



The Role of Future Computing Technology in Business Management

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ARTICLE INFO

Keywords:

Future Computing
Technologies; Quantum
Computing; Edge Analytics;
Agentic Artificial
Intelligence; Business
Management Performance

Received: Feb, 12, 2026

Accepted: Apr, 11, 2026

Published: Jun, 25, 2026

ABSTRACT

The present study explores how emerging computing technologies can help boost business management performance with a particular focus on QC, EA, and AAI. Quantitative exploratory design has been selected, and the data have been gathered from the managers, IT professionals, and decision-makers from the manufacturing industries relying on technology through an organized questionnaire. In total, 223 completed questionnaires were received and further analyzed using SmartPLS 4 (PLS-SEM). Measurement results demonstrated acceptable values of reliability, convergent validity, and discriminant validity of all research constructs. Structural model analysis revealed the statistically significant and positive impact of Quantum Computing on Business Management Performance and the statistically significant positive effect of Edge Analytics. Agentic AI has proven to have the most significant relationship with Business Management Performance. In total, all three emerging technologies can explain 62.4% of the variance in Business Management Performance. Overall, the results suggest that proper and strategic implementation of future computing technologies will help organizations improve their decision-making, operational effectiveness, productivity, innovation, and competitive position. The paper makes a valuable contribution to the existing literature through its integration of the aforementioned three technologies into one theoretical framework.

1. INTRODUCTION

The ongoing evolution of computing technologies is transforming the basic foundations of modern business management and affecting the ways that organizations process information, make decisions, and formulate competitive strategies. As business environments become more complex, organizations are producing unprecedented amounts of data and are under pressure to make decisions faster, more accurately, and more adaptively (Casati, 2020). Traditional computing infrastructures are still required, but are increasingly challenged by the requirements of modern enterprises that operate in highly dynamic and data intensive environments. New computing paradigms such as quantum computing, edge analytics, and agentic artificial intelligence (AI) are

being explored as potentially transformative capabilities that could address these challenges and reshape organizational processes and management practices (Brogi, 2025). Quantum computing offers the potential to address computationally intensive problems, including complex optimization, simulation, and advanced analytics, that remain difficult for classical computing systems to handle efficiently. Edge analytics enhances organizational responsiveness by enabling real-time data processing closer to the point of generation, thereby reducing processing delays and supporting immediate operational decisions (Aljaafari, 2023). Meanwhile, agentic AI represents a shift from conventional AI applications toward autonomous intelligent

systems capable of reasoning, learning, and executing complex tasks with limited human involvement. Together, these technologies represent a new generation of computing capabilities that can support organizations in improving efficiency, innovation, and strategic decision-making.

Although the potential of emerging technologies is widely acknowledged, organizations still encounter considerable difficulties in transforming technological capabilities into tangible management outcomes (Ayoub, 2026). The availability of advanced computing technologies alone does not guarantee improved organizational performance; rather, successful implementation depends on strategic alignment, technological maturity, managerial capabilities, and the ability to integrate these technologies into existing business processes. Previous research has extensively investigated areas such as digital transformation, artificial intelligence adoption, and technological innovation, yet limited scholarly attention has been directed toward examining the collective and individual contributions of quantum computing, edge analytics, and agentic AI within the broader framework of future computing technologies (Brogi, 2025). Existing studies often focus on single technological developments, leaving insufficient understanding of how multiple emerging computing paradigms collectively influence business management performance (Ayoub, 2026). Furthermore, the mechanisms through which these technologies enhance organizational decision-making, operational effectiveness, productivity, and competitive positioning remain underexplored. This research gap is particularly important because organizations require empirical evidence to determine which future computing capabilities provide the greatest strategic value and how these technologies can be effectively incorporated into management practices.

To address this research gap, this study investigates the role of future computing technologies, specifically quantum computing, edge analytics, and agentic AI, in improving business management performance. The study conceptualizes these technologies as key dimensions of future computing capability and examines their individual contributions toward enhancing organizational outcomes. By adopting an integrated perspective, this research extends

existing discussions on digital transformation and technology-enabled management by exploring multiple emerging computing paradigms within a unified framework. The study contributes theoretically by providing deeper insight into the relationship between next-generation computing technologies and organizational performance, while also expanding the understanding of how technological advancement influences modern management practices. From a practical perspective, the findings offer valuable guidance to managers, technology strategists, and policymakers regarding the effective adoption and utilization of future computing technologies. By identifying the strategic relevance of these emerging capabilities, the research supports organizations in developing intelligent, adaptive, and innovation-driven approaches that enhance resilience and sustain competitive advantage in an increasingly digital economy.

