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Turning Technology Capability Into Operational Performance: the Role of Organizational Culture in Water Utilities

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Digital transformation is reshaping water utility operations, yet technological investment alone does not necessarily translate into stronger operational performance. This research examines the relationship between Technology Capability (TC), Organizational Culture (OC), and Water Utility Performance (WUP) from the perspective of Dynamic Capabilities Theory (DCT). Using a quantitative cross-sectional design, data from 412 employees were analysed through Partial Least Squares Structural Equation Modelling (PLS-SEM). Organizational Culture is positioned as an internal mechanism through which technological capability can be embedded into organizational practices, collaboration, learning, and decision-making. By moving beyond technology acquisition, the research contributes to Industrial Management literature by highlighting the interaction between technological capability and organizational conditions in supporting operational efficiency, asset reliability, service continuity, and data-driven management within water utilities.
Keywords: Technology Capability; Organizational Culture; Water Utility Performance; Digital Transformation; PLS-SEM

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1. Introduction

Water utilities are increasingly operating within a digitally intensive environment in which service reliability, infrastructure efficiency, asset management, and data-driven decision-making have become central to operational performance. Daniel et al. (2023) observed that digital transformation within water utilities is accelerating through the integration of smart monitoring, data analytics, automation, and connected infrastructure. More recently, Grigg (2025) emphasised that digitalisation is changing the way utilities manage operational information, infrastructure conditions, and service delivery. These developments have encouraged water utilities to invest substantially in digital systems; however, acquiring advanced technologies does not necessarily ensure that such investments will translate into stronger operational outcomes.

Technology Capability (TC) therefore represents more than the availability of digital infrastructure. It reflects an organisation's capacity to integrate, deploy, and utilise technological resources effectively within its operational processes. Barba-Sánchez et al. (2024) demonstrated that technology-related capabilities are important in translating digital transformation into improved organisational outcomes. Within water utilities, this capability becomes particularly relevant because operational activities depend increasingly on integrated information systems, real-time monitoring, analytics, infrastructure management, and technology-supported decision-making. Technology capability can consequently determine whether digital investment remains merely a technological asset or develops into a strategic operational resource.

The performance implications of technology capability are particularly important for infrastructure-intensive organisations. Goh and See (2022) highlighted the significance of operational efficiency in water utility management, particularly where resource losses and service performance must be managed simultaneously. From a broader utility perspective, Amaral et al. (2023) demonstrated that operational performance is influenced by organisational and managerial conditions rather than technological resources in isolation. Consequently, stronger technological capability should enable utilities to improve asset reliability, operational responsiveness, service continuity, and the effective utilisation of organisational resources.

Nevertheless, technology does not operate independently of the organisational environment in which it is introduced. Ghafoori et al. (2024) identified organizational culture as an important element in data-driven digital transformation because shared values and behavioural norms influence the way technological resources are accepted and utilised. Similarly, O'Reilly et al. (2024) demonstrated that organizational culture remains closely connected with organisational performance. A culture that encourages collaboration, learning, adaptability, information sharing, and evidence-based decision-making may therefore strengthen an organisation's ability to convert technological capability into meaningful operational outcomes.

This interaction becomes especially important in water utilities, where technological systems frequently require coordination across technical, operational, managerial, and customer-service functions. Wu et al. (2024) showed that organizational conditions can shape the performance value derived from information technology capability. Technology capability may therefore strengthen operational performance directly while simultaneously contributing to organizational practices that encourage greater technology utilisation, knowledge sharing, and coordinated decision-making. Organizational culture, in this context, provides an important internal mechanism through which technological resources can become embedded in everyday operational practices. Despite increasing research on digital transformation and organizational performance, an important gap remains in understanding the organisational mechanisms through which technology capability is converted into operational value within water utilities. Existing studies have frequently examined digital transformation at the broader organisational level, while comparatively less attention has been given to the interaction between Technology Capability, Organizational Culture, and Water Utility Performance within a single infrastructure-intensive setting. This distinction is important because the operational value of technology may depend not only on technological sophistication but also on whether the organisation possesses a culture capable of supporting its effective utilisation.

Accordingly, this study examines the relationship between Technology Capability and Water Utility Performance while considering the role of Organizational Culture within a water utility context. Drawing on Dynamic Capabilities Theory, the study views technology capability as an organisational capacity that enables technological resources to be integrated, reconfigured, and applied in response to changing operational requirements. By focusing on the process through which technological capability is transformed into operational value, the study contributes to Industrial Management literature and provides practical insights for water utilities seeking to strengthen operational efficiency, asset reliability, service continuity, and data-driven management.

