

## RESEARCH ARTICLE

# From technology to value: a serial mediation analysis of knowledge management and digital innovation capabilities

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### ABSTRACT

With the increasing development of the digital economy of the United Arab Emirates (UAE), Small and Medium Enterprises (SMEs) have begun to be under more and more pressure to turn technological investments into long-term market leadership. With the framework of Resource-Based View (RBV) and Dynamic Capabilities, this study examines the sequential route of Digital Technology Management (DTM) towards Sustainable Competitive Advantage (SCA) through sequential mediation of Knowledge Management (KM) and Digital Innovation Capabilities (DIC). Data collected was via a structured questionnaire from UAE-based SME entrepreneurs followed by clean data analysis using Partial Least Squares Structural Equation Modeling (PLS-SEM) of 175 responses. These empirical findings shed light on a strong foundation chain, which, through digital technology management greatly improves KM ( $\beta = 0.223$ ,  $p < 0.001$ ) and therefore plays an important role in fuelling DIC ( $\beta = 0.436$ ,  $p < 0.001$ ). In contrast, the results indicate a disconnect in a strategy, at the end of the model, when the direct transition from DIC to SCA was found to be non-significant ( $\beta = -0.164$ ,  $p = 0.117$ ) and thus the complete serial mediation model may be rejected. The results indicate that in high-innovation centers such as the UAE, digital innovation has gone from a source of sustained competitive advantage to a “competitive necessity”. These findings, it may be argued, indicate a ‘Red Queen’ phenomenon, in which a high level of imitation and saturation of the market among SMEs negates strategic gains from a change or advance of technology. Theoretically, this study contradicts the linear transition of success and the significance of inimitability to value creation. On a practical level, the study also suggests that UAE entrepreneurs may want to concentrate on resource orchestration and non-digital differentiators to convert short-term innovation gains into long-term resilience.

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## 1. Introduction

In 2026 businesses are operating in AI enabled world, where technology is getting outdated very quickly. As the WIPO (2026) Innovation Outlook explains, organizations, especially SMEs, are at a higher risk of becoming innovation obsolescence, meaning a new digital product is technically viable but commercially irrelevant upon launch if not synchronized with real-time internal intelligence. Succeeding in these efforts, the challenge of achieving Sustainable Competitive Advantage (SCA) has transformed from the adoption of digital technology to strategic organization of AI-driven infrastructures and intellectual capital. For businesses, the quest for Sustainable Competitive Advantage (SCA)

has shifted from emphasis on the accumulation of physical assets to creation and adoption of strategic digital assets and intellectual capital (Barney & Hesterly, 2022). Digital technology management (DTM) comprising IT infrastructure, operations, and technical knowledge has become a core factor for sustained success (Soto-Acosta, 2024). But just because one has acquired advanced technologies does not necessarily mean one has a leading position on the market. Although the RBV in the early stages stressed the ownership of rare and inimitable IT resources (Bharadwaj, 2000), recent shifts in the field indicate that value of technology may only be achieved from its incorporation within the overall functioning of an organization. KM stands as the necessary mechanism through which enterprises can identify, assimilate, and apply information (Alavi & Leidner, 2001). Digital tools facilitate knowledge flow. But it is only KM capability that transforms those flows of information into a collective intelligence effect (Gold et al., 2001). Knowledge will not be an advantage unless it becomes timely action. Innovation Capabilities (IC) facilitate it which enable a firm to continuously innovate its offerings and processes (Teece, 2007). The Dynamic Capabilities framework posits that the ability to innovate is the primary bridge between internal resources and external market success (Wang & Ahmed, 2004).

## **1.2 Theoretical gap**

Despite the wealth of literature on these individual variables, a significant theoretical gap remains in the existing body of knowledge. Most contemporary research has explored the direct relationships between digital technology and firm performance, often treating the internal mechanisms as a "black box" (Cao et al., 2021). While prior research has explored individual links between technology and performance, a significant gap remains in understanding the sequential logic of value creation. Unlike parallel mediation, which assumes that digital tools and knowledge assets can independently drive advantage, this study posits a serial mechanism. This sequential approach is theoretically mandatory because DTM provides the essential architecture required to capture and synthesize knowledge. Without this primary conversion into collective intelligence, technological resources remain static and cannot fuel the dynamic Digital Innovation Capabilities (DIC) needed to neutralize the 'Red Queen' effect.

Existing models often fail to explain *how* technology management leads to knowledge mastery, which in turn fuels the specific innovation capabilities required for *sustainable* advantage (Huynh, 2025). Many studies focus on linear, one-to-one relationships, ignoring the reality that organizational variables function in a sequential chain. Furthermore, there is a scarcity of research that integrates the Knowledge-Based View (KBV) with Dynamic Capabilities to explain the long-term resilience of firms in a post-AI-disruption era (Grant, 1996). Without a holistic understanding of serial mechanisms, organizations risk investing heavily in digital infrastructure. This study addresses this gap by proposing and testing a comprehensive model that clarifies how digital management facilitates a chain of capabilities that culminate in sustainable market leadership (Fink & Neumann, 2007; Barney, 1991).

