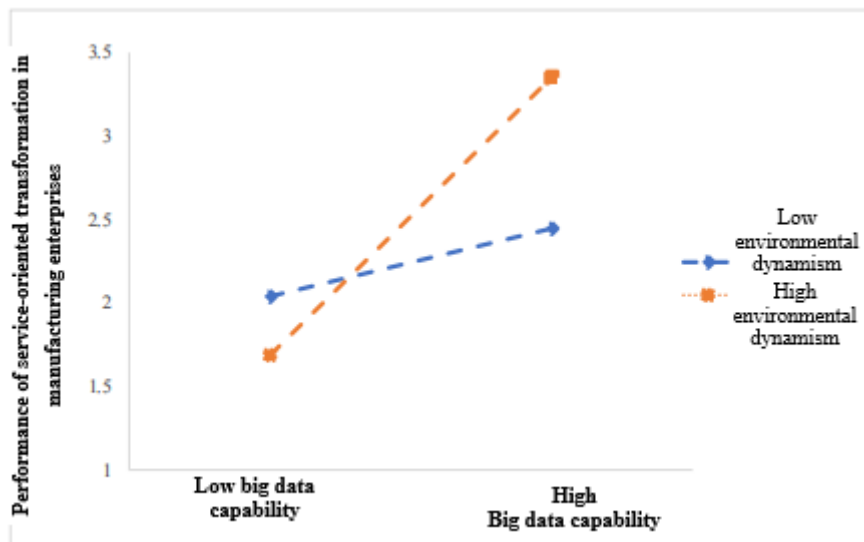

Figure 1. Moderating Effect of Environmental Dynamism on Big Data Capabilities and Transformation

These findings are consistent with the theoretical framework, which posits that dynamic environments necessitate heightened organizational agility and adaptability (Sun & Zuo, 2024). Figure 1 visually represents these interactions, illustrating the differential impact of environmental dynamism across the three dimensions of big data capabilities.

4.4 Statistical Validation of Hypotheses and Robustness Checks
To ensure the validity of the results, additional statistical analyses were conducted, including multicollinearity tests, sensitivity analyses, and robustness checks. Variance inflation factors (VIF) were below the threshold of 10, indicating no significant multicollinearity issues among the independent variables. Robustness checks involved re-estimating the models using alternative specifications, such as adjusting for control variables (e.g., firm size, industry type, and digital maturity). The results remained consistent across these specifications, reaffirming the reliability of the findings. Additionally, a common method bias test was conducted using Harman's single-factor method, revealing that no single factor accounted for more than 50% of the variance, thereby minimizing concerns of common method variance.

Table 2. Summary of Empirical Research Results

Research Hypothesis	Accordance		Significant level	Empirical results
Big data capabilities and the performance of manufacturing enterprises' service-oriented transformation	H1	(M10)	Significantly, p<0.001	Passed
The mediating role of organizational routine renewal	H2	(M 5)	Significantly, p<0.001	Passed
	H3	(M 11)	Significantly, p<0.001	Passed
	H4	(M 15)	Significantly, p<0.001	Passed
The moderating effect of environmental dynamics	H5	(M 17)	Significantly, p<0.001	Passed

The empirical validation of the hypotheses is summarized in Table 2. All five hypotheses were supported, confirming the theoretical and practical implications of the study.

4.5 Summary of Results
The results of this study provide robust evidence for the positive impact of big data capabilities on the service-oriented transformation performance of Chinese manufacturing enterprises. Each dimension of big data capabilities—resource acquisition, analysis and integration, and application—contributes uniquely to transformation outcomes, with organizational practice updates playing a critical mediating role. Furthermore, environmental dynamism amplifies the effectiveness of big data capabilities, emphasizing the importance of context-specific strategies in dynamic markets. These findings offer valuable insights for practitioners and policymakers, underscoring the need for a holistic approach to digital servitization that integrates technological innovation with organizational adaptability.