2. Literature Review and Hypotheses

Technology Capability and Water Utility Performance

Technology Capability refers to an organisation's ability to acquire, integrate, deploy, and effectively utilise technological resources to support operational and strategic activities. In digitally transforming organisations, technological capability extends beyond technology ownership because value emerges from the ability to combine digital infrastructure, information systems, analytics, and technical expertise with existing organisational processes. Barba-Sánchez et al. (2024) emphasised that technology-related capabilities play an important role in converting digital transformation initiatives into organisational performance. This capability is particularly relevant to water utilities, where increasingly complex infrastructure requires timely information, integrated systems, and technology-supported operational decisions.

Digital technologies have progressively changed the management of water utility operations. Daniel et al. (2023) identified digital monitoring, interconnected technologies, data analytics, and automation as important components of contemporary water utility transformation. These capabilities allow utilities to obtain more timely operational information and strengthen their capacity to identify infrastructure conditions, coordinate maintenance, manage assets, and respond to service disruptions. Grigg (2025) further observed that digital transformation is becoming increasingly important for improving the management and resilience of modern water utilities.

Operational performance in water utilities is multidimensional and extends beyond conventional financial measures. Goh and See (2022) demonstrated the importance of operational efficiency and non-revenue water considerations when evaluating water utility performance. Meanwhile, Amaral et al. (2023) highlighted that utility performance is shaped by several managerial and operational conditions. Technology capability may therefore contribute to performance by improving resource utilisation, operational visibility, infrastructure reliability, service continuity, and the quality of managerial decision-making.

From the perspective of Dynamic Capabilities Theory, technological resources generate greater strategic value when organisations possess the capacity to integrate and reconfigure them in response to changing operational requirements. In the water utility context, technology capability can enable an organisation to transform digital resources into coordinated operational practices rather than allowing individual technologies to function as isolated systems. Based on this reasoning, the following hypothesis is proposed:
H1: Technology Capability has a positive and significant relationship with Water Utility Performance.

Technology Capability and Organizational Culture

Technology adoption can also influence the internal organisational environment. As digital systems become embedded in operational processes, employees increasingly interact through shared information platforms, integrated databases, real-time monitoring systems, and technology-supported decision structures. Ghafoori et al. (2024) explained that organizational culture is closely associated with data-driven digital transformation because values, behavioural expectations, and organizational practices shape the use of digital information.

Technology capability may encourage a working environment characterised by greater information sharing, collaboration, learning, and evidence-based decision-making. Wu et al. (2024) demonstrated that the organisational context surrounding information technology capability is important in explaining how technological resources contribute to performance. When employees possess access to reliable

technological systems and relevant information, traditional functional boundaries may become less restrictive, allowing operational knowledge to circulate more effectively across organisational units.

The relationship is therefore not limited to employees adapting to new technologies. Technology capability can progressively reshape routines, communication patterns, learning practices, and expectations concerning the use of information. Lam et al. (2021) associated organizational culture and knowledge-related processes with stronger innovation capability, suggesting that technology-intensive environments require cultural conditions supportive of learning and knowledge exchange. Within water utilities, such conditions can be particularly important because technological systems often connect engineering, operations, asset management, customer services, and managerial decision-making. Accordingly, stronger technology capability is expected to support an organizational culture that is more adaptive, collaborative, learning-oriented, and receptive to technology-enabled working practices. Thus:

H2: Technology Capability has a positive and significant relationship with Organizational Culture.

Organizational Culture and Water Utility Performance

Organizational Culture represents the shared values, norms, assumptions, and behavioural practices that influence how employees interact and perform their responsibilities. In contemporary organisations, culture is increasingly important because technological and operational transformation requires employees to collaborate, learn, share information, and adapt to changing working practices. O'Reilly et al. (2024) demonstrated that different organizational culture configurations are associated with variations in firm performance, reinforcing the importance of culture as an organisational performance mechanism.

A supportive culture can strengthen operational performance by encouraging coordination, accountability, continuous improvement, and effective knowledge utilisation. Azeem et al. (2021) linked organizational culture with knowledge sharing and organizational innovation, indicating that shared organisational values can facilitate behaviours necessary for improved organisational outcomes. Within water utilities, these behaviours may improve coordination between operational units, accelerate responses to infrastructure problems, and encourage employees to use available information more effectively.