2. THEORETICAL FRAMEWORK

This study is theoretically anchored in the Technology–Organization–Environment (TOE) framework and the Resource-Based View (RBV) theory, which together provide a comprehensive explanation of how emerging computing technologies can influence organizational performance. The TOE framework argues that technology adoption and effective utilization are determined by the interaction of technological characteristics, organizational capabilities, and external environmental factors (Aligarh et al., 2025). Within this research context, quantum computing, edge analytics, and agentic artificial intelligence (AI) represent emerging technological capabilities that can provide organizations with enhanced computational power, real-time analytical capabilities, and autonomous decision-support mechanisms. However, the successful realization of these benefits is not solely dependent on the availability of advanced technologies. Instead, organizations must possess the necessary readiness, strategic vision, and managerial capabilities to integrate these technologies into existing business processes. From the TOE perspective, organizations with stronger technological preparedness and better alignment between technological investments and business objectives are more likely to achieve improvements in decision-making effectiveness,

operational efficiency, and competitive performance (Bin-Nashwan et al., 2026). The RBV theory complements the TOE framework by emphasizing that organizational success depends on the development and effective deployment of valuable, rare, and difficult-to-replicate resources. From this perspective, future computing technologies can be viewed as strategic digital resources that enable organizations to build distinctive capabilities and improve management outcomes (Aligarh et al., 2025). Quantum computing may provide organizations with advanced problem-solving capabilities for complex analytical challenges, while edge analytics enables faster decision-making through localized and real-time data processing. Similarly, agentic AI introduces autonomous intelligence that can enhance process automation, adaptive learning, and operational responsiveness. Nevertheless, these technologies create strategic value only when organizations successfully transform technological capabilities into organizational competencies (Rosado et al., 2026). Therefore, this theoretical framework suggests that future computing technologies act as strategic enablers that improve business management performance by strengthening analytical capabilities, accelerating decision processes, and supporting innovation-oriented management practices.

3. LITERATURE REVIEW

The rapid development of future computing technologies has introduced new possibilities for organizations seeking to improve operational capabilities, decision-making processes, and competitive strategies. As digital business environments become increasingly complex, organizations are exploring advanced computing approaches to overcome the limitations of traditional technological infrastructures (Casati, 2020). Among these developments, quantum computing, edge analytics, and agentic artificial intelligence (AI) have emerged as promising technologies with the potential to significantly influence modern business management practices. Quantum computing has received increasing attention because of its ability to address computational problems that remain challenging for classical computing systems (Chakraborty, 2022). By utilizing principles such as quantum parallelism and advanced computational methods,

quantum technologies offer potential advantages in solving complex optimization problems, conducting sophisticated simulations, and analyzing large-scale data structures (Nayak, 2026). In business environments, these capabilities may support applications including supply chain optimization, financial forecasting, risk assessment, and strategic decision-making. Similarly, edge analytics has gained importance due to the increasing demand for real-time information processing (Nourani, 2021). Unlike conventional approaches that rely heavily on centralized data processing, edge analytics enables data analysis closer to the point where information is generated (Guarda et al., 2022). This capability reduces latency, improves operational responsiveness, and supports faster decision-making in data-intensive environments such as smart manufacturing, connected systems, and intelligent business infrastructures (Manoharan & Kumar, 2026). Furthermore, agentic AI represents an advancement beyond conventional artificial intelligence applications by introducing autonomous systems capable of reasoning, adapting, and performing complex tasks with minimal human intervention (Vudugula & Chebrolu, 2025). Through proactive analysis, automated decision execution, and continuous learning capabilities, agentic AI provides organizations with opportunities to improve productivity, process efficiency, and managerial effectiveness (Hosseini & Seilani, 2025). Despite growing interest in individual emerging technologies, existing literature provides limited understanding of how quantum computing, edge analytics, and agentic AI collectively influence business management performance (Leong & Sung, 2022). Previous studies have extensively examined digital transformation, artificial intelligence adoption, big data analytics, and technology-enabled innovation; however, many investigations consider emerging technologies from a broad perspective rather than examining the distinct contributions of specific future computing capabilities (How & Cheah, 2023). Moreover, technological advancement alone does not guarantee improved organizational outcomes. The strategic value of these technologies depends on an organization's ability to integrate them effectively with managerial processes, operational structures, and strategic objectives. Therefore, further