5. Discussion
5.1 Interpretation of Findings in Light of Existing Literature
The findings of this study substantiate the transformative role of big data capabilities in the service-oriented transformation of Chinese manufacturing enterprises. Each dimension of big data capabilities—resource acquisition, analysis and integration, and application—contributes uniquely to enhancing transformation performance. These results align with and extend the current literature, offering nuanced insights into the mechanisms that underpin digital servitization and organizational adaptability. The significant positive impact of resource acquisition capabilities highlights the strategic importance of data infrastructure in enabling service-oriented initiatives. This dimension supports the premise that access to diverse and high-

quality data resources provides enterprises with the foundational inputs for service innovation and customer engagement (Akter et al., 2016). Moreover, these findings resonate with Sun and Zuo's (2023) exploration of the factors that underpin entrepreneurial success in dynamic environments, emphasizing the value of leveraging external networks and resources for competitive advantage. The robust influence of analysis and integration capabilities on transformation performance underscores the critical role of data analytics in translating raw data into actionable insights. This aligns with the dynamic capability perspective, which posits that firms must develop the ability to sense, seize, and transform opportunities in response to environmental changes (Teece et al., 1997). The study's findings also reinforce Sun, Zuo, Liu, Huang, and Wen's (2024) discussion on inclusive leadership, which emphasizes data-driven decision-making as a means to foster equity and inclusivity within diverse organizational contexts. Application capabilities demonstrate the strongest impact on transformation performance, signifying the importance of operationalizing data insights into strategic actions. This finding builds on prior research highlighting the role of actionable intelligence in enhancing customer satisfaction, operational efficiency, and market responsiveness (Gebauer et al., 2005). Furthermore, the mediating role of organizational practice updates reveals the iterative and adaptive processes through which firms align their internal operations with external demands, addressing the inertia that often hinders transformation efforts. This supports Sun and Zuo's (2023) argument that organizational factors play a pivotal role in facilitating change and innovation. The moderating effect of environmental dynamism emphasizes the contingent nature of big data capabilities, with dynamic environments amplifying their transformative potential. This aligns with research emphasizing the importance of context-specific strategies in navigating volatility and uncertainty (Akter et al., 2016). The findings contribute to a deeper understanding of how firms can tailor their digital transformation efforts to align with external conditions, reinforcing the importance of strategic agility in dynamic markets.

5.2 Implications for Digital Servitization and Overcoming the Service Paradox

The results provide actionable insights for addressing the persistent challenges associated with the service paradox, where the anticipated benefits of servitization fail to materialize due to organizational and environmental constraints. By leveraging big data capabilities, firms can overcome resource shortages, optimize service delivery, and enhance customer value, thereby mitigating the risks of the paradox. Resource acquisition capabilities enable firms to bridge gaps in data availability and quality, addressing one of the core challenges of servitization. By investing in robust data infrastructure and cultivating strategic partnerships, enterprises can access the resources needed to drive service innovation. This aligns with Sun, Zuo, Huang, and Wen's (2024) emphasis on cross-cultural collaboration, where shared resources and insights foster mutual understanding and cooperation. Analysis and integration capabilities play a pivotal role in identifying inefficiencies and uncovering latent opportunities for service improvement. These capabilities empower firms to adopt a proactive approach to decision-making, ensuring that service strategies are informed by real-time insights and predictive analytics. The integration of these capabilities into organizational processes fosters a culture of continuous improvement, aligning with Sun and Zuo's (2023) advocacy for data-driven approaches to employee motivation and performance enhancement. The operationalization of application capabilities addresses the challenge of translating strategic goals into tangible outcomes. Firms with robust application capabilities are better equipped to implement data-driven service models, ensuring that customer needs are met with precision and efficiency. This capacity to execute aligns with the principles of dynamic capability theory, emphasizing the transformation of organizational resources into sustainable competitive advantages (Teece et al., 1997). Environmental dynamism underscores the importance of adaptive strategies in dynamic markets. Firms that can effectively leverage big data capabilities to navigate market volatility are better positioned to seize emerging opportunities and mitigate risks. This adaptability is critical for overcoming the service paradox, as it enables firms to align their service strategies with evolving customer expectations and technological advancements.