Organizational culture is particularly relevant when operational performance depends on interactions between people, technology, and organisational processes. Employees working within a collaborative and learning-oriented environment may be more willing to adopt new practices, exchange technical knowledge, and use digital information in operational decisions. Such cultural characteristics can therefore contribute to service reliability, operational efficiency, asset performance, and organisational responsiveness. Based on these arguments, the following hypothesis is proposed:
H3: Organizational Culture has a positive and significant relationship with Water Utility Performance.

The Role of Organizational Culture

Technology capability does not automatically produce operational value. An organisation may possess sophisticated digital infrastructure and technical systems but still experience limited performance improvement when employees do not share information, collaborate effectively, or integrate technology into routine decision-making. Ghafoori et al. (2024) positioned organizational culture as an important element of data-driven digital transformation, suggesting that cultural conditions influence whether technological resources become embedded in organisational practices.

Organizational culture can therefore provide the behavioural environment through which technology capability is translated into operational outcomes. Technology can provide information, connectivity, analytical capacity, and operational visibility, while culture influences whether employees actually use

these resources collaboratively and consistently. Wu et al. (2024) provided further evidence that organisational mechanisms surrounding IT capability are relevant to explaining performance outcomes. This suggests that the technology– performance relationship should not be viewed exclusively as a direct technological effect. Within water utilities, the mechanism is especially relevant because technology-supported operations require coordination among multiple functional areas. A culture characterised by learning, adaptability, collaboration, and information sharing can enable technological capability to become integrated into everyday operational practices. Organizational culture may consequently explain part of the process through which technology capability contributes to Water Utility Performance. Accordingly:

H4: Organizational Culture mediates the relationship between Technology Capability and Water Utility Performance.

Theoretical Foundation

This study is grounded in Dynamic Capabilities Theory (DCT), which provides an appropriate theoretical lens for explaining how organizations transform technological resources into operational value. Rather than viewing competitive and operational advantage as the result of resource ownership alone, DCT emphasises an organisation's ability to integrate, reconfigure, and deploy resources in response to changing environmental and operational conditions. Barba-Sánchez et al. (2024) demonstrated that technology-related capabilities are important in translating digital transformation into improved organizational outcomes, reinforcing the relevance of a capability-based perspective in technology-intensive environments.

Within water utilities, Technology Capability represents the organisational capacity to integrate digital infrastructure, information systems, analytics, technical expertise, and technology-supported processes into operational activities. Daniel et al. (2023) highlighted the increasing integration of digital technologies within water utilities, where interconnected systems and data-driven practices are reshaping operational management. Technology capability is therefore considered a dynamic organisational capability when technological resources are continually adapted and applied to improve asset management, operational monitoring, decision-making, and service delivery. However, the transformation of technological resources into operational performance also depends on the organisational environment in which those resources are utilised. Ghafoori et al. (2024) emphasised the importance of organizational culture in supporting data-driven digital transformation, particularly where organizational values and practices influence technology utilisation and information-based decision-making. From the DCT perspective, Organizational Culture can facilitate the integration and reconfiguration of technological resources by encouraging learning, collaboration, adaptability, and knowledge sharing.

Accordingly, this study extends the capability perspective by positioning Organizational Culture as an internal organisational mechanism connecting Technology Capability with Water Utility Performance. The framework proposes that Technology Capability can contribute directly to operational performance while also shaping cultural conditions that facilitate the effective utilisation of technological resources. This theoretical perspective provides a focused explanation of how water utilities can move beyond technology acquisition towards the development of organizational capabilities capable of generating sustained operational value.

Conceptual Framework

Based on the theoretical arguments and proposed hypotheses, the conceptual framework integrates Technology Capability (TC), Organizational Culture (OC), and Water Utility Performance (WUP).

Technology Capability is positioned as the independent variable, Organizational Culture as the mediating organizational mechanism, and Water Utility Performance as the dependent variable. The framework proposes both direct and indirect relationships. Technology Capability is expected to influence Water Utility Performance directly, while also contributing to Organizational Culture. Organizational Culture is subsequently expected to influence Water Utility Performance and transmit part of the effect of Technology Capability on performance. This structure enables the study to examine not only whether technology capability matters, but also the organisational pathway through which technological resources may be converted into operational value.