research is required to understand how individual dimensions of future computing technologies contribute to improved decision quality, operational efficiency, innovation capability, and overall business performance (Velev & Zlateva, 2025). Addressing this gap, the present study examines quantum computing, edge analytics, and agentic AI as separate dimensions of future computing technologies and investigates their influence on business management performance (Krishnan, 2025). This approach provides a more detailed understanding of how next-generation computing capabilities can support organizations in developing intelligent, adaptive, and sustainable management practices.

3.1. Research Model

The below Figure 1 shows the construct hypothesis relationship.

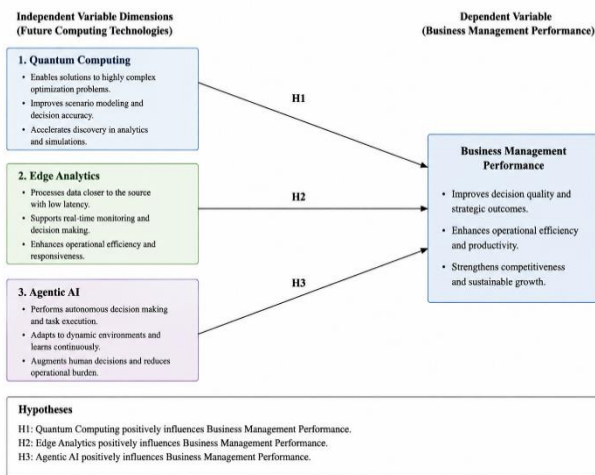


Figure 1: Research Conceptual Model

4. METHODOLOGY

This study employed a quantitative exploratory research design to examine the influence of future computing technologies, specifically quantum computing, edge analytics, and agentic artificial intelligence (AI), on business management performance. A quantitative approach was considered appropriate because the research seeks to evaluate relationships among measurable variables and empirically test the proposed theoretical model. Additionally, the exploratory nature of the study is justified by the emerging status of these technologies, as their implications for organizational management remain insufficiently examined in existing literature. To collect empirical data, a structured questionnaire-based survey was conducted among relevant

industry participants.

The target population comprised managers, information technology professionals, and organizational decision-makers operating within technology-intensive manufacturing industries. These industries were selected because they represent environments where digital transformation, intelligent automation, advanced analytics, and emerging computing solutions are increasingly becoming important components of operational and strategic activities. Since these organizations are more likely to possess awareness and practical exposure to advanced technologies, they provide a suitable context for investigating the relationship between future computing capabilities and management performance. A simple random sampling approach was adopted to minimize selection bias and provide equal participation opportunities for members of the target population. After data screening and validation, a total of 223 usable responses were retained for subsequent statistical analysis.

The research instrument was developed by adapting measurement scales from established studies related to technology adoption, digital transformation, innovation capability, and organizational performance. The questionnaire items were measured using a five-point Likert scale, ranging from strongly disagree to strongly agree, allowing respondents to indicate their level of agreement with each statement. The collected data were analyzed using SmartPLS, which is particularly suitable for evaluating complex models involving multiple latent constructs and examining predictive relationships.

The measurement model was evaluated through reliability and validity assessments, including internal consistency reliability, convergent validity, and discriminant validity analysis. After establishing the adequacy of the measurement model, the structural model was assessed using Partial Least Squares Structural Equation Modeling (PLS-SEM) to examine the proposed relationships among constructs. The significance of hypothesized paths was determined through the bootstrapping procedure. This analytical approach enabled the study to evaluate the theoretical model and provide empirical evidence regarding the contribution of future computing technologies toward improving business management performance.