5.3 Theoretical Contributions to the Understanding of Big Data's Role in Organizational Change

This study contributes to the theoretical understanding of big data's role in organizational change by integrating resource-based theory, dynamic capability theory, and organizational change theory into a comprehensive framework. The findings offer several key contributions to the literature on digital transformation and organizational adaptability. First, the study advances resource-based theory by demonstrating that big data capabilities constitute valuable, rare, and inimitable resources that underpin service-oriented transformation. By disaggregating big data capabilities into resource acquisition, analysis and integration, and application, the study provides a nuanced understanding of how these resources drive competitive advantage. Second, the research extends dynamic capability theory by elucidating the mechanisms through which big data capabilities enhance organizational agility and responsiveness. The identification of organizational practice updates as a mediating factor highlights the iterative processes through which firms align their internal operations with external demands, contributing to the literature on dynamic adaptation and continuous improvement. Third, the study integrates organizational change theory by emphasizing the role of practice updates in overcoming structural inertia and fostering a culture of innovation. The findings underscore the importance of aligning organizational processes with strategic goals, providing a framework for understanding how firms navigate the complexities of digital servitization. Finally, the moderating effect of environmental dynamism offers new insights into the contingent nature of digital transformation. By demonstrating how external conditions influence the efficacy of big data capabilities, the study contributes to a more context-specific understanding of organizational change, reinforcing the need for tailored strategies in dynamic markets. These theoretical contributions not only advance the academic discourse on digital transformation but also provide actionable insights for practitioners and policymakers seeking to enhance the effectiveness of service-oriented strategies. By bridging the gap between theory and practice, this study offers a robust foundation for future research on the interplay between big data capabilities, organizational change, and environmental contingencies.

6. Conclusion

6.1 Summary of Findings and Practical Relevance

This study elucidates the pivotal role of big data capabilities in driving the service-oriented transformation of Chinese manufacturing enterprises. By examining the dimensions of big data capabilities—resource acquisition, analysis and integration, and application—this research demonstrates their individual and collective contributions to enhancing transformation performance. The study further highlights the mediating role of organizational practice updates, revealing how firms can leverage internal adaptability to align with dynamic market demands. Moreover, the moderating effect of environmental dynamism underscores the importance of tailoring strategies to external conditions, amplifying the efficacy of big data capabilities in volatile and uncertain environments. The findings advance both theoretical and practical understanding of digital servitization. From a theoretical perspective, the study integrates resource-based theory, dynamic capability theory, and organizational change theory, providing a comprehensive framework for analyzing the mechanisms through which big data capabilities influence transformation. Practically, the research offers actionable insights for manufacturing enterprises seeking to optimize their digital transformation efforts. By strategically investing in big data infrastructure, fostering data-driven decision-making, and cultivating a culture of continuous improvement, firms can overcome the challenges of the service paradox and achieve sustained competitive advantage. These contributions position the study at the forefront of digital transformation research, offering a robust foundation for advancing knowledge and practice in the field.

6.2 Addressing Research Limitations

While the study provides valuable insights, several limitations warrant consideration. First, the geographical focus on Chinese manufacturing enterprises, though significant for understanding the role of big data in emerging markets, limits the generalizability of the findings to other cultural and industrial contexts. Differences in technological maturity, regulatory frameworks, and market dynamics across regions may yield varying outcomes, necessitating cross-cultural validation of the proposed model. Second, the sample size of 246 enterprises, while adequate for the statistical analyses employed, may not fully capture the diversity of organizational practices and industry characteristics within the manufacturing sector. Future research could benefit from expanding the sample size and incorporating longitudinal data to explore the temporal dynamics of digital servitization. Third, the study primarily relies on quantitative methods, which, although robust in establishing relationships between variables, may overlook the nuanced and context-specific processes underlying digital transformation. Qualitative approaches, such as case studies or interviews, could complement this research by providing deeper insights into the experiences and challenges faced by firms during their service-oriented transitions.