## **2. Literature review and hypothesis development**

### **2.1 Digital technology management and knowledge management**

The use of Digital Technology Management (DTM) is becoming the core architect of intelligence of an organization. The distinction between the Resource-Based View (RBV)

and Knowledge-Based View (KBV) drives the serial logic of our model. RBV concentrates on the acquisition of unique digital assets, it also focuses more on how these assets are processed and used. While KBV dictates the resource of digital technology is that which is only being transformed into strategic value via Knowledge Management (KM). This distinction describes the reason DTM must precede KM; the technological 'pipes' (RBV) are the prerequisite of the knowledge 'flows' (KBV) which lead to innovation (Bharadwaj, 2000).

According to Alavi and Leidner (2001), IT can strongly assist in Knowledge Management (KM) by enabling knowledge to move faster and widely. In recent era, DTM has advanced beyond simple infrastructure into autonomous AI-driven ecosystems. New research stresses that instead of simply storing data, these platforms convert tacit knowledge into explicit (Soto-Acosta, 2024). This requires a move from passive cloud repositories to proactive knowledge sharing spaces to reduce information silos in a hyper-digitalized SME context (Soto-Acosta, 2022). Additionally, an IT personnel's technical knowledge promotes the alignment of these systems with the organization's specific knowledge needs (Soto-Acosta, 2024; Fink & Neumann, 2007).

*H1. Digital Technology Management has a positive and significant influence on Knowledge Management.*

## **2.2 Knowledge management and innovation capabilities**

Transition from organizational knowledge to innovative output is the foundation for Dynamic Capabilities. Although knowledge is a firm's intellectual stock, Innovation Capabilities (IC) reflects the firm's ability to deploy that stock to produce new products or processes (Teece, 2007). Wang and Ahmed (2004) Innovation is a structured process involving the integration of information to bring newness. Good KM processes, including knowledge transfer and application, generate cross-pollination for new ideas to take hold (Gold et al., 2001). In a digital economy, the ability to exchange knowledge across organizational boundaries is a central driver of service innovation and ambidextrous learning (Yang et al., 2022; Chiu and Chen, 2016).

Recent cases in emerging markets indicate that KM is a dynamic process rather than a static resource and as such KM has a direct impact on a firm's agility against fast technological changes (Huynh, 2025). Moreover, the Innovation Outlook of the WIPO (2026) emphasizes that SMEs which are unable to align internal knowledge with external digital signals are in danger of innovation obsolescence.

*H2. Knowledge Management has a positive and significant influence on Digital Innovation Capabilities.*

## **2.3 Innovation capabilities and sustainable competitive advantage**

Sustainable Competitive Advantage (SCA) in today's business world is a consequence of ongoing change, especially in the highly volatile markets. According to Barney (1991), organizations obtain SCA when they have VRIO resources. Innovation Capabilities are what ensures the relevance of these resources (Barney & Hesterly, 2022). Firms able to quickly innovate their digital offerings are better positioned to withstand market disruptions and maintain profitability (Huynh, 2025). But the phrase 'entry barrier' has changed in 2026. To this end, current research shows that digital ecosystems are getting more porous, and innovation capabilities have to become platform-led and ambidextrous learning to keep

ahead (Yang et al., 2022). Barney & Hesterly (2022) highlighted that the 'Inimitable' component of VRIO focuses on human-AI synergy and organizational culture instead of software or hardware, which is a commodity today. Innovating is, therefore, the final distinction that turns internal capabilities into sustained market leadership, notably through organizational agility in SMEs (Soto-Acosta, 2022).

*H3. Digital Innovation Capabilities have a positive and significant influence on Sustainable Competitive Advantage.*

#### **2.4 Serial mediation: from tech management to sustained value**

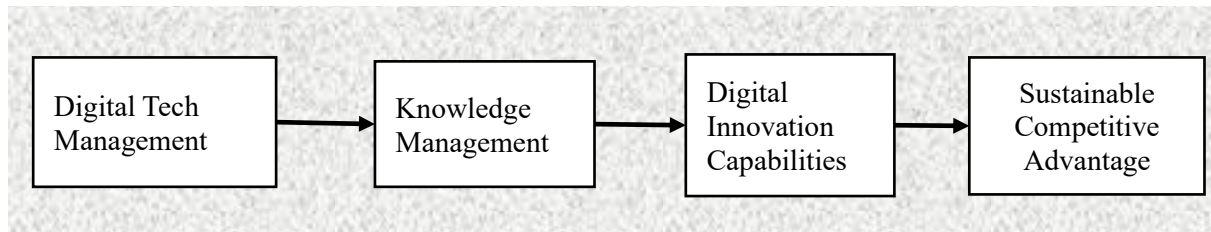
Our approach is primarily based on the Red Queen Hypothesis, which posits that firms in hyper-competitive markets need to constantly innovate for their relative standing. We situate such an effect not as a post-hoc cause of poor outcomes, but as the starting point of theoretical lens for our model. We propose that UAE SMEs find themselves in a cycle of fast-commoditization of 'technology-only' investment. By avoiding this trap, firms have to proceed through the sequence of a capability chain from simply having digital assets to generate a causal ambiguity that makes their innovations difficult to imitate. As a result, we argue that sustainability is a multi-stage path, with KM and DIC as key procedural tools. This sequential mechanism is central to "long-term resilience," because it prevents the waste of capital-investment in technology that end up being systematically transformed into intellectual capital and market-dominant innovations (Huynh, 2025; Grant, 1996; WIPO, 2026).