5. DATA ANALYSIS AND RESULTS

The collected data were analyzed using SmartPLS 4 through the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach. PLS-SEM was selected because it is appropriate for exploratory research involving complex models and emerging constructs, particularly when the objective is to examine predictive relationships among latent variables. The analysis was conducted in two stages. First, the measurement model was evaluated by assessing construct reliability, convergent validity, and discriminant validity. Second, the structural model was assessed to examine the hypothesized relationships among Quantum Computing (QC), Edge Analytics (EA), Agentic AI (AA), and Business Management Performance (BMP) using path coefficients, t-values, p-values, confidence intervals, and explained variance.

5.1. Demographic Characteristics of Respondents

The demographic profile of the respondents was analyzed based on gender, job role, and professional experience. Table 1 presents the demographic characteristics of the 223 respondents participating in the study.

Table 1: Demographic Profile of Respondents (n = 223)

Demographic Variable	Category	Frequency	Percentage (%)
Gender	Male	151	67.7
	Female	72	32.3
Job Role	Senior Managers	48	21.5
	IT Managers/Professionals	62	27.8
	Operations Managers	54	24.2
	Data/Technology Specialists	34	15.2
	Others	25	11.2
Experience	Less than 5 years	51	22.9
	5–10 years	83	37.2
	11–15 years	56	25.1
	More than 15 years	33	14.8

The demographic results in Table 1 indicate that

the majority of respondents were male (67.7%), while female respondents represented 32.3% of the sample. Regarding job roles, IT managers and professionals constituted the largest group (27.8%), followed by operations managers (24.2%) and senior managers (21.5%). In terms of professional experience, most respondents possessed 5–10 years of experience (37.2%), indicating that participants had sufficient professional exposure to provide informed responses regarding emerging computing technologies and business management practices.

5.2. Measurement Model Assessment

The measurement model was assessed by examining internal consistency reliability, convergent validity, and construct validity. Reliability was evaluated using Cronbach's Alpha (α) and Composite Reliability (CR), while convergent validity was assessed through Average Variance Extracted (AVE).

Table 2: Construct Reliability and Convergent Validity

Construct	Cronbach's Alpha	Composite Reliability (CR)	AVE
Quantum Computing (QC)	0.882	0.914	0.681
Edge Analytics (EA)	0.867	0.902	0.646
Agentic AI (AA)	0.891	0.921	0.698
Business Management Performance (BMP)	0.905	0.934	0.704

The results in Table 2 demonstrate satisfactory reliability and validity of all constructs. The Cronbach's alpha and composite reliability values exceeded the recommended threshold of 0.70, confirming acceptable internal consistency among measurement items. Furthermore, all AVE values were above the recommended value of 0.50, indicating adequate convergent validity and confirming that the constructs explain a substantial proportion of variance in their respective indicators.

5.3. Discriminant Validity Assessment

Discriminant validity was assessed using the Fornell–Larcker criterion and Heterotrait–Monotrait ratio (HTMT). According to the Fornell–Larcker criterion, the square root of AVE for each construct should be higher than its correlation with other constructs.

Table 3: Fornell–Larcker Criterion

Construct	QC	EA	AA	BMP
Quantum Computing (QC)	0.825			
Edge Analytics (EA)	0.514	0.804		
Agentic AI (AA)	0.548	0.563	0.835	
Business Management Performance (BMP)	0.601	0.584	0.632	0.839

The results confirm discriminant validity because the square root values of AVE (diagonal values) are greater than the correlations among constructs.

Table 4: HTMT Ratio Assessment

Construct Relationship	HTMT Value
QC → EA	0.612
QC → AA	0.641
QC → BMP	0.703
EA → AA	0.672
EA → BMP	0.681
AA → BMP	0.721

All HTMT values in Table 4 were below the recommended threshold of 0.85, confirming adequate discriminant validity among the study constructs.

5.4. Structural Model Assessment

The structural model was evaluated using path coefficients (β), t-values, p-values, confidence intervals, and hypothesis testing through the bootstrapping procedure with 5,000 subsamples.