Figure 1. Conceptual Framework

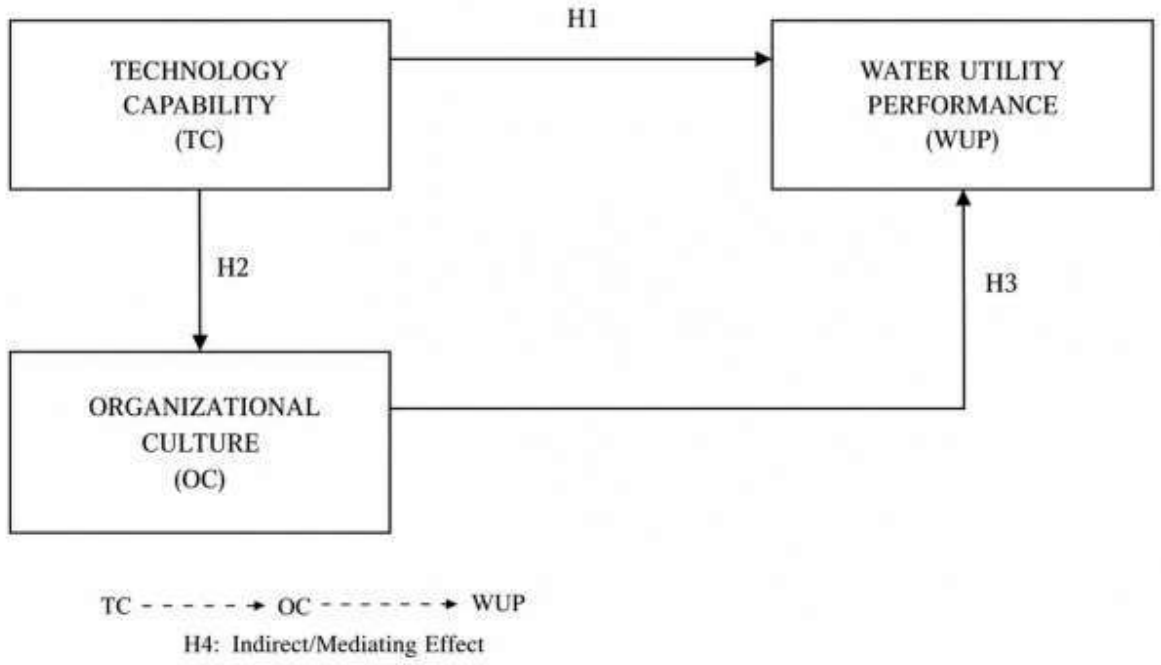


Figure 1 illustrates the proposed relationships among the three constructs. The solid paths represent the direct relationships proposed in H1, H2, and H3, whereas the indirect pathway represents H4, through which Organizational Culture transmits the effect of Technology Capability to Water Utility Performance. This framework keeps the model parsimonious while allowing the study to explain both the performance effect of technological capability and the organizational mechanism through which that effect may occur.

3. Methodology

Research Design

This study employed a quantitative cross-sectional research design to examine the relationships among Technology Capability (TC), Organizational Culture (OC), and Water Utility Performance (WUP) within a water utility context. A quantitative approach was considered appropriate because the study focuses on testing theoretically established relationships among organizational constructs using empirical data. Partial Least Squares Structural Equation Modelling (PLS-SEM) was employed to assess the measurement model and examine the direct and indirect relationships within the proposed framework.

Population and Data Collection

The study was conducted among employees of a water utility organization operating within an increasingly technology-intensive environment. Purposive sampling was employed to identify respondents with relevant exposure to organizational operations and technology-enabled working

practices. Questionnaires were distributed to eligible employees across relevant functional and operational areas.

A total of 412 valid questionnaires were retained for the final analysis. Participation was voluntary, and respondents were informed of the purpose of the research. Confidentiality and anonymity were maintained throughout the data collection process to protect both respondent and organizational information.

Measurement Instrument

Data were collected using a structured questionnaire adapted from established measures and contextualised for the water utility environment. The instrument measured Technology Capability, Organizational Culture, and Water Utility Performance using a five-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. Technology Capability captured the organisation's capacity to integrate and utilise technological resources, while Organizational Culture reflected collaborative, adaptive, and learning-oriented organisational practices. Water Utility Performance captured operational outcomes associated with efficiency, infrastructure and asset performance, service reliability, and operational effectiveness.