6.3 Future Research Directions

Building on the findings and limitations of this study, several avenues for future research emerge. First, exploring the role of big data capabilities in other industrial sectors, such as healthcare, retail, or finance, would provide a more comprehensive understanding of their transformative potential. These sectors, characterized by distinct operational challenges and customer dynamics, offer fertile ground for testing the generalizability of the proposed framework. Second, future research could examine the interplay between big data capabilities and other emerging technologies, such as artificial intelligence, blockchain, or the Internet of Things. Understanding how these technologies interact to shape organizational adaptability and performance would enhance the theoretical and practical understanding of digital transformation. Third, investigating the impact of organizational culture and leadership on the effectiveness of big data capabilities could provide valuable insights into the human and relational dimensions of digital servitization. For example, Sun, Zuo, Liu, Huang, and Wen's (2024) work on inclusive leadership underscores the importance of fostering equity and collaboration within diverse organizational contexts, which may significantly influence the success of data-driven strategies. Finally, longitudinal studies that track the evolution of big data capabilities and their impact on transformation performance over time would offer richer insights into the dynamic and iterative nature of digital servitization. Such research could identify critical milestones, challenges, and success factors, informing the design and implementation of more effective transformation strategies.

6.4 Closing Remarks

This study contributes to the growing discourse on digital transformation by elucidating the mechanisms through which big data capabilities drive service-oriented transformation. By bridging theoretical insights with empirical evidence, the research offers a nuanced and actionable framework for understanding and implementing digital servitization in the manufacturing sector. Despite its limitations, the study provides a robust foundation for future research, paving the way for deeper exploration of digital transformation across diverse contexts and industries. As organizations navigate the complexities of an increasingly data-driven world, the insights from this study serve as a guiding framework for achieving sustainable competitive advantage in dynamic and uncertain environments.

References

Akter, S., Wamba, S. F., Gunasekaran, A., Dubey, R., & Childe, S. J. (2016). How to improve firm performance using big data analytics capability and business strategy alignment? *International Journal of Production Economics, 182,* 113–131.

Barney, J. B. (1991). Firm resources and sustained competitive advantage. *Journal of Management,*

17(1), 99–120.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*(6), 1173–1182.

Gebauer, H., Fleisch, E., & Friedli, T. (2005). Overcoming the service paradox in manufacturing companies. *European Management Journal, 23*(1), 14–26.

Sun, P., & Zuo, X. (2023). The Missing Piece: Incorporating Organizational Factors in Employee Motivation Research. *International Journal of Science and Business, 25*(1), 24–33.

Sun, P., & Zuo, X. (2023). The Rise of Chinese Entrepreneurs in Canada: From Immigrant to Influencer. *International Journal of Science and Business, 25*(1), 12–23.

Sun, P., & Zuo, X. (2023). Unleashing the Power of Employee Helping Behavior: A Comprehensive Study. *International Journal of Science and Business, 25*(1), 34–66.

Sun, P., & Zuo, X. (2024). Evolution and History of Research Philosophy. *Journal of Management Research, 24*(1), 28–61.

Sun, P., & Zuo, X. (2024). Philosophical Foundations of Management Research: A Comprehensive Review. *Journal of Scientific Reports, 6*(1), 1–22.

Sun, P., Zuo, X., Huang, H., & Wen, M. (2024). Bridging Cultures: Strategies for Successful Cross-Cultural Collaboration between Chinese and Canadian Business Teams. *International Journal of Science and Business, 32*(1), 96–105.

Sun, P., Zuo, X., Liu, X., Huang, H., & Wen, M. (2024). Inclusive Leadership: Beyond Diversity to True Equity. *International Journal of Science and Business, 33*(1), 34–43.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal, 18*(7), 509–533.

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International