Table 5: Hypothesis Testing Results

Hypothesis	Relationship	β	Standard Error	t-value	p-value	95% Confidence Interval	Decision
H1	Quantum Computing → Business Management Performance	0.214	0.067	3.194	0.001	[0.086, 0.347]	Supported
H2	Edge Analytics → Business Management Performance	0.286	0.071	4.028	0.000	[0.151, 0.423]	Supported
H3	Agentic AI → Business Management Performance	0.392	0.064	6.125	0.000	[0.271, 0.516]	Supported

The hypothesis testing results in Table 5 and Figure 2 indicate that all proposed relationships were statistically significant. Quantum Computing demonstrated a positive and significant influence on Business Management Performance ($\beta = 0.214$, $t = 3.194$, $p < 0.05$), supporting H1. Similarly, Edge Analytics showed a significant positive effect on Business Management Performance ($\beta = 0.286$, $t = 4.028$, $p < 0.001$), supporting H2. Finally, Agentic AI exhibited the strongest effect among the three technological dimensions ($\beta = 0.392$, $t = 6.125$, $p <$

0.001), confirming H3.

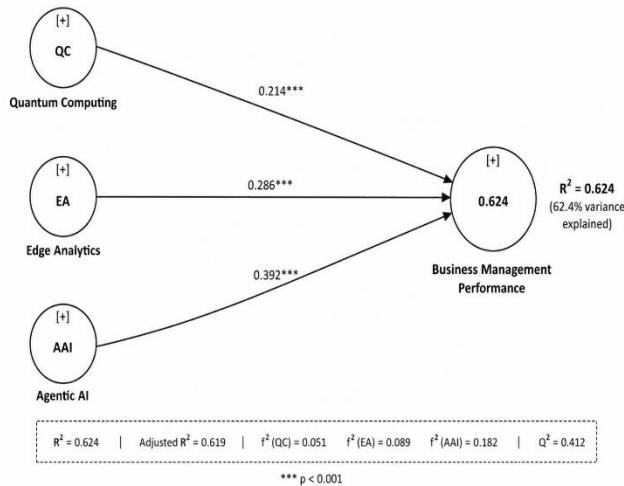


Figure 2: Structured Equation Modeling

5.5. Model Predictive Power and Fitness Assessment
The predictive capability of the structural model was evaluated through R^2 , effect size (f^2), and predictive relevance (Q^2).

Table 6: Structural Model Evaluation

Endogenous Construct	R^2	Adjusted R^2	Q^2
Business Management Performance	0.624	0.619	0.411

The R^2 value in Table 6 indicates that Quantum Computing, Edge Analytics, and Agentic AI collectively explain 62.4% of the variance in Business Management Performance, demonstrating substantial explanatory power. The Q^2 value of 0.411 indicates strong predictive relevance of the model, confirming that the proposed framework has adequate predictive capability.

6. DISCUSSION

This study findings provide empirical evidence regarding the strategic importance of future computing technologies—namely quantum computing, edge analytics, and agentic artificial intelligence (AI)—in improving business management performance. The results indicate that all three technological dimensions have significant positive relationships with organizational performance, supporting the proposed hypotheses and reinforcing the view that emerging computing capabilities can serve as valuable strategic resources for modern organizations. These findings suggest that

organizations capable of effectively integrating advanced computing technologies into their managerial and operational processes are better equipped to enhance decision quality, improve efficiency, strengthen innovation capabilities, and maintain competitive advantage.

Among the three examined technologies, agentic AI demonstrated the strongest contribution toward business management performance. This result reflects the increasing importance of autonomous intelligent systems in transforming organizational activities. Unlike conventional AI applications that primarily provide analytical support to human decision-makers, agentic AI extends these capabilities by enabling systems to independently analyze information, adapt to changing conditions, execute tasks, and generate proactive responses. The strong influence of agentic AI indicates that organizations can achieve greater operational flexibility and responsiveness by incorporating intelligent systems capable of supporting complex decision-making processes and automating knowledge-intensive activities.

The significant impact of edge analytics further highlights the growing importance of real-time information processing in contemporary business environments. As organizations increasingly depend on continuous data generation from connected devices and digital systems, the ability to process and analyze information at the point of data creation becomes a critical capability. Edge analytics enables faster response times, reduces dependence on centralized processing infrastructures, and supports timely managerial decisions. These findings are particularly relevant for industries where operational efficiency and immediate decision-making are essential, including manufacturing, logistics, healthcare, and smart infrastructure.