Data Analysis

Data analysis was performed using SmartPLS. The measurement model was first assessed through Cronbach's alpha, Composite Reliability (CR), and Average Variance Extracted (AVE) to establish construct reliability and convergent validity. The structural model was subsequently examined to evaluate the proposed relationships among TC, OC, and WUP. Bootstrapping was applied to assess the statistical significance of the direct paths and the indirect relationship involving Organizational Culture. This analytical procedure enables the study to determine whether technology capability contributes to water utility performance directly and through the organizational mechanism proposed in the conceptual framework.

4. Results and Discussion

Descriptive Analysis

A total of 412 valid responses were included in the final analysis. Initial data screening indicated no missing values, supporting the completeness of the dataset for subsequent analysis. Across the measured items, mean scores ranged approximately from 3.443 to 4.299, indicating generally favourable perceptions of Technology Capability, Organizational Culture, and Water Utility Performance. Standard deviations ranged from approximately 0.661 to 1.224, demonstrating sufficient variation in respondents' perceptions while remaining within an acceptable range for further multivariate analysis.

Measurement Model Assessment

The measurement model was evaluated to establish the reliability and convergent validity of the three constructs. Internal consistency was assessed using Cronbach's Alpha and Composite Reliability (CR), while convergent validity was examined through Average Variance Extracted (AVE). As shown in Table 1, all constructs achieved satisfactory measurement properties.

Table 1. Measurement Model Assessment

Construct	Cronbach's Alpha	CR	AVE
Technology Capability (TC)	0.800	0.862	0.555
Organizational Culture (OC)	0.711	0.813	0.526

Construct	Cronbach's Alpha	CR	AVE
Water Utility Performance (WUP)	0.811	0.869	0.569

Technology Capability recorded a Cronbach's Alpha of 0.800, Composite Reliability of 0.862, and AVE of 0.555, demonstrating satisfactory reliability and convergent validity. Organizational Culture similarly achieved acceptable values, with an Alpha of 0.711, CR of 0.813, and AVE of 0.526. Water Utility Performance recorded an Alpha of 0.811, CR of 0.869, and AVE of 0.569. Collectively, these results indicate that the constructs demonstrate adequate internal consistency and capture sufficient variance in their respective indicators.

Discriminant Validity

Discriminant validity was assessed to establish that Technology Capability, Organizational Culture, and Water Utility Performance represent empirically distinct constructs. The square roots of the Average Variance Extracted (AVE) were 0.745 for Technology Capability, 0.725 for Organizational Culture, and 0.754 for Water Utility Performance. These values provide construct-specific benchmarks for assessing the distinction among the latent variables. In addition to the Fornell–Larcker criterion, discriminant validity was evaluated using the Heterotrait–Monotrait Ratio (HTMT), providing further assessment of construct distinctiveness. Establishing discriminant validity is particularly important in this study because Organizational Culture functions as the mechanism linking Technology Capability with Water Utility Performance.

Structural Model Assessment

Following the satisfactory assessment of the measurement model, the structural model was evaluated to examine the proposed relationships among Technology Capability, Organizational Culture, and Water Utility Performance. The analysis focused on three direct relationships and one indirect relationship. Specifically, the model examined the relationship between Technology Capability and Water Utility Performance, the relationship between Technology Capability and Organizational Culture, and the relationship between Organizational Culture and Water Utility Performance. The indirect relationship further examined the role of Organizational Culture in linking Technology Capability with Water Utility Performance. The structural relationships examined in this article were derived from the broader model tested in the original study. For the purpose of the present focused analysis, only the relationships relevant to Technology Capability, Organizational Culture, and Water Utility Performance were retained. This provides a more specific assessment of the organizational pathway through which technological capability may contribute to operational performance within the water utility environment.

Table 2. Structural Relationships

Hypothesis	Relationship	Effect
H1	Technology Capability → Water Utility Performance	Direct
H2	Technology Capability → Organizational Culture	Direct
H3	Organizational Culture → Water Utility Performance	Direct
H4	Technology Capability → Organizational Culture → Water Utility Performance	Indirect/Mediation

The structural model therefore examines whether Technology Capability contributes to Water Utility Performance both directly and through Organizational Culture. This distinction is important because technological resources may generate operational value not only through their direct application but also through organizational practices that support collaboration, learning, information sharing, and effective technology utilisation.

Discussion

The proposed relationships provide a focused explanation of how Technology Capability may contribute to performance within a digitally transforming water utility environment.