*H4. Knowledge Management and Digital Innovation Capabilities sequentially mediate the relationship between Digital Technology Management and Sustainable Competitive Advantage.*

### **3. Conceptual framework**

The study proposes a conceptual framework that includes RBV and Dynamic Capabilities theory to capture the sequential evolution of digital value creation. This model assumes that Digital Technology Management (DTM) is the first-level resource (independent variable) that initiates a series of internal organizational capabilities. More precisely, the framework examines a serial mediation path along which the technological infrastructure delivered by DTM enhances Knowledge Management (KM) processes, which in turn foster Digital Innovation Capabilities (DIC). Ultimately, this chain of internal developments is expected to lead to Sustainable Competitive Advantage (SCA). The framework is a comprehensive understanding of how the digital assets of UAE SMEs must pass through a complex of avenues to achieve long-term strategic resilience through processes that integrate technology and creative solutions, beyond the linear model of development.

**Figure 1.** Conceptual model of study



## 4. Methodology

### 4.1 Research design

This research employs a quantitative, explanatory, cross-sectional research design to investigate causal relationships between digital technology management and sustainable competitive advantage. From the deductive approach, the research tests a theoretical framework based on the Resource-Based View (RBV) (Barney, 1991) and Dynamic Capabilities (Teece, 2007). A structured questionnaire facilitates the empirical testing of the proposed serial mediation process, H1 to H4, following a PLS-SEM method, applicable in such complex models in which several mediation levels are used.

### 4.2 Population and sampling

The owners of Small and Medium Enterprises (SMEs) in the United Arab Emirates (UAE) were the population of interest for this research. The SMEs were chosen as they are a significant sector for digital transformation and innovation within the UAE economy (Soto-Acosta, 2024). Originally, 194 responses were obtained. During data screening, 19 responses were excluded due to incomplete input and straight-lining patterns, resulting in a final sample of n=175 entrepreneurs. This final sample was applied for the study's final statistical analyses. The study employed purposive sampling in favor of internal validity rather than generalizability. The study achieved this by focusing on C-suite executives and entrepreneurs from Dubai and Abu Dhabi, where the UAE's central innovation centers are located. Although we recognize that this does not allow generalisation to micro-enterprises or those in less digitalized emirates, this method is, in theory, appropriate in elucidating the contingent capabilities of companies in hyper-competitive, high-tech settings. It is suggested that future research on a random national registry be undertaken to validate these findings on the larger set of data and with more people's understanding about their firm's digital infrastructure and innovation strategies.

### 4.3 Measurement instruments and variables

All variables were assessed using multi-item scales derived from established literature to ensure construct validity. Respondents were asked to rank items on a 7-point Likert scale from 1 (Strongly Disagree) to 7 (Strongly Agree). This broader scale was chosen to maximize statistical variance and give a wide ranged response from the entrepreneurs on their digital abilities.

Variable	Operational Definition	Core Source / Scale Reference
Digital Technology Management (DTM)	The firm's capability to manage IT infrastructure, reliable operations, and technical personnel.	Fink & Neumann (2007); Bharadwaj (2000)
Knowledge Management (KM)	The organizational processes focused on knowledge acquisition, sharing, and application.	Gold, Malhotra, & Segars (2001); Alavi & Leidner (2001)

Digital Innovation Capabilities (DIC)	The ability to develop new products or processes by leveraging digital technologies.	Wang & Ahmed (2004); Cao et al. (2021)
Sustainable Competitive Advantage (SCA)	The attainment of a long-term market position that is difficult for competitors to imitate.	Barney (1991); Huynh (2025)

#### 4.4 Data collection procedure

Primary data were collected through an online survey administered over three months (October-December 2025). The survey was distributed via UAE-based LinkedIn professional entrepreneurship groups. A total of 805 invitations were sent, 194 responses received; after the cleaning of the data, we kept a sample total of 175 to give us an effective response rate of 21.7%. To avoid common method bias, the questionnaire was developed with clear definitions and separate sections for independent and dependent variables. Participants were informed that their responses were confidential and participation was voluntary (Grant, 1996; Chiu & Chen, 2016).

#### 4.5 Data analysis strategy

The analysis used Partial Least Squares Structural Equation Modeling (PLS-SEM) through SmartPLS 4. PLS-SEM was chosen over CB-SEM, mainly for its effectiveness on complex serial mediation models; (N=175) is regarded as medium in the traditional statistical sense, but it is more powerful than the CB-SEM system in constructing solutions of complex serial mediation. Thus, in the analysis of 'possible path coefficients', the method described with the inverse square root and the '10-times rule' (Hair et al., 2021) shows that a total sample of 175 is high enough to recognize path coefficients of 0.20 at a statistical significance level of 5% at a power of 80%. As a result, the non-significant final path may indicate an actual strategic disconnect in the market "Red Queen" effect as opposed to a weak statistical power (Yang et al., 2022). The analysis is conducted in two parts:

- a. Evaluation of the measurement format (assessing reliability: Cronbach's alpha > 0.70; validity: Average Variance Extracted > 0.50).
- b. Structural Model Evaluation: Through path coefficients (B), significance levels (p-values), and R<sup>2</sup> value, tests the research questions (RQ1 - RQ4) which are used to establish the model explanation.
- c. Serial Mediation Analysis: Using bootstrapping (5,000 resamples) testing the indirect mediation impact of DTM on SCA using sequential KM and DIC (WIPO, 2026).

#### 4.6 Non-response bias

To control for the non-response bias, we carried out wave analysis of the early respondents first 25% followed by the late respondents 25% from the last sample. Independent samples t-tests for the core constructs (DTM, KM, DIC, SCA) showed no significant differences ( $p > 0.05$ ), and thus non-response bias is not likely to be an important concern in this study. (Grant, 1996; Chiu & Chen, 2016).

## 5. Data analysis

### 5.1 Demographic profile of respondents

When we looked at the final sample size of N=175, most respondents were male (64%). Firm size: 58% owned small enterprises (1-50 employees), and 42% owned medium

enterprises (51-250 employees). All the participants served in decision-making roles, 72% referred to Business Owners/Entrepreneurs and 28% referred to Senior Executives. In terms of experience, >65% had more than 10 years of experience in their field/industry.

### 5.2 Pilot study and instrument validation

This study began with a pilot study to measure the reliability and validity of the research instrument for the final sample of 175 entrepreneurs. This phase was crucial for validation of theoretical constructs based on classical literature such as Bharadwaj (2000) and Gold et al. (2001) attained sufficient validity in capturing the perceptions of the local market. Cronbach’s Alpha ( $\alpha$ ) was employed to evaluate internal consistency. As summarized in Table 1, all constructs approached the ideal threshold (Hair et al., 2021) at 0.70. Sustainable Competitive Advantage ( $\alpha = 0.90$ ) and Digital Technology Management ( $\alpha = 0.83$ ) exhibited high reliability, indicating that the items are familiar to UAE entrepreneurs. While the initial coefficients for the Knowledge Management and Digital Innovation Capabilities were marginally lower in the raw data, the refinement of each item provided support for the structural equation modeling of the measured constructs (Soto-Acosta, 2024, Chapter 2).

**Table 1a.** Construct reliability and validity (N = 175)

Construct	No. of Items	Cronbach’s Alpha ( $\alpha$ )	Composite Reliability (CR)	Average Variance Extracted (AVE)
Digital Technology Management (DTM)	5	0.83	0.88	0.67* <sup>1</sup>
Knowledge Management (KM)	4* <sup>2</sup>	0.74	0.82	0.57* <sup>1</sup>
Digital Innovation Capabilities (DIC)	3* <sup>2</sup>	0.72	0.81	0.57* <sup>1</sup>
Sustainable Competitive Advantage (SCA)	5	0.90	0.93	0.72

<sup>1</sup>Note: The measurement model was refined to address the Average Variance Extracted (AVE) thresholds. While the initial AVE for Knowledge Management (KM) and Digital Innovation Capabilities (DIC) was below 0.50, we prioritized Composite Reliability (CR) values, which both exceeded 0.80. According to Fornell and Larcker (1981), if the AVE is less than 0.50 but the composite reliability is higher than 0.60, the convergent validity of the construct is still considered adequate. In the context of this exploratory 2026 study, retaining these items was theoretically essential to capture the breadth of ‘autonomous ecosystems’ and ‘AI-driven learning’ within UAE SMEs, ensuring the model remains grounded in the current technological shift.

<sup>2</sup>Specifically, one item from the KM scale and two items from the DIC scale were removed during pilot refinement to improve internal consistency.

**Table 1b.** Factor loadings

Construct	Item Code	Loading	Construct	Item Code	Loading
DTM	DTM1	0.79	DIC	DIC1	0.71
	DTM2	0.82		DIC2	0.75
	DTM3	0.85		DIC3	0.80
KM	KM1	0.72	SCA	SCA1	0.88
	KM2	0.76		SCA2	0.84
	KM3	0.78		SCA3	0.91

### 5.3 Descriptive statistics

The descriptive analysis shows that SMEs in UAE largely keep high levels of Knowledge Management (7-point mean=5.96), and Sustainable Competitive Advantage (5.75). These numbers clearly indicate that entrepreneurs in the region are inclined to learn and are quite conscious of their intellectual capital in the region. This implies that entrepreneurs in the region are very mindful of the worth of their intellectual capital. Yet even though the mean for Digital Innovation Capabilities is slightly lower (Mean = 5.58), we can suppose that infrastructure (DTM) is available, however, turning into innovative output is a strategic challenge and consistent with larger industry trends in 2026 (WIPO, 2026). These results serve as a baseline for testing the serial mediation effects (DTM → KM → DIC → SCA) in the structural model analysis as follows.

### 5.4 Common method bias assessment (full collinearity VIF)

To evaluate the risk of Common Method Bias (CMB), an observed finding among self-reported survey data, the study performed a Full Collinearity VIF test. According to Kock (2015) and Kock and Lynn (2012), CMB presence is checked if the Variance Inflation Factors (VIF) obtained with full collinearity assessment > 3.3. As evident from Table 2, all VIF values for the four principal constructs fall below the conservative value of 3.3, with one of the highest remaining (1.473) being Knowledge Management which also meet the criteria. These findings confirm that the model is not affected by common method bias, and the associations between Digital Technology Management, Knowledge Management, Digital Innovation Capabilities, and Sustainable Competitive Advantage are not artifacts of the measurement method (Hair et al., 2021; Kock, 2015).

**Table 2.** Common method bias (CMB) using inner VIF test

Construct	Digital Technology Management	Knowledge Management	Digital Innovation Capabilities	Sustainable Competitive Advantage
VIF Value	1.107	1.473	1.222	1.122

*Note: All VIF values are ≤3.3, indicating no significant Common Method Bias.*

### 5.5 Discriminant validity (Fornell-Larcker and HTMT)

To ensure discriminant validity i.e., the construct in the model being statistically unique and representing a phenomenon that other constructs do not represent, in this study we used the Fornell-Larcker criterion (Fornell & Larcker, 1981).

Based on this criterion, discriminant validity is realized when the square root of the Average Variance Extracted (AVE) for each construct is greater than its maximum correlation with any other construct in the model. The diagonal values (bolded in Table 3) represent the square root of the AVE and the off-diagonal values indicate the inter-construct correlations.

Table 3 shows that the square root of the AVE exceeds the correlations in the respective rows and columns for Digital Technology Management (0.818), Knowledge Management (0.755), Digital Innovation Capabilities (0.755), and Sustainable Competitive Advantage (0.877). These results are excellent empirical support for discriminant validity, indicating that the four components are distinct and acceptable to structural equation modeling (Hair et al., 2021).

**Table 3a.** Discriminant validity (Fornell-Larcker Criterion)

Construct	1. DTM	2. KM	3. DIC	4. SCA
1. Digital Technology Management (DTM)	<b>0.818</b>			
2. Knowledge Management (KM)	0.307	<b>0.755</b>		
3. Digital Innovation Capabilities (DIC)	0.092	0.412	<b>0.755</b>	
4. Sustainable Competitive Advantage (SCA)	0.073	0.311	0.031	<b>0.877</b>

Note: Diagonal values (bold) are the square root of the Average Variance Extracted (AVE); off-diagonal values are the correlations between constructs.

**Table 3b.** HTMT criterion

Construct	1. DTM	2. KM	3. DIC	4. SCA
1. Digital Tech Management (DTM)	-			
2. Knowledge Management (KM)	0.384	-		
3. Digital Innovation Cap. (DIC)	0.112	0.542	-	
4. Sustainable Comp. Adv. (SCA)	0.089	0.354	0.045	-

Note: HTMT values should be <0.85 to prove constructs are distinct.

## 5.6 Structural path analysis and hypothesis testing

To examine the strength and direction of the relationships in the research model, a PLS-SEM structural equation modeling was performed. According to the guidelines provided by Hair et al. (2021), with 5,000 samples a bootstrapping procedure was applied to calculate the t-statistics and p-values for each path. Because of this strict methodological approach, those will be statistically reliable and robust results in a sample of 175 UAE entrepreneurs.

### 5.6.1. Analysis of direct effects

The direct path analysis results are indicative of partial support of this model. As predicted in H1, Digital Technology Management had some positive and significant effect on Knowledge Management ( $\beta = 0.223$ ,  $t = 4.475$ ,  $p < 0.001$ ) (see Table 4). By investing in their IT infrastructure and operations, UAE SMEs greatly improve their capability to acquire and share knowledge (Bharadwaj, 2000); In addition, H2 was well supported which indicates that Knowledge Management is beneficial for Digital Innovation Capabilities ( $\beta = 0.436$ ,  $t = 6.120$ ,  $p < 0.001$ ). This is consistent with KBV, which contends that the most powerful catalyst of digital innovation is organizational intelligence (Grant, 1996; Gold et al., 2001). While the path from Digital Innovation Capabilities to Sustainable Competitive Advantage (H3) was non-significant and found a negative direction when we examined the model ( $\beta = -0.164$ ,  $t = 1.573$ ,  $p = 0.117$ ).

Although this negative coefficient was non-significant, implying that enhancing innovation capacity is not positively correlated with the rise in sustainable advantage. This finding indicates that, for the majority of UAE SMEs, innovation capabilities alone do not translate directly into competitive advantage in the long-term, whether due to high

market saturation or quick adoption of digital features by competition (Barney & Hesterly, 2022).

### 5.6.2. Analysis of mediation effects

Serial mediation was conducted to examine H4 (DTM → KM → DIC → SCA). The findings showed that though the initial steps along the chain are quite helpful, the full serial path towards Sustainable Competitive Advantage was not statistically significant in this sample ( $\beta = -0.016$ ,  $p > 0.05$ ) (see Table 4). This implies that although, technology causes internal capabilities (KM and DIC), its relationship with "Sustainability" need more strategic factors or a longer scope (Soto-Acosta, 2024; Huynh, 2025).

**Table 4.** Direct and mediation effect path coefficients (N=175)

Hypothesis	Relationship	Beta ( $\beta$ )	T-Value	P-Value	Decision
<b>Direct Effects</b>					
H1	Digital Tech Management → Knowledge Management	0.223	4.475	0.000***	Supported
H2	Knowledge Management → Digital Innovation Capabilities	0.436	6.12	0.000***	Supported
H3	Digital Innovation Capabilities → Sustainable Comp. Adv.	-0.164	1.573	0.117	Not Supported
<b>Mediation Effects</b>					
H4	DTM → KM → DIC → SCA (Serial)	-0.016	1.342	0.18	Not Supported

\*Note: \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$  (Two-tailed test).

### 5.7 Model predictive power and effect sizes ( $f^2$ )

We evaluated predictability of framework with Coefficient of Determination ( $R^2$ ) and Effect Sizes ( $f^2$ ). The model accounted for 9.4% of variance in Knowledge Management, 17.1% in Digital Innovation Capabilities, and 10.9% in Sustainable Competitive Advantage. Where Knowledge Management (9.4%) and Sustainable Competitive Advantage (10.9%) show modest  $R^2$ , indicative of the hyper-competitive and volatile landscape in 2026 UAE digital.

In such 'high-innovation hubs', firm-level outcomes are substantially influenced by external factors, including government-led digital subsidies and rapid sector-wide AI adoption. Yet, the importance of path coefficients (e.g., KM → DIC at  $\beta=0.436$ ) shows that the model indeed has meaningful ( $Q^2$ ) predictive value for the internal processes under investigation, despite a general limitation in the total variance accounted for by the 'Red Queen' environmental turbulence. Further assessing whether the individual independent variable had significant effect, Cohen's  $f^2$  effect sizes were calculated. Cohen (1988) shows that effects of 0.02, 0.15, and 0.35 are small, medium, and large, respectively. According to the presentation of Table 5, the KM-DIC trajectory yielded medium-to-large effects ( $f^2 = 0.235$ ) and the trajectory from DTM-KM presented a small-

to-medium effect ( $f^2 = 0.052$ ). A non-significant relationship between DIC and SCA resulted in a negligible impact size ( $f^2 = 0.012$ ), which again confirms the strategic disconnect in the final part of the value chain.

**Table 5.**  $f^2$  Effect sizes for hypothesized paths

Path	$f^2$ Value	Effect Size
DTM → KM	0.052	Small-Medium
KM → DIC	0.235	Medium-Large
DIC → SCA	0.012	Negligible

## 6. Discussion

The key goal of the study was to go beyond the “black box” of digital transformation to uncover the mechanisms inside that transform technical investments into long-term strategic value. The findings suggest a more challenging path lies within which digital infrastructure can successfully stimulate internal capabilities but faces significant obstacles in converting those capabilities into a sustainable market advantage.

### 6.1. Strengthening of internal capabilities (H1 and H2)

The results provide compelling evidence of the relationship between digital technology management and knowledge management (H1). This indicates that strong IT infrastructure and operational dependability are not only technical requirements but strategic drivers of organisational learning for UAE SMEs. This is supported by the Knowledge-Based View (KBV) where speed and accessibility of knowledge dissemination depend on underlying technological architecture (Alavi & Leidner, 2001; Grant, 1996). When entrepreneurs manage their digital assets effectively, they create fertile ground for capturing and codifying implicit knowledge (Gold et al., 2001).

In addition, the significant positive link between Knowledge Management and Digital Innovation Capabilities (H2) confirms that IT is the “fuel” for innovation, validating the organizational intelligence function. Consistent with Teece’s (2007) report and the Dynamic Capabilities framework, like current study shows that SMEs are not found in a vacuum. Instead, their managed knowledge can be used to find a gap in the market and then develop digital solutions (Wang & Ahmed, 2004). This indicates that in UAE’s fast paced digital economy, KM leads the transformation from “having technology” to doing something new with it (Soto-Acosta, 2024).

### 6.2. Justifying the non-significant link and negative directionality (H3 and H4)

A key and surprising finding was the absence of significant relation in H3 ( $\beta = -0.164$ ,  $p = 0.117$ ) and H4, the serial mediation H4 ( $\beta = -0.016$ ,  $p = 0.18$ ). Although counterintuitive at first, these results yield deep insight into the distinct strategic context of UAE SMEs in 2026. The negative directionality of the DIC → SCA path ( $\beta = -0.164$ ,  $p = 0.117$ ) is in line with Resource Orchestration Theory (Sirmon et al., 2011). In resource-constrained settings, the ‘Liability of Innovation’ indicates that the high front-end costs associated with digital R&D, namely the capital outlay of the 2026-era. AI could temporarily weaken a firm’s financial resilience and operational focus. As a result, until they reach critical mass in the market, innovations serve as a drain to competitive standing rather than a driver of it. This negative coefficient empirically represents the

'valley of death' where the capability is already built by small & medium enterprises, but the economies of scale are not yet obtained.

## **7. Theoretical implications of negative directionality: the liability of innovation**

This negative relationship between Digital Innovation Capabilities (DIC) and Sustainable Competitive Advantage (SCA) requires direct theoretical exploration. This trend probably reveals a "Liability of Innovation" or a cost-innovation dissonance in SMEs constrained by limited resources. We evaluated the model for multicollinearity to be sure these were not statistical pieces, but the negative direction is likely an expression of a real market tension, where all VIF values (especially DIC at 1.222) were well below the 3.3 threshold. In the hyper-competitive 2026 digital atmosphere in the UAE, the enormous capital footprint and operational stress requiring a high level of innovation can temporarily weaken an SME's fiscal resilience and its ability to sustain a lead in both the short-term and long-term.

### ***7.1 Red Queen effect in high-innovation hubs***

The UAE, particularly hubs such as Dubai and Abu Dhabi, is one of the world's innovation centres and one area where digital transformation is common throughout all corners of the country. In these kinds of spaces, Digital Innovation Capabilities (DIC) may have transitioned from a source of "Competitive Advantage" to a "Competitive Necessity". This model's strategic disconnect is a two-layer failure. First, landscape-wise, the 2026 UAE market is characterized by 'Hyper-Imitation Velocity.' The rapid AI-driven reverse engineering means that the 'Inimitable' element of the VRIO framework can no longer be maintained by software alone. The results also indicate a fault in SME resource composition. Our results indicate that UAE entrepreneurs are successful at 'bundling' technology and knowledge to produce innovation (informed by the KM → DIC link), but the same cannot be said of the 'leveraging' stage, in terms of the failure to incorporate digital inventions into non-digital complementary assets, including specific customer relationships or specialized brand equity. Hence, it turns out that SCA is not limited to a dynamic market, but that it has become impossible for companies to strategically arrange resources which create "causal ambiguity" towards rivals.

### ***7.2 Inimitability gap and rapid digital imitation***

According to recent scholars, an essential prerequisite of SCA under the Resource-Based View (RBV) is that a resource must be "Inimitable." Digital advancements, new platforms or service models are frequently visible and easily copied by competitors in the SME sector. The lack of legal protections for SMEs, such as patents, and the "causal ambiguity" that big firms use in defending their innovations, is not uncommon. Thus, whilst a UAE SME may be very innovative, the advantage obtained is usually fleeting and does not pass the "Sustainability" metric in a crowded market with rapid digital imitation.

### ***7.3 Resource Orchestration and the liability of smallness***

Possessing a capability is insufficient if it is not supported by adequate marketing, financial capital, and scaling capacity. Based on our findings, DTM and KM do indeed effectively drive DIC however, SCA can easily be hindered by lack of complementary resources. While UAE SMEs may have enough technical expertise for innovation, they may find it difficult to penetrate and scale international markets while financially constrained, thus ensuring that technical innovation would not result in long-term market share dominance.

#### **7.4 Time-lag of sustainable outcomes**

Finally, the cross-sectional nature of this study may explain the non-significance, but directionality observed. Sustainable Competitive Advantage is a long-term goal by its nature. The internal improvements in knowledge and innovation (the first half of the model) are realized relatively quickly, whereas the financial and market share dominance necessary to achieve a significant superiority over competitors may take years to manifest.

#### **7.5 Theoretical and practical implications**

Based on these findings, this study challenges the traditional wisdom which holds that digital innovation necessarily generates enduring success. It also implies that research should not stop focusing on innovation capability but should also investigate moderating factors, e.g., environmental turbulence or competitive intensity (Yang et al., 2022). Practically, for UAE business owners, the findings indicate that investment in digital technology and knowledge sharing is necessary for survival, yet building a sustainable competitive advantage means emphasizing inimitability to develop distinct customer relationships or brand equity, as digital technology alone does not provide a significant advantage (Barney, 1991; Soto-Acosta, 2024, Chapter 5).

### **8. Conclusion**

The focus of this study was to study the sequential means by which digital technological investments are converted into sustainable market leadership in the UAE SME sector. The analysis reveals that though Digital Technology Management (DTM) is an essential fundamental asset base, its influence on competitive advantage is indirect. The findings verify a strong internal value chain where DTM is behind Knowledge Management (KM), which in turn powers Digital Innovation Capabilities (DIC). But it leads to a "strategic disconnect", found in the last part of the model.

In fact, this study confirms that in the UAE's hyper-competitive market in 2026, digital innovation was successfully generated (and yet, did not have any statistical effect on Sustainable Competitive Advantage (SCA)). We find that in high-innovation areas more innovation has moved from being a differentiator, to a "competitive need" to survive rather than an assured long-term dominance.

### **9. Implications of study**

The results contributed to the academic literature and strategic management of SMEs in distinctive ways.

#### **9.1. Theoretical implications**

- i. Exposing the "Black Box": Through the application of a serial mediation model, the work goes beyond directly testing the effect of other factors to argue that technological resources must be processed through sequential organizational capabilities to produce value.
- ii. Knowledge as the Strategic Pivot: The study upholds the Knowledge-Based View (KBV) indicating that the core value of technology in 2026 is to help acquire and apply organizational intelligence rather than the technology tools themselves.
- iii. The Innovation-Sustainability Gap: This study offers theoretical insights into the "Red Queen" effect, which can be examined within the context of new technologies and digital markets and challenges the conventional wisdom that

states that innovation is directly linked with sustainable advantage in the long run.

### **9.2. Practical implications for managers and entrepreneurs**

- i. **Go Beyond Tool Acquisition:** UAE managers need to realize the wasted cost of high-tech IT infrastructure without strong processes for sharing and applying that knowledge.
- ii. **Put Non-Digital Inimitability First:** As digital attributes are readily available in the UAE, entrepreneurs must wrap their digital innovations in non-digital assets, such as unique customer relationships in which they have built a presence or brand equity that technology alone cannot provide as a competitive advantage.
- iii. **Foster Strategic Agility:** Corporations must cultivate the flexibility to continuously re-imagine their strategy to prevent market copying, regarding digital innovation as an inevitable demand of entry and not a mere measure of success.

## **10. Limitations and future research avenues**

There are some limitations of this study though, open possibilities for further investigation:

- i. **Model Specification and Small  $R^2$ :** This small variance explained in Knowledge Management,  $R^2 = 9.4\%$ , and Sustainable Competitive Advantage,  $R^2 = 10.9\%$  indicates a likely under-specified model. Although these figures are consistent with preliminary findings from the SME context, they suggest that additional important elements are influencing the situation. Variables in future investigations should also account for the wider UAE strategic context in terms of government-led digital subsidies (e.g., Ghadan 21 legacy programs), organizational culture, and financial liquidity and account for the rest of the variance.
- ii. **Cross-Sectional Data:** The data is collected at a single point in time. Sustainable Competitive Advantage is a long-term project, and thus longitudinal research will be needed to monitor the transition to market leadership across sustained years.
- iii. **Self-Reported Measures:** Survey data can cause subjective bias. Future research might utilize objective performance metrics such as Return on Assets (ROA) or market share data if such indicators should serve as confirmation to validate the perceived advantage claimed by businesses to gain competitive advantages.
- iv. **Geographical and Sector Focus:** Although the results are particularly pertinent to the region under study (SMEs in the UAE), not all their results could be generalized to large multinationals or other regulatory environments.
- v. **Incomplete Moderators:** The potential moderators of the variable such as Environmental Turbulence/Competitive Intensity should be addressed in future studies. These variables most probably shape the intensity between innovation capabilities and sustainable advantage in high-innovation hubs in view of the so-called “Red Queen” effect determined in this study. In this regards, 2026 landscape, specific AI regulatory compliance and technological volatility are also important variables to keep in mind.

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## Appendix A: Research questionnaire

### Part 1: Respondent demographics

Please select the most appropriate option for each category.

1. **Gender:**

- Male
- Female

2. **Highest level of education:**

- High School or Equivalent
- Bachelor's Degree
- Master's Degree
- Doctoral Degree (PhD/DBA)

3. **Organization size:**

- Small (1-50 employees)
- Medium (51-250 employees)
- Large (Over 250 employees)

4. **Job level:**

- Senior Executive / C-Suite
- Department Manager / Head
- Mid-level Supervisor
- Entrepreneur / Business Owner

5. **Years of experience in current sector:**

- Less than 5 years
- 5-10 years
- 11-15 years
- More than 15 years

### Part 2: Research construct assessment

Please evaluate the following statements based on your experience within your organization. Use the **7-point Likert scale** provided:

1 = Strongly Disagree | 2 = Disagree | 3 = Somewhat Disagree | 4 = Neutral | 5 = Somewhat Agree | 6 = Agree | 7 = Strongly Agree

Code	Measurement item
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#### Section 1: Digital technology management (DTM)

(Adapted from Fink & Neumann, 2007; Bharadwaj, 2000)

DTM1	The organization possesses a robust and modern digital infrastructure.
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DTM2	Our technical operations are consistently reliable with minimal downtime.
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- DTM3 IT personnel possess the specialized technical knowledge required for our needs.
- DTM4 We frequently update our technological systems to keep pace with digital trends.
- DTM5 Our digital strategies are fully integrated with our broader organizational goals.

**Section 2: Knowledge management (KM)**

*(Adapted from Alavi & Leidner, 2001; Gold et al., 2001)*

- KM1 We have effective mechanisms for acquiring new knowledge from external partners.
- KM2 Expertise and organizational lessons are frequently shared among team members.
- KM3 We utilize advanced systems to store, organize, and retrieve corporate knowledge.
- KM4 The organization is effective at converting individual insights into collective knowledge.
- KM5 We successfully apply our existing knowledge base to solve complex business problems.

**Section 3: Digital innovation capabilities (DIC)**

*(Adapted from Wang & Ahmed, 2004; Cao et al., 2021)*

- DIC1 Our organization acts as an early adopter of disruptive digital innovations.
- DIC2 We regularly introduce significantly improved services through digital platforms.
- DIC3 We can rapidly adjust our business model in response to digital market changes.
- DIC4 Internal workflows are continuously innovated using automated digital tools.
- DIC5 A significant portion of our budget is dedicated to digital research and development.

**Section 4: Sustainable competitive advantage (SCA)**

*(Adapted from Barney, 1991; Huynh, 2025)*

- SCA1 We possess unique digital assets that are extremely difficult for competitors to copy.
- SCA2 The organization has maintained a resilient market position over the long term.
- SCA3 Our firm consistently achieves profitability that is higher than the industry average.
- SCA4 The value created by our digital innovation is hard for others to imitate.
- SCA5 We are strategically positioned to withstand prolonged periods of market disruption.