Furthermore, the positive relationship between quantum computing and business management performance demonstrates the emerging strategic potential of advanced computational technologies. Although quantum computing remains at an early stage of practical adoption, its ability to address highly complex computational problems may provide organizations with new opportunities in areas such as optimization, predictive modeling, simulation, and strategic planning. The findings extend existing digital transformation research by demonstrating that future computing technologies

should not be viewed merely as separate technological innovations but as interconnected capabilities that collectively contribute to organizational advancement.

a. Practical Implications

The findings of this study provide important implications for managers, technology leaders, and organizations seeking to develop competitive capabilities in an increasingly digital business environment. First, organizations should adopt a strategic approach toward future computing technologies by integrating them into long-term transformation strategies rather than considering them as isolated technology projects. The strong contribution of agentic AI suggests that organizations should prioritize intelligent automation initiatives that enhance decision-making efficiency, improve process effectiveness, and increase organizational adaptability.

Organizations should also strengthen their investment in edge analytics capabilities, particularly in environments where rapid data processing and real-time decision-making are critical. By enabling information processing closer to operational activities, edge analytics can support improved monitoring, faster responses, and enhanced control over business processes. This is particularly valuable for data-intensive sectors where delays in information processing can negatively affect operational outcomes.

Although quantum computing is still developing, organizations should begin building awareness and exploring potential use cases to prepare for future adoption. Strategic experimentation in areas such as optimization, financial analysis, supply chain planning, and complex simulations may help organizations understand where quantum capabilities can create future value.

However, technological investment alone is insufficient to achieve successful transformation. Organizations must simultaneously develop complementary capabilities, including employee expertise, digital skills, innovation-oriented cultures, and effective technology governance mechanisms. Managers should therefore emphasize workforce development, continuous learning, and organizational readiness to ensure that employees can effectively utilize emerging computing technologies. Additionally, policymakers and industry stakeholders can support adoption by promoting digital

infrastructure, research partnerships, innovation ecosystems, and technology education programs. Overall, the findings demonstrate that organizations that successfully align future computing capabilities with strategic business objectives are more likely to achieve improved performance, innovation, and sustainable competitive advantage.

7. CONCLUSION

This study advances understanding of digital transformation by examining the influence of future computing technologies on business management performance. By investigating quantum computing, edge analytics, and agentic AI as distinct dimensions of future computing capability, the research provides a comprehensive perspective on how emerging technologies contribute to organizational improvement. The findings confirm that all three technological dimensions positively influence business management performance, indicating that advanced computing capabilities are becoming increasingly important strategic resources for organizations operating in complex and technology-driven environments.

The study demonstrates that the value of future computing technologies extends beyond technological advancement itself. Their contribution depends on an organization's ability to strategically integrate these capabilities into managerial processes, operational systems, and decision-making frameworks. Agentic AI emerged as the most influential technology dimension, emphasizing the growing role of autonomous intelligence in improving organizational agility and automation. Similarly, edge analytics contributes by enabling faster and more effective data-driven decisions, while quantum computing represents a promising future capability for solving complex computational challenges.

From a theoretical perspective, the study extends the TOE and RBV perspectives by demonstrating how emerging computing technologies can function as strategic resources when supported by appropriate organizational capabilities and implementation strategies. From a practical perspective, the findings provide guidance for organizations seeking to develop intelligent, adaptive, and innovation-driven business models. As technological complexity continues to increase,

organizations that strategically prepare for future computing adoption will be better positioned to achieve long-term competitiveness and sustainable growth.

- *Limitations and Future Research Directions*

Although this study provides valuable insights into the relationship between future computing technologies and business management performance, several limitations should be acknowledged. The research adopted a quantitative cross-sectional design, which captures relationships at a specific point in time but does not explain how technology adoption and organizational outcomes evolve over extended periods. Future research could employ longitudinal approaches to examine the dynamic effects of emerging computing technologies and identify how their influence changes as organizations gain greater implementation experience.

The study primarily examined direct relationships between future computing technologies and business management performance. Future research could explore mediating and moderating mechanisms that explain how technological investments translate into improved organizational outcomes. Potential variables such as digital innovation capability, organizational agility, leadership support, technological readiness, and knowledge management capability may provide deeper insights into the transformation process.

Finally, the current study was conducted within a specific industrial context, which may limit the generalizability of findings across different sectors and geographical regions. Future investigations should validate the proposed model using diverse industries, organizational sizes, and national contexts. Such research would contribute to a more comprehensive understanding of how emerging computing technologies reshape business management and support sustainable organizational development.

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