Technology Capability should not be interpreted merely as the availability of sophisticated technological infrastructure, but as the organizational capacity to integrate and utilise technological resources within operational processes. Barba-Sánchez et al. (2024) similarly emphasised the importance of technology-related capabilities in translating digital transformation into organizational outcomes. Within water utilities, this capability is particularly relevant because operational activities increasingly depend on integrated systems, digital monitoring, analytics, and timely information for infrastructure and asset-related decisions.

The relationship between Technology Capability and Organizational Culture further illustrates that digital transformation involves organizational as well as technological change. Ghafoori et al. (2024) emphasised that organizational culture plays an important role in data-driven transformation because shared values and practices influence how employees engage with digital resources. Technology capability can facilitate greater information accessibility, cross-functional coordination, and technology-supported decision-making, while a receptive organizational culture can encourage employees to incorporate these capabilities into everyday working practices.

Organizational Culture also provides an important theoretical explanation for operational performance. O'Reilly et al. (2024) associated organizational culture with variations in firm performance, while Azeem et al. (2021) demonstrated its importance for knowledge sharing and organizational innovation. Within a water utility setting, collaborative and learning-oriented cultural practices can strengthen the use of operational information, encourage coordination across functional boundaries, and support more responsive decision-making. Culture can therefore complement technological capability by creating organizational conditions that facilitate its effective application.

More importantly, the indirect relationship offers a deeper interpretation of the technology– performance link. Technology provides infrastructure, information, connectivity, and analytical capacity, whereas Organizational Culture provides the behavioural environment through which these resources can be incorporated into operational activities. Wu et al. (2024) similarly demonstrated that organizational mechanisms surrounding IT capability are relevant in explaining performance outcomes. This perspective moves beyond the assumption that technology investment alone is sufficient and instead highlights the organizational conditions required to transform technological capability into operational value.

From an Industrial Management perspective, the framework reinforces the importance of coordinating technology, people, and organizational processes within infrastructure-intensive utilities. Rather than approaching digital transformation primarily as technology acquisition, water utility management should develop the organizational capability required to integrate technological resources with operational routines, employee practices, and decision-making processes. This capability-based perspective provides a stronger explanation of how digital transformation can support operational efficiency, asset reliability, service continuity, and sustainable water utility management.

Implications

Theoretical Implications

This study contributes to Dynamic Capabilities Theory (DCT) by extending its application to the water utility context. Technology Capability is conceptualised not simply as the possession of technological

resources, but as an organizational capacity to integrate, utilise, and reconfigure those resources in response to operational requirements. This perspective strengthens the argument that technology creates greater organizational value when it becomes embedded within operational routines and decision-making processes.

The inclusion of Organizational Culture further extends this capability-based perspective by providing an organizational mechanism connecting Technology Capability with Water Utility Performance. A culture that supports learning, collaboration, adaptability, and information sharing can create conditions in which technological resources are more effectively utilised. The framework therefore contributes to Industrial Management literature by integrating technology capability, organizational conditions, and operational performance within an infrastructure-intensive utility setting.

Practical Implications

Building Technology Capability alongside a supportive Organizational Culture can provide a stronger foundation for improving operational efficiency, asset reliability, infrastructure management, service continuity, and managerial decision-making. For water utilities, successful digital transformation therefore requires not only technological advancement but also organizational practices capable of converting technological resources into operational value.

5. Conclusion

Digital transformation in water utilities requires more than the acquisition of advanced technologies. Technology Capability becomes valuable when technological resources are effectively integrated into operational routines, decision-making, asset management, and service delivery. Organizational Culture provides an important internal mechanism by supporting collaboration, learning, adaptability, information sharing, and effective technology utilisation.

From an Industrial Management perspective, the framework highlights the interaction between technology, people, and organizational processes in strengthening Water Utility Performance. Grounded in Dynamic Capabilities Theory, the research extends the technology–performance discussion beyond technology acquisition and emphasises capability development as an important foundation for operational efficiency, asset reliability, service continuity, and data-driven management.

Limitations and Future Research

The cross-sectional design captures organizational perceptions at a particular point in time and does not reflect changes throughout different stages of digital transformation. Future research could adopt longitudinal designs to examine how Technology Capability, Organizational Culture, and Water Utility Performance evolve over time.

The research is also limited to a single water utility organization. Future studies could examine multiple utilities or undertake comparative research across different organizational and institutional environments. Further research may also incorporate digital skills, knowledge integration, organizational agility, or employee readiness to provide a broader understanding of how technological capability is transformed into sustainable operational value